NorthMet Mining Project and Land Exchange

Preliminary Final Environmental Impact Statement

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Prepared by

Minnesota Department of Natural Resources
United States Army Corps of Engineers
United States Forest Service

This document is a working document. This document may change over time as a result of new information, further deliberation, or other factors not yet known to the Co-lead Agencies.

TABLE OF CONTENTS – OVERVIEW

-Page Intentionally Left Blank-

TABLE OF CONTENTS

VOLUME I

VOLUME II

VOLUME III

VOLUME IV

(Provided electronically with the PFEIS)

-Page Intentionally Left Blank-

LIST OF TABLES

LIST OF FIGURES

-Page Intentionally Left Blank-

LIST OF ACRONYMS/ABBREVIATIONS

(%EPT) Percent ephemeroptera, plecoptera, or tricoptera

(°F) degrees Fahrenheit

(µg/L) microgram(s) per liter

(µg/m^3) microgram(s) per cubic meter

(µm) micrometer(s)

(AADT) annual average daily traffic

(ACHP) Advisory Council on Historic Preservation

(ACI) Aquatic Connectivity Index

(ACM) Asbestos-Containing Material

(AERA) Air Emissions Risk Analysis

(AERMOD) American Meteorological Society/USEPA Regulatory Model

(amsl) above mean sea level

(ANFO) Ammonium Nitrate Fuel Oil Mixture

(AOC) Area of Concern

(APE) Area of Potential Effect

(AQRV) Air Quality Related Value

(AST) Aboveground Storage Tank

(ASTM) American Society for Testing and Materials

(Au/PGE) gold and platinum group elements

(AWMP) Adaptive Water Management Plan

(BA) Biological Assessment

(BACT) Best Available Control Technology

(BART) Best Available Retrofit Technology

(Barr) Barr Engineering

(BBER) Bureau of Business and Economic Research

(BBLV) Beaver Bay to Lake Vermilion

(BE) Biological Evaluation

(bgs) below ground surface

(Bois Forte) Bois Forte Band of Chippewa

(BP) before present

(BWCAW) Boundary Waters Canoe Area Wilderness

(CAA) Clean Air Act

(CAIR) Clean Air Interstate Rule

(CALPUFF) California Puff Model

(CCP) Coordination and Communication Plan

(CDSM) cement deep soil mixing

(CEAA) Cumulative Effects Assessment Area

(CEC) Continuation of Existing Conditions

(CEQ) United States Council on Environmental Quality

(CERCLA) Comprehensive Environmental Response, Compensation, and Liability Act

(CFE) chemical for evaluation

(CFR) Code of Federal Regulations

(cfs) cubic feet per second

(CH_4) methane

(cm/sec) centimeter(s) per second

(CO) carbon monoxide

(CO_2) carbon dioxide

(CO_{2e}) carbon dioxide equivalents

(CPS) Central Pumping Station

(CPT) Cone Penetrometer Testing

(CR) County Road

(cRNA) candidate Research Natural Area

(CSAPR) Cross State Air Pollution Rule

(CWA) Clean Water Act

(DA) Department of the Army

(DAT) Deposition Analysis Threshold

(dB) decibel(s)

(dBA) A-weighted decibel(s)

(dbh) diameter at breast height

(dBL) linear-weighted decibel(s)

(DDT) dichlorodiphenyltrichloroethane

(DEIS) Draft Environmental Impact Statement - October 2009

(DM&IR) Duluth, Missabe, and Iron Range

(DOT) Department of Transportation

(DRI) direct reduced iron

(dv) deciview

(e.g.) for example

(EAW) Environmental Assessment Worksheet

(ECS) Ecological Classification System

(EDR) Environmental Data Resources, Inc.

(EIS) Environmental Impact Statement

(EJ) Environmental Justice

(ELT) Ecological Land Type

(EO) Executive Order

(EPCRA) Emergency Planning and Community Right-to-Know Act

(EQB) Environmental Quality Board

(ERC) Emergency Response Commission

(ERM) Environmental Resources Management

(ESA) Endangered Species Act

(ESSA) Effective Stress Stability Analysis

(ETSC) Endangered, Threatened, and Special Concern

(FEIS) Final Environmental Impact Statement

(FEMA) Federal Emergency Management Agency

(FIRM) Flood Insurance Rate Map

(FLAG) Federal Land Managers' Air Quality Related Values Work Group

(FLM) Federal Land Manager

(FLPMA) Federal Land Policy and Management Act

(Fond du Lac) Fond du Lac Band of Lake Superior Chippewa

(Forest Plan) 2004 Superior National Forest Land and Resource Management Plan

(FR) Federal Register

(FSH) Forest Service Handbook

(ft) foot or feet

(ft/day) feet per day

(ft/ft) feet per foot

(ft/sec) feet per second

(ft^2) square feet

(FTE) Full-time Equivalent

(GAP) Gap Analysis Program

(GHG) greenhouse gas

(GIS) Geographic Information System

(GLIFWC) Great Lakes Indian Fish & Wildlife Commission

(GLO) General Land Office

($g/m^2/yr$) grams per square meter per year

(gpm) gallon(s) per minute

(GPS) Global Positioning System

(gpy) gallon(s) per year

(gr/dscf) grains per dry standard cubic foot

(Grand Portage) Grand Portage Band of Lake Superior Chippewa

(H_2S) hydrogen sulfide

(HAP) Hazardous Air Pollutant

(HBI) Hilsenhoff Biotic Index

(HEPA) High-efficiency Particulate Air

(Hg(p)) particle-bound mercury

(Hg) mercury

(Hg^{+2}) oxidized mercury

(HI) Hazard Index

(hp) horsepower

(HRL) Health Risk Limit

(HUC) Hydrologic Unit Code

(Hz) Hertz

(i.e.) that is

(IBI) Index of Biological Integrity

(IMPROVE) Interagency Monitoring of Protected Visual Environments

(in/s) inch(es) per second

(IPCC) Intergovernmental Panel on Climate Change

(ISO) International Standards Organization

(kg) kilogram(s)

(kg/ha/yr) kilogram(s) per hectare per year

(kg/m^2) kilogram(s) per square meter

(km) kilometer

(ksf) kip(s) per square foot

(L10) noise level exceeding standard for 10% of the monitored time

(L50) noise level exceeding standard for 50% of the monitored time

(LAU) Lynx Analysis Unit

(lb/MMBTU) pound(s) per million British thermal units

(lbs/yr) pounds per year

(LDPE) low-density polyethylene

(LEDPA) least environmentally damaging practicable alternative

(Leq) equivalent noise levels

(LLDPE) linear low-density polyethylene

(LQ) location quotient

(LTA) Land Type Association

(LTVSMC) LTV Steel Mining Company

(MAAQS) Minnesota Ambient Air Quality Standards

(MACT) Maximum Achievable Control Technology

(MBS) Minnesota Biological Survey

(MCL) Maximum Contaminant Level

(MCWCS) Minnesota Comprehensive Wildlife Conservation Strategy

(MDH) Minnesota Department of Health

(MDNR) Minnesota Department of Natural Resources

(MDO) major difference of opinion

(MeHg) methylmercury
(MEPA) Minnesota Environmental Policy Act
(MEQB) Minnesota Environmental Quality Board
(mg/kg) milligram(s) per kilogram
(mg/L) milligram(s) per liter
(MGD) million gallons per day
(MIBC/DF250) methyl isobutyl carbinol and polyglycol ether
(MIH) Management Indicator Habitat
(mm) millimeter(s)
(mm/s) millimeter(s) per second
(MMBTU) 1 million British thermal units
(MMREM) MPCA Mercury Risk Estimation Method
(MDOT) Minnesota Department of Transportation
(MN-fiber) Minnesota regulated fiber
(MnRAM) Minnesota Routine Assessment Method
(MOA) Memorandum of Agreement
(MODFLOW) groundwater model
(MOU) Memorandum of Understanding
(MPCA) Minnesota Pollution Control Agency
(m/s) meter(s) per second
(MSDS) Material Safety Data Sheet
(MSHA) Mine Safety and Health Act
(mtpy) metric ton(s) per year
(NA) not applicable
(NAAQS) National Ambient Air Quality Standards
(NAC) Noise Area Classification
(NAICS) North American Industrial Classification System
(NEPA) National Environmental Policy Act
(NESHAP) National Emission Standards for Hazardous Air Pollutants
(NFS) National Forest System
(ng/L) nanogram(s) per liter
(NHFEU) National Hierarchy Framework of Ecological Units
(NHIS) Natural Heritage Information System
(NHPA) National Historic Preservation Act
(NIOSH) National Institute for Occupational Safety and Health
(NO_2) nitrogen dioxide
(NOI) Notice of Intent
(NO_x) nitrogen oxides
(NPDES) National Pollutant Discharge Elimination System
(NRCS) Natural Resources Conservation Service
(NRHP) National Register of Historic Places
(NSPS) New Source Performance Standards
(NTS) Northeast Technical Services, Inc.
(NWI) National Wetlands Inventory
(O_3) ozone
(OSHA) Occupational Safety and Health Administration
(PAX) potassium amyl xanthate
(Pb) lead
(PCB) polychlorinated biphenyl
(PGE) platinum group element
(Phase I ESA) Phase I Environmental Site Assessment
(PM) particulate matter
(PM_{10}) particulate matter up to 10 micrometers in diameter
($PM_{2.5}$) particulate matter up to 2.5 micrometers in diameter
(PMC) coarse particulate matter
(pMCL) Primary Maximum Contaminant Level
(PMF) fine particulate matter
(PMP) probable maximum precipitation
(PolyMet) PolyMet Mining Corporation
(POTW) Publically Owned Treatment Works
(ppm) part(s) per million
(PPV) peak particle velocity
(PRB) permeable reactive barrier
(PSB) permeable sorptive barrier
(PSD) Prevention of Significant Deterioration
(PSDEIS) Preliminary Supplemental Draft Environmental Impact Statement
(psig) pounds per square inch gauge
(PUC) Public Utilities Commission
(QHEI) Qualitative Habitat Evaluation Index
(RCI) Riparian Connectivity Index
(REL) reference exposure level
(RFSS) Regional Forester Sensitive Species
(RGU) Responsible Governmental Unit
(RME-OSW) reasonable maximum exposed off-site worker
(RNA) Research Natural Area
(RO) reverse osmosis

(ROD) Record of Decision
(ROS) Recreation Opportunity Spectrum
(ROW) right-of-way
(RQD) rock quality designation
(SAG) semi-autogenous grinding
(SAM) sulfuric acid mist
(SAP) Sampling and Analysis Plan
(SDD) Scoping Decision Document
(SDEIS) Supplemental Draft Environmental Impact Statement
(SDS) State Disposal System
(SER) Significant Emission Rate
(SGCN) Species of Greatest Conservation Need
(SHPO) State Historic Preservation Office
(SIC) Standard Industrial Classification
(SIL) Significant Impact Limit
(SIO) Scenic Integrity Objective
(SIP) State Implementation Plan
(sMCL) Secondary Maximum Contaminant Level
(SNA) Scientific and Natural Area
(SO_2) sulfur dioxide
(SO_4) sulfate
(SPCC) Spill Prevention, Control, and Countermeasure
(stpd) standard ton(s) per day
(stpy) standard ton(s) per year
(S) sulfur
(SVOC) Semi-volatile Organic Compound
(SWPPP) Storm Water Pollution Prevention Plan
(TBD) to be determined
(TCP) Traditional Cultural Property
(TDS) Total Dissolved Solids
(106 Group) The 106 Group Ltd.
(the Bands) Bois Forte Band of Chippewa, Grand Portage Band of Lake Superior Chippewa, and the Fond du Lac Band of Lake Superior Chippewa
(THPO) Tribal Historic Preservation Office
(TMDL) Total Maximum Daily Load
(tpd) ton(s) per day
(TPPP) Toxic Pollution Prevention Plan
(tpy) ton(s) per year
(Tract 1) Hay Lake Lands
(Tract 2) Lake County Lands
(Tract 3) Wolf Lands
(Tract 4) Hunting Club Lands
(Tract 5) McFarland Lake Lands
(TRI) Toxics Release Inventory
(TSI) Trophic Status Index
(TSP) total suspended particulates
(TWP) Treated Water Pipeline
(U.S. Steel) United States Steel Corporation
(UBA) Unique Biological Area
(UMD) University of Minnesota Duluth
(USACE) United States Army Corps of Engineers
(USC) United States Code
(USDA) United States Department of Agriculture
(USEPA) United States Environmental Protection Agency
(USFS) United States Forest Service
(USFWS) United States Fish and Wildlife Service
(USGS) United States Geological Survey
(USSA) Undrained Strength Stability Analysis
(USSR) Undrained Shear Strength Ratio
(UST) Underground Storage Tank
(VIC) Voluntary Investigation and Cleanup
(VOC) Volatile Organic Compound
(VSEP) Vibratory Shear Enhanced Process
(WCA) Wetland Conservation Act
(WWTF) Wastewater Treatment Facility
(WWTP) Wastewater Treatment Plant
(WQBEL) water quality based effluent limit
(XP-SWMM) surface water model
(ZDDP) Zero Discharge Demonstration Program

GLOSSARY

1854 Treaty Authority: An inter-tribal natural resource management agency that manages the off-reservation hunting, fishing, and gathering rights of the Grand Portage and Bois Forte Bands of the Lake Superior Chippewa in the territory ceded under the Treaty of 1854.

1854 Treaty of La Pointe: In 1854, the Chippewa of Lake Superior entered into a treaty with the United States whereby the Chippewa ceded to the United States ownership of their lands in northeastern Minnesota. These lands are generally known as the "1854 ceded territory." Article 11 of the 1854 Treaty provides, *"...And such of them as reside in the territory hereby ceded, shall have the right to hunt and fish therein, until otherwise ordered by the President."* The Chippewa of Lake Superior who reside in the ceded territory are the Fond du Lac, Grand Portage, and Bois Forte Bands.

Acid rock drainage: Produced by the oxidation of sulfide minerals, chiefly iron pyrite disulfide (FeS_2). This is a natural chemical reaction which can proceed when minerals are exposed to air and water. Acidic drainage is found around the world, as a result of both naturally occurring processes and activities associated with land disturbances, such as highway construction and mining where acid-forming minerals are exposed to air. These acidic conditions can cause metals in geologic materials to dissolve, which can lead to impairment of water quality when acidic and metal-laden discharges enter waters used by terrestrial and aquatic organisms.

Ad valorem tax: A tax based on the value to real estate or personal property. Municipal ad valorem taxes are also known as "property taxes."

Adverse effect (for cultural resources): A significant alteration to the qualifying characteristics of a historic property included in or eligible for inclusion in the National Register.

Adverse effect: A harmful or undesired effect from the proposed project on the environment.

AERMOD air dispersion model: The United States Environmental Protection Agency (USEPA)-approved model designed to predict short-range (up to 50 kilometers) dispersion of air pollutant emissions from stationary industrial sources.

Air dispersion model: A computer program that incorporates a series of mathematical equations used to predict downwind concentrations in the ambient air resulting from emissions of a pollutant. Inputs to a dispersion model include the emission rate; characteristics of the emission release such as stack height, exhaust temperature, and flow rate; and atmospheric dispersion parameters such as wind speed and direction, air temperature, atmospheric stability, and height of the mixed layer.

Airblast overpressure: A transient air pressure, such as the shock wave from an explosion, that is greater than the surrounding atmospheric pressure.

Ambient air quality: The quality of the portion of the atmosphere, external to buildings, to which the public has general access.

Ammonium nitrate fuel oil (ANFO): Primary blasting agent used in open-pit mining; a mixture of solid ammonium nitrate and liquid fuel oil.

Amphibole: A class of silicate minerals containing iron and magnesium.

Anthropogenic: Relating to or resulting from the influence of human beings on nature.

Aquatic biota: Collective term describing the organisms living in or depending on the aquatic environment.

Aquifer: A subsurface saturated rock unit or formation of sufficient permeability to transmit groundwater and yield usable quantities of water to wells and springs.

Archaeological site: The physical remains of any area of human activity, generally greater than 50 years of age, for which a boundary can be established. Examples of such resources could include domestic/habitation sites, industrial sites, earthworks, mounds, quarries, canals, roads, etc. Under the general definition, a broad range of site types would qualify as archaeological sites without the identification of any artifacts.

Archaic period: A cultural period circa 9,000 to 3,000 years ago, or 7,000 to 1,000 B.C.; its characteristic features included semi-permanent seasonal camps, atlatls and bannerstones, deer hunting, some copper tools, and the first long-distance trade.

Area of Potential Effect (APE): The geographic region in which a historic or cultural property may be impacted as a result of the construction and operation of the NorthMet Project Proposed Action or alternatives.

Attainment: Air quality in the locality that meets the established standards.

Augmentation: The act of adding treated water to replace affected surface water flows.

Autoclave: A mineral processing pressure vessel for conducting chemical reactions such as sulfide mineral oxidation and leaching of metals.

Batholith: A large emplacement of igneous intrusive rock that forms from cooled magma deep in the earth's crust.

Bedrock isopach map: A map of the bedrock thickness within a tabular unit or stratum, usually illustrated with contour lines.

Bedrock outcrop: A visible exposure of bedrock on the surface of the earth.

Beneficiation: Crushing and separating ore into valuable substances or waste.

Bentonite: An absorptive and colloidal clay used especially as a sealing agent or suspending agent.

Best Available Control Technology (BACT): An emission limitation (including a visible emission standard) based on the maximum degree of reduction for each pollutant subject to regulation under the Clean Air Act that would be emitted from any proposed major stationary source or major modification, taking into account energy, environmental, and economic impacts and other costs.

Best Management Practice (BMP): The schedule of activities, prohibition of practices, maintenance procedures, and other management practices to avoid or minimize pollution or habitat destruction to the environment. BMPs can also include treatment requirements, operating procedures and practices to control runoff, spillage, or leaks; sludge or waste disposal; or drainage from raw material storage.

Bioaccumulation: The accumulations of chemicals in the tissue of organisms through any route, including respiration, ingestion, or direct contact with contaminated water or sediments.

Bioassay: A type of scientific experiment that is typically conducted to measure the effects of a substance on a living organism and is essential in monitoring environmental pollutants.

Biodiversity: The degree of variation in lifeforms within a given species, ecosystem, or biome. It is a measure of the health of ecosystems.

Biotic community: A group of interdependent organisms inhabiting the same region and interacting with each other.

Biwabik Iron Formation: An approximately 1.9-billion-year-old sequence of iron-rich sedimentary rocks that was metamorphosed at its easternmost extent by approximately 1.1-billion-year-old intrusions of the Duluth Complex.

Brownfield site: Abandoned or underutilized industrial or commercial property available for reuse which may be contaminated by the presence or potential presence of a hazardous substance or pollutant.

Buffer zone: An area or region distinguished from adjacent parts by a distinctive feature or characteristic.

Calcareous fen: Rare and distinctive wetlands characterized by a substrate of non-acidic peat and dependent on a constant supply of cold, oxygen-poor groundwater rich in calcium and magnesium bicarbonates.

CALPUFF model: The USEPA-approved non steady-state puff dispersion model that simulates the effects of time- and space-varying meteorological conditions on pollution long-range transport, transformation, and removal. CALPUFF can be applied in complex terrain conditions.

Class I area: Under the Clean Air Act, a Class I area is one in which some criteria pollutants, visibility, and other air quality related values (AQRVs) are protected more stringently than under the national ambient air quality standards. Class I areas include national parks, wilderness areas, monuments, and other areas of special national and cultural significance.

Class II area: Under the Clean Air Act, Class II areas are all areas that have been demonstrated to be in attainment with the federal National Ambient Air Quality Standards that are not designated as Class I areas; modest increments of new pollution would be allowed.

Clean Air Act (CAA): The Clean Air Act of 1970 is a United States federal law intended to control air pollution and protect air quality. The act—which underwent major revisions in 1990 and 2003—deals with ambient air pollution (that which is present in the ambient air) as well as source-specific air pollution. The Clean Air Act sets standards for air quality that limit the amount of various pollutants to specified levels. The Clean Air Act also sets deadlines for governments and industries to meet the standards. The federal USEPA is ultimately responsible for establishing national standards and enforcing the Clean Air Act. State and local authorities that have approved plans to control air pollution are given local authority by the USEPA to administer these regulations.

Clean Air Interstate Rule (CAIR): The USEPA issued the CAIR in March 2005. This rule provides states with a solution to the problem of power plant pollution that drifts from one state to another. The rule uses a cap and trade system to reduce target pollutants—sulfur dioxide (SO_2) and nitrogen oxides (NOx)—by 70 percent.

Clean Water Act (CWA): A federal act that establishes the basic structure for regulating discharges of pollutants into the waters of the United States and regulating quality standards for surface waters. The basis of the Act was enacted in 1948 and was called the federal Water Pollution Control Act, but the Act was significantly reorganized and expanded in 1972. "Clean Water Act" became the Act's common name with amendments in 1972. Under the Clean Water Act, the United States has implemented pollution control programs including industrial wastewater standards and water quality standards for all contaminants in surface waters. The Act has made it unlawful to discharge any pollutant from a point source into navigable waters, unless a permit is obtained.

CWA Section 404 Permit: Permit that authorizes the discharge of dredged or fill material into waters of the United States, including many wetlands. Responsibility for implementing Section 404 is shared by the United States Army Corps of Engineers (USACE) and USEPA.

Closure: The process of terminating and completing final steps in reclaiming any specific portion of a mining operation. Closure begins when, as prescribed in the Permit to Mine, there will be no renewed use or activity by the permittee.

Coarse tailings: 50% or more of waste byproducts of mineral beneficiating processes other than heap and dump leaching, is retained on a No. 200 sieve and consists of rock particles, which have usually undergone crushing and grinding, from which the profitable mineralization has been separated.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA): Commonly known as Superfund, legislation enacted in 1980 which created a tax on the chemical and petroleum industries and provided broad federal authority to respond directly to releases or threatened releases of hazardous substances that may endanger public health or the environment.

Comprehensive Land Use Plan: A document adopted by local elected officials that establishes policies and guidance for land use, municipal growth, public services, and infrastructure. Comprehensive plans can provide the rationale and legislative basis for local zoning and subdivision ordinances.

Coniferous bog recharge: The amount of precipitation that maintains and refills coniferous bogs, which are perched wetlands with generally no groundwater connection.

Connected action: According to Council on Environmental Quality (CEQ) regulations (40 CFR Part 1508.25), actions are connected if they automatically trigger other actions which may require environmental impact statements, cannot or will not proceed unless other actions are taken previously or simultaneously, and/or are interdependent parts of a larger action and depend on the larger action for their justification.

Consent decree: Also referred to as a consent order, this is a final, binding judicial decree or judgment memorializing a voluntary agreement between parties to a suit or dispute in return for withdrawal of a criminal charge or an end to a civil litigation. In a typical consent decree, the defendant has already ceased or agrees to cease the conduct alleged by the plaintiff to be illegal and consents to a court injunction barring the conduct in the future.

Consultation (for cultural resources): The process of seeking, discussing, and considering the views of other participants, and, where feasible, seeking agreement with them regarding matters arising in the Section 106 process. The Secretary's "Standards and Guidelines for federal Agency Preservation Programs pursuant to the National Historic Preservation Act" provide further guidance on consultation.

Contact period: Relating to the period of initial interaction between an indigenous people with an outside culture. In the United States, the term refers to an era of initial interaction between Native Americans and Europeans.

Cooperating Agency: According to CEQ regulations (40 CFR Part 1508.5), "Cooperating Agency" means any federal agency other than a lead agency which has jurisdiction by law or special expertise with respect to any environmental impact involved in a proposal (or a reasonable alternative) for legislation or other major federal action significantly affecting the quality of the human environment.

Council on Environmental Quality (CEQ): An agency within the Executive Office of the President that established the procedures to implement the National Environmental Policy Act of 1970. Regulations are found in 40 CFR 1500, et seq.

Criteria air pollutant: Seven common air pollutants for which the USEPA has set primary (may harm human health) or secondary (may affect the environment and/or cause property damage) national air quality standards. These pollutants are: particulate matter less than or equal to 10 microns in size, particulate matter less than or equal to 2.5 microns in size, sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone, and lead.

Cubic feet per second: The rate of flow representing a volume of 1 cubic foot passing a given point in 1 second.

Culpability Analysis: The relative contribution of various contaminant sources to the overall contaminant load at a specific evaluation location.

Cultural resources: Archaeological, traditional, and built environment resources, including but not necessarily limited to buildings, structures, objects, districts, and sites.

Cumulative effect: The effects on the environment that would result from the incremental effect of the NorthMet Project Proposed Action when added to other past, present, and reasonably foreseeable future actions, regardless of who undertakes such actions. Cumulative effects can result from individually minor but collectively significant actions taking place over a period of time.

Cutoff trench: A trench which is below the foundation base line of a dam or other structure and is filled with an impervious material, such as clay or concrete.

Cuyuna Range: An iron range to the southwest of the Mesabi Range, largely between Brainerd and Aitkin within Crow Wing County, Minnesota.

Density factor: A pre-determined qualitative value which is then assigned to wild rice stands based on the density of wild rice present.

Detection limit: The lowest quantity of a material that can be detected from the absence of that material within a stated confidence.

Direct effect (for cultural resources): A physical alteration to the qualifying characteristics of a historic property included in or eligible for inclusion in the National Register.

Disseminated sulfide: Deposits of sulfide minerals which are distributed more or less uniformly within the surrounding waste rock.

Dissolved oxygen: The amount of gaseous oxygen dissolved into an aqueous solution, whether through diffusion from the air, aeration by agitation, or as a waste product of photosynthesis.

Drawdown: The lowering of the water level relative to a background condition.

Drift: Material such as sand, clay, gravel, and rocks transported and deposited by a glacier or glacial process.

Drilling log: A record of events or features of the formations penetrated or encountered during boring. Also known as a boring log.

Duluth Complex: A mafic intrusive igneous geological formation with quantities of copper, nickel, cobalt, platinum, palladium, and gold. The Duluth Complex lies at the eastern end of the Mesabi Iron Range in northeastern Minnesota.

Ecological land type: A hierarchical level of the National Hierarchical Framework of Ecological Units and Ecological Classification System that is determined based on differences in vegetation, soils, climate, geology, and/or hydrology.

Effect (for cultural resources): Alteration to the qualifying characteristics of a historic property included in or eligible for inclusion in the National Register.

Effluent: An outflow or discharge of a liquid.

Eligible (for cultural resources): Cultural properties formally determined as such in accordance with the regulations of the Secretary of the Interior and all other properties that meet the National Register criteria.

Emergency Planning and Community Right-to-Know Act (EPCRA): A federal act enacted in 1986 to help communities plan for emergencies involving hazardous substances. It establishes requirements for federal, state, and local governments; Indian tribes; and industry regarding emergency planning and "Community Right-to-Know" reporting on hazardous and toxic chemicals.

Endangered Species: The classification provided to an animal or plant in danger of extinction within the foreseeable future throughout all or a significant portion of its range as defined in the Endangered Species Act (ESA).

Endangered Species Act: A federal act enacted in 1973 to provide for the conservation of ecosystems upon which threatened and endangered species of fish, wildlife, and plants depend. The ESA authorizes the determination and listing of species as endangered and threatened, and prohibits unauthorized taking, possession, sale, and transport of endangered species. Section 7 of the ESA requires federal agencies to ensure that any action authorized, funded, or carried out by them is not likely to jeopardize the continued existence of listed species or modify their critical habitats.

Environmental Justice: The fair treatment and meaningful involvement of all people regardless of race, color, national origin, age, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no group of people—including racial, ethnic, age or socioeconomic groups—should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of federal, state, local, and tribal programs and policies. Executive Order 12898 directs federal agencies to make achieving environmental justice part of their missions by identifying and addressing disproportionately high and adverse effects of agency programs, policies, and activities on minority and low-income populations.

Ephemeral: Lasting for a short time or a short-lived organism. An ephemeral water body is a wetland, stream, or pond that exists briefly during and following a period of rainfall or snow melt.

Evapotranspiration: The amount of water removed from a land area by the combination of direct evaporation from the soil and plant transpiration.

Factor of Safety: Used to describe the ratio of resisting forces to driving forces along a potential failure surface, whereby a Factor of Safety of 1.0 represents equilibrium between the estimated resisting shear strength to the applied shearing load. Systems are often designed to a Factor of Safety above 1.0 to allow for unexpected loads, unexpected operating conditions, and variations in estimated material properties.

Fen: Peat-forming wetlands that receive nutrients from sources other than precipitation—usually from upslope sources through drainage from surrounding mineral soils and from groundwater movement. These systems are often covered by grasses, sedges, rushes, and wildflowers. Over time, peat may build up and separate the fen from its groundwater supply. When this happens, the fen receives fewer nutrients and may become a bog.

Final closure: The period of time when ore-extracting activities of a mine or ore-production activities of a processing facility cease to continue, and decommissioning and reclamation activities are being completed.

Fine tailings: More than 50% of waste byproducts of mineral beneficiating processes, other than heap and dump leaching, passes the No. 200 sieve and consists of rock particles, which have usually undergone crushing and grinding, from which the profitable mineralization has been separated.

Fish assemblage: The list of fish species that occupy a given area, which is used as a sensitive indicator of overall ecosystem health, habitat degradation, or environmental contamination.

Fish consumption advisory: Federal, state, or local government guideline restricting the amount of fish consumption when certain species of fish are unsafe to eat due to the presence of harmful chemicals in their tissues.

Floodplain: The lowland areas adjacent to lakes, wetlands, streams, and rivers that are prone to being inundated by water during flood conditions.

Flotation tailings: Materials left over after valuable minerals have been separated during a flotation process.

Footwall: The mass of rock underlying a mineral deposit or the bedrock located beneath a fault plane.

Forb: A flowering, herbaceous (non-woody) plant other than a grass species.

Fragmentation: A decrease in the area of contiguous habitat available to wildlife.

Fugitive dust: Particulate matter composed of soil that is not emitted from a stack, vent, or hood; can include emissions from haul roads, wind erosion or exposed surfaces, and other activities in which soil is removed and redistributed.

GAP land cover: A hierarchically organized vegetation cover map developed as part of the U.S. Geological Survey's Gap Analysis Program (GAP). Units of analysis are Minnesota Ecological Classification System subsections.

General Land Office (GLO): The GLO records managed by U.S. Bureau of Land Management are the repository for all Federal land title records issued between 1820 and the present.

Geographic Information System (GIS): A system designed to store, modify, analyze, or present various types of geographical spatial data.

Geosynthetic membrane cover system: A process designed to exclude certain waste rock materials from oxidation, and which would include the installation of limestone, overburden, a geomembrane material, cover soil, and a vegetative soil layer.

Geotechnical assessment: An assessment of the stability of a slope or ground surface under load; used to identify risks or potential hazards of structural failure.

Giants Range: The Giants Range batholith is a body of granite in northeastern Minnesota that lies between the Mesabi and Vermilion iron-mining ranges. It outcrops as a narrow belt that strikes east-northeast and occupies an area of about 1,000 square miles. The Giants Range goes from just north of Hibbing (the "Hill of Three Waters" is in the Hull-Rust Mine) to Babbitt and rises from 200 to 400 feet above the surrounding area.

Glacial deposit: A collection of various-sized rocks and debris that is deposited by a glacier as it advances or recedes across a landscape. There are many types of deposits, including till, drift, erratics, and moraines.

Glacial till: Direct glacial deposits of rocks, gravel, or boulders that are unsorted and unstratified.

GoldSim: A probabilistic simulation platform for visualizing and simulating many types of physical, financial, or organizational systems. Most GoldSim applications fall into one of three categories: environmental systems modeling, business and economic modeling, or engineered systems modeling.

Greenhouse gas: Gases that trap heat in the atmosphere. Some greenhouse gases, such as carbon dioxide, occur naturally and are emitted to the atmosphere through natural processes and human activities. The principal greenhouse gases that enter the atmosphere because of human activities are carbon dioxide, methane, nitrous oxide, and fluorinated gases.

Groundwater baseflow: Groundwater discharge from the surficial aquifer and bedrock unit into a perennial stream.

Groundwater Containment System: An active or passive measure (typically, either is engineered) put into place to prevent or significantly reduce the migration of contaminants or groundwater flow, in groundwater or in the groundwater aquifer.

Groundwater divide: The boundary between two adjacent groundwater basins represented by a high point in the water table.

Groundwater drawdown: The lowering of the groundwater level (water table) relative to a background condition in a specific aquifer.

Groundwater mound: The increase or rise in height of a water table due to concentrated recharge in a given area.

Groundwater plume: The downgradient extension or spread of contaminated groundwater within the pore spaces or fractures of soil or rock.

Groundwater: The water located beneath the ground surface in soil or rock pore spaces or fractures.

Hardness: A measure of the amount of minerals that are dissolved in a water source; a higher mineral content indicates harder water, while lower mineral content indicates softer water. See Total dissolved solids (TDS).

Hazardous air pollutant: Air pollutants that are not covered by ambient air quality standards, but may present a threat of adverse human health effects or adverse environmental effects, and are specifically listed on the federal list of 189 hazardous air pollutants in 40 CFR 61.01 or in section 112(b) of the CAA.

Hazardous material: Any item or agent (biological, chemical, physical) that has the potential to cause harm to humans, animals, or the environment, either by itself or through interaction with other factors. The term includes hazardous substances, hazardous waste, marine pollutants, and elevated-temperature materials—materials designated as hazardous under the provisions of 49 CFR 172.101. Hazardous material categories include: explosives, gases, flammable liquids, flammable solids, spontaneous combustibles/dangerous when wet, oxidizers and organic peroxides, poisons and infectious substances, and corrosives.

Hazardous waste: Defined in the *Minnesota Statutes* as any refuse, sludge, or other waste material (or combinations of materials) in solid, semi-solid, liquid, or contained gaseous form which, because of its quantity, concentration, or chemical, physical, or infectious characteristics, may cause or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible illness, or pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, disposed of, or otherwise managed.

Hazardous Materials Response Team: Personnel specially trained to handle dangerous goods, which include materials that are radioactive, flammable, explosive, corrosive, oxidizing, asphyxiating, biohazardous, toxic, pathogenic, or allergenic.

Health Risk Limit (HRL): A concentration of a substance or chemical adopted by rule of the Commissioner of Health that is a potential drinking water contaminant because of a systemic or carcinogenic toxicological result from consumption (*Minnesota Statute* 103H.005).

Herbaceous: Plants with leaves and stems that die down at the end of each growing season, and have no woody or persistent stems above ground.

Herbivore: An organism that is anatomically and physiologically adapted to survive by consuming only plant-based foods.

Hilsenhoff Biotic Index: An index of organic pollution that utilizes macroinvertebrate tolerances of pollution to assess water quality in streams and rivers.

Historic property: Any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in, the National Register of Historic Places maintained by the Secretary of the Interior. This term includes artifacts, records, and remains that are related to and located within such properties. The term includes properties of traditional religious and cultural importance to an Indian tribe or Native Hawaiian organization and that meet the National Register criteria.

Humidity cell: Geochemical kinetic tests designed to mimic weathering at the laboratory or at bench scale (controlled setting) to obtain bulk reaction rates. The test determines the rate of acid generation and the variation over time in leachate water quality.

Hydraulic conductivity: A measure of the ease with which a medium transmits water, such as water moving through pore spaces or fractures in soil or rock.

Hydrograph: A graph showing the variation of discharge with respect to time, with discharge meaning the volume of water flowing past a specific point versus the time it takes for it to do so, generally cubic feet per second (cfs).

Hydrology: The science dealing with the origin, distribution, and circulation of waters of the earth such as rainfall, streamflow, infiltration, evaporation, and groundwater storage.

Hydrometallurgical residue: Waste residues in the form of sludges that contain concentrations of metals as well as sulfur-bearing minerals in crystalline form.

Hydrometallurgical: Pertaining to hydrometallurgy; involving the use of liquid reagents in obtaining metals from their ores.

Igneous rock: Rock formed from cooling and solidification of magma (molten rock).

Impaired water: As defined under Section 303(d) of the Clean Water Act, waters that are too polluted or degraded to meet the water quality standards set by states, territories, or authorized tribes.

IMPLAN: Economic modeling software that analyzes how local economies function and the economic consequences for a particular project in a geographic region.

In-advance mitigation: A form of mitigation that is designed, permitted, and constructed in advance of a permitted impact.

Indirect effect (for cultural resources): An alteration to the qualifying characteristics of a historic property included in or eligible for inclusion in the National Register that would not be considered a direct effect, which could include effects to a property's use, setting, or feeling, or introduction of incompatible visual, atmospheric, or audible elements.

Infiltration: The process of water entering the soil at the ground surface and the ensuing movement downward. Infiltration becomes percolation when water has moved below the depth at which it can return to the atmosphere by evaporation or evapotranspiration.

In-kind mitigation: The replacement of the impacted aquatic site with one of the same hydrologic regime and plant community types (same species composition).

In-place mitigation: The replacement of the impacted aquatic site would take place in the same 8-digit Hydrologic Unit Code (HUC) watershed as the proposed impacted resource. The USACE St. Paul District Policy uses the term "in-place" to include on site, which is defined as an area located on the same parcel of land as the impact site, or on a parcel of land contiguous to the impact site.

In situ: This refers to actions happening "in place" or "in position" where they would naturally occur.

Integrity (for cultural resources): The ability of a property to convey its significance based on its location, design, setting, materials, workmanship, feeling, and association.

Invasive species: Organisms that cause, or are likely to cause, harm to the economy, environment, or human health due to their tendency to out-compete other species.

Laurentian Divide: A geological formation that runs along the crest of low, rocky hills and divides the Red River and Rainy River basins from the Minnesota River and Lake Superior basins. The Laurentian Divide is part of the Northern Divide, a continental divide that separates drainages to the Hudson Bay and Arctic Ocean from all other drainages in North America. Streams on the north slope of the divide flow through Canada to Hudson Bay. On the south side of the divide, streams flow south to either Lake Superior and the Atlantic Ocean, or the Mississippi River and the Gulf of Mexico.

Laydown area: Material and equipment storage area during the construction phase of a project.

L_{dn}: The day-night average sound level.

Leachate: Solution of product obtained by leaching, in which a substance is dissolved by the action of a percolating liquid.

Legacy contamination: Historic or existing pollution.

Location quotient: The ratio between the local economy and the economy of a reference unit.

Logging slash: The residue (e.g., treetops and branches) left on the ground after logging.

Long-term closure: An assessment of the sustainability of the site "post-closure" and defining the need for long-term monitoring and maintenance required by the site (i.e., the "burden" placed on succeeding generations).

Low solubility: Not easily dissolved in water.

Lynx analysis unit: Landscape-scale analysis areas used for lynx management.

Macroinvertebrate: An invertebrate (i.e., animal without vertebrae or backbone) that is large enough to be seen without the use of a microscope. Freshwater benthic macroinvertebrates comprise the following three animal phyla: Athropoda (crustaceans, insects, spiders), Annelida (segmented worms), and Mollusca (mollusks).

Management Area: The framework that defines intended land and resource uses on national forest lands, including timber harvesting regimes, Recreational Opportunity Spectrum designations, and other similar characteristics.

Management Indicator Habitat (MIH): Categories of forest types, including dominant species, stand age class, and stand condition.

Maximum Contaminant Level (MCL): The highest level of a contaminant that is allowed in drinking water under the Safe Drinking Water Act. MCLs are enforceable standards.

Maximum Contaminant Level Goals (MCLGs): The level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs allow for a margin of safety and are non-enforceable public health goals.

Mercury: A highly toxic element that is found both naturally and as an introduced contaminant in the environment. Although concentrations in water are very low, mercury accumulates through the aquatic food chain, resulting in high concentrations in fish that can threaten the health of people and wildlife.

Mesabi Iron Range: A vast deposit of iron ore and the largest of four major iron ranges in the region collectively known as the Iron Range of Minnesota, Discovered in 1866, it is the chief deposit of iron ore in the United States. The Mesabi Iron Range is a belt of iron ore 110 miles long, averaging 1 to 3 miles wide, and reaching a thickness as great as 500 feet. It is located between Grand Rapids and Babbitt, Minnesota. The Mesabi Range was known to the local Ojibwe as *Mesabe Widjiu* which means "Giant's Mountain" or "Big-Man's Mountain."

Mesic prairie: A plant community dominated by native grasses, with soil moisture content that is between wet and dry.

Mesotrophic: Refers to a body of water having a moderate amount of dissolved nutrients.

Metamorphic rock: Rock that has been changed from an original form to a new form due to heat and pressure.

Meteoric water: The water derived from precipitation (snow and rain). This includes water from lakes, rivers, and icemelts, which all originate from precipitation indirectly.

Methylmercury (MeHg): A form of organic mercury which can accumulate up the food chain in aquatic systems and lead to high concentrations in predatory fish, which, when consumed by humans, can result in an increased risk of adverse effects in highly exposed or sensitive populations.

Mine pit dewatering: Removal of water from the mine pit(s).

Mineland reclamation: To reclaim, restore, enhance, or develop areas that have been affected by mining.

Mineral interest: The ownership rights to exploit, mine, and/or produce any or all of the minerals lying below the surface of a property.

Minerotrophic: Soils and vegetation whose water supply comes mainly from streams or springs, resulting in high nutrient levels and reduced acidity.

Minnesota Ambient Air Quality Standards (MAAQS): Air quality standards established under authority of *Minnesota Rules*, Part 7009 that apply for outdoor air to protect human health and public welfare.

Mitigation measure: Actions to reduce, avoid, or offset the potential adverse environmental consequences of development activities.

Modeling: Predicting the probability of an outcome given a set amount of input data.

Monte Carlo simulation: A computerized mathematical technique that allows people to account for risk in quantitative analysis and decision-making. The simulation furnishes the decision-maker with a range of possible outcomes and the probabilities they will occur for any choice of action.

MODFLOW: A computer model used to simulate the flow of groundwater through an aquifer.

National Ambient Air Quality Standards (NAAQS): Air quality standards established under authority of the Clean Air Act that apply for outdoor air to protect human health and public welfare.

National Environmental Policy Act (NEPA) of 1970: Under NEPA, projects and activities that require federal agency approvals or funding must undergo an evaluation of their impacts. The CEQ regulations (40 CFR 1500 et seq.) contain the procedures for implementing NEPA.

National Historic Preservation Act (NHPA): Legislation enacted in 1966 intended to preserve historical and archaeological sites in the United States. Among other things, the Act requires federal agencies to evaluate the impact of all federally funded or permitted projects on historic properties (buildings, archaeological sites, etc.) through a process known as Section 106 Review. The main purpose for the establishment of the Section 106 Review process is to minimize potential harm and damage to historic properties. It allows interested parties an opportunity to comment on the potential impact projects may have on significant archaeological or historic sites. Additionally, the Act established the Advisory Council on Historic Preservation, State Historic Preservation Offices, National Register of Historic Places, and the list of National Historic Landmarks.

National Pollutant Discharge Elimination System (NPDES) Permits: Permits issued to regulate wastewater discharges to lakes, streams, wetlands, and other surface waters. In Minnesota, these permits establish specific limits and requirements to protect surface and groundwater quality for a variety of uses, including drinking water, fishing, and recreation. An individual NPDES permit for an industrial facility may cover a number of different waste types and activities, including industrial process wastewater, contact and non-contact cooling water, stormwater, contaminated groundwater pumpouts, water supply treatment backwash, and wastewater treatment sludges.

National Register criteria: The criteria established by the Secretary of the Interior for use in evaluating the eligibility of properties for inclusion on the National Register (36 CFR part 60).

National Register of Historic Places: The official list of the Nation's historic places worthy of preservation. Authorized by the National Historic Preservation Act of 1966, the National Park Service's National Register of Historic Places is part of a national program to coordinate and support public and private efforts to identify, evaluate, and protect America's historic and archeological resources.

New Source Performance Standards: Pollution control standards issued by the USEPA and under Section 111 of the Clean Air Act which dictate the level of pollution that a new stationary source (constructed on or after January 30, 2004) may emit.

Noise-sensitive receptors: Locations or areas where dwelling units or other fixed, developed sites of frequent human use occur.

Non-contact Stormwater: Stormwater that has not been affected by sulfides and metal leachates from oxidized rock exposed through mining.

Non-degradation: As applied under the Clean Water Act and federal regulations, the term refers to both a policy and a regulatory process for the preservation of existing uses, preventing unnecessary degradation of high water quality, and protecting and maintaining specific waterbodies with outstanding characteristics.

North American Industrial Classification System (NAICS): The standard used by federal statistical agencies in classifying business establishments for the purpose of collecting, analyzing, and publishing statistical data related to the United States business economy.

Oligotrophic: Lacking in plant nutrients such as phosphates, nitrates, and organic matter, and consequently having few plants and a large amount of dissolved oxygen throughout.

One Hundred Mile Swamp: A large wetland located between Babbitt and Hoyt Lakes, Minnesota that has been rated high quality due to high watershed integrity, large amount of interior forest, and high-quality lowland coniferous forests.

Open bog: A carpet of living sphagnum moss growing over a layer of acid peat.

Ore stripping ratio: Ratio of waste rock to ore.

Ore Surge Pile: A temporary ore storage pile located near the Rail Transfer Hopper, which would help maintain a steady delivery of ore to the Processing Plant.

Ore: A type of rock that contains minerals with important elements including metals that are economically extracted through mining processes.

Outcrop area: A visible exposure of bedrock or ancient superficial deposits on the surface of the Earth.

Outfall: The discharge point of a waste stream into a body of water; alternatively, it may be the outlet of a river, drain, or a sewer where it discharges into a lake or other body of water.

Out-of-kind mitigation: The replacement of an impacted aquatic site with one of a different hydrologic regime and plant community type (different species composition).

Out-of-place mitigation: The replacement of the impacted aquatic site would take place in a different 8-digit HUC watershed as the proposed impacted resource.

Outlier: An observation that is numerically distant from the rest of the data.

Overburden: Material of any nature, consolidated or unconsolidated, that overlies a deposit of useful materials, ores, or coal, especially those deposits that are mined from the surface by open cuts.

Overstory: The larger, taller trees which occupy a forest area and shade young trees, hardwoods, brush, and other deciduous varieties that are growing beneath the larger trees (i.e., understory).

Oxidation: A common chemical reaction involving the combination of a substance such as sulfide minerals with oxygen.

P90: 90th percentile probability, which means that there is at least a 90 percent probability that a constituent would not exceed the evaluation criteria.

Paleoindian period: A cultural period circa 12,000 to 9,000 years ago, or 10,000 to 7,000 B.C.; the earliest North American archaeological epoch, characterized by retreating glaciers, mastodons and other large mammals, and small mobile groups of hunters.

Particulate matter: Fine liquid or solid particles such as dust, smoke, mist, fumes, or smog, found in ambient air or emissions.

Paste or thickened tailings: Tailings that have been significantly dewatered to a point where they will form a homogeneous nonsegregated mass when deposited from the end of a pipe.

Peat deposit: Deposits of partially decayed organic material (vegetation) that typically forms in wetland bog areas.

Perched: Contained by an underlying impervious layer, often used in reference to wetlands.

Perennial: Occurring or persisting for more than 2 years, often in reference to plant species.

Perimeter dam: Outer constructed embankments of a tailings basin.

Permeability: A measure of the ability of a material (such as soil or rock) to transmit fluids.

Permeable reactive barrier: On-site method for remediating contaminated water that combines a passive chemical or biological treatment zone with subsurface fluid flow management.

Permit to Mine: Pursuant to *Minnesota Rules*, Part 6132, a Permit to Mine means a legal approval issued by the commissioner of the Minnesota Department of Natural Resources to conduct a mining operation. Under Wetlands Conservation Act provisions, wetlands must not be impacted as part of a project for which a permit to mine is required, except as approved by the commissioner (*Minnesota Rules*, Part 8420.0930).

pH: A measure of relative acidity or alkalinity of a solution, expressed on a scale from 0 to 14, with the neutral point at 7. Acid solutions have pH values lower than 7, and basic (alkaline) solutions have pH values higher than 7.

Phase I Environmental Site Assessment (ESA): An environmental site assessment and report that identify potential or existing environmental contamination liabilities associated with a specific property.

Phreatic: Term used to refer to groundwater (e.g., "The phreatic surface coincides with the water table.").

Piezometer: A device that measures the pressure or level of groundwater at a specific point.

Point source discharge: Discharge of wastewater or other materials at a single location.

Porosity: A measure of the void (i.e., "empty") spaces in a material.

Post-closure: Phase of activities (inspection, maintenance, and reporting) that occur after the closure activities are complete.

Post-contact period: Relating to the period of time subsequent to the initial interaction of an indigenous people with an outside culture. In the United States, the term refers to an era of significant European influence for which a written record exists.

Precipitation: Any product of the condensation of atmospheric water vapor that falls under gravity. The main forms of precipitation include drizzle, rain, sleet, snow, and hail.

Pre-contact period: Relating to the period of time before contact of an indigenous people with an outside culture. In the United States, the term refers to an era before significant European influence for which a written record does not exist.

Prevention of Significant Deterioration: A federal preconstruction permitting program that applies to areas that are not violating National Ambient Air Quality Standards.

Private mineral estate: The ownership of mineral rights on land, which allows the owner to mine or produce any minerals lying below the surface of the property.

Process water: Any water that, during manufacturing or processing, comes into direct contact with or results from the production or use of any raw material, intermediate product, finished product, byproduct, or waste product.

Progressive reclamation: Reclamation activities that could occur while the mining project is still in operation, allowing for a portion of the disturbed areas to be reclaimed prior to closure.

Proposed Connected Actions: The Proposed Connected Actions would involve both the NorthMet Project Proposed Action and the Land Exchange Proposed Action.

Proposed Connected Actions Alternative B: Proposed Connected Actions Alternative B would involve the NorthMet Project Proposed Action and the Land Exchange Alternative B.

Pumping test: Conducted to evaluate an aquifer by "stimulating" the aquifer through constant pumping, and observing the aquifer's drawdown in observation wells. It is a tool that hydrogeologists use to characterize a system of aquifers, aquitards, and flow system boundaries.

Rail Transfer Hopper: A unit located at the Mine Site and would consist of a raised platform from which haul trucks would dump ore into a hopper over a pan feeder, which would discharge into a rail car below it.

Reclamation: Activities that successfully accomplish the requirements of *Minnesota Rules*, Parts 6132.2000 to 6132.3200. Actions intended to return the land surface to an equivalent undisturbed condition. Restoration of mined land to original contour, use, or condition. Steps or operations integral to mining that prepare the land for post-mining use are called reclamation. When the objective of reclamation is to return the land to pre-mining conditions and uses, it is sometimes called restoration.

Recreation Opportunity Spectrum (ROS): The framework expressing the desired range of recreational activities that will be encouraged and permitted on national forest lands.

Reject concentrate: Process water or brine that would result from the reverse osmosis process.

Remediation: Actions taken to respond to a hazardous material release or threat of a release that could affect human health and/or the environment.

Riparian: Relating to or located on the bank of a natural watercourse (or a river or stream).

Rock buttress: A rock aggregate structure built against a slope for reinforcement and support.

Rosgen geomorphic survey: A four-level hierarchy survey designed to classify streams based on quantifiable field measurements to produce consistent and reproducible descriptions of stream types and conditions.

Saturated overburden: That material unable to contain or hold more moisture of any nature, consolidated or unconsolidated, that overlies a deposit of useful materials, ores, or coal, especially those deposits that are mined from the surface by open cuts.

Scenic Integrity Objective (SIO): A statement of the intended visual conditions of national forest lands. Scenic Integrity Objectives are part of the United States Forest Service Scenery Management System.

Section 303(d) of the Clean Water Act: A portion of the federal act that requires states, territories, and authorized tribes to develop lists of impaired waters. These impaired waters do not meet water quality standards that the regulatory authorities have set for them, even after point sources of pollution have installed the minimum required levels of pollution control technology. The law requires that these jurisdictions establish priority rankings for waters on the lists and develop total maximum daily loads for these waters.

Section 404 of the Clean Water Act: see CWA Section 404 Permit.

Section 401 water quality certification: According to the Clean Water Act, anyone who wishes to obtain a federal permit for any activity that may result in a discharge to navigable waters of the United States must first obtain a state Section 401 water quality certification to ensure that the project will comply with the state water quality standards. For example, if someone proposes to discharge dredged or fill material into waters of the United States, including many wetlands, they generally must obtain a Section 404 permit from the USACE and, in Minnesota, a Section 401 water quality certification from the Minnesota Pollution Control Agency.

Sedge meadow: An open, groundwater-influenced, sedge- and grass-dominated wetland that typically borders streams but is also found on pond and lake margins and above beaver dams. Soils are nearly always sapric peat and range from strongly acid to neutral in pH.

Sedimentary rock: Rock formed from consolidation of loose sediment that has accumulated in layers.

Severed mineral interest: Any whole or partial interest in any or all minerals underlying land that has been separated from surface land ownership.

Significance (for cultural resources): The importance of a cultural property for its historical, architectural, archeological, engineering, or cultural values based upon the National Register criteria.

Significant effect: An effect that is predicted to be above an identified threshold and/or an effect that was determined by the lead agencies to have a magnitude that is large based on the context and intensity of that effect.

Slimes: The mixture of fine particles derived from ore, tailings, rock, or clay generally held in suspension in water as generated during ore processing.

Sludge: A semi-solid residue containing a mixture of solid waste material and water from air or water treatment processes.

Slug test: A type of aquifer test where water is quickly added or removed from a groundwater well to monitor and determine the hydraulic conductivity of the material in which the well is located.

Slurry wall: An underground reinforced wall in areas of soft earth or with a high water table typically made of concrete or bentonite; often used to restrict flow of groundwater from one area to another.

Spigots: Devices used to discharge tailings for conventional storage. They are typically located along the embankment(s) of a facility.

Spill Prevention Control and Countermeasure (SPCC) Plan: A written plan that includes requirements for oil spill prevention, preparedness, and response to prevent oil discharges to navigable waters and adjoining shorelines.

Standard: A level of quality or attainment set by Minnesota water use classifications (*Minnesota Rules*, Part 7060, 7050, and 7052), USEPA primary MCLs (pMCL), USEPA secondary MCLs (sMCL), and MDH HRLs.

Standard Industrial Classification (SIC) codes: A system for categorizing businesses in the United States, used by the United States government from 1937 to 1996. The Standard Industrial Classification system was replaced by the North American Industry Classification System in 1997.

State Disposal System (SDS) permit: In Minnesota, this is a permit that establishes the terms and conditions that must be met when a facility discharges wastewater to the ground surface or subsurface.

State Historic Preservation Office (SHPO): The office and official appointed or designated pursuant to section 101(b)(1) of the National Historic Preservation Act to administer the State Historic Preservation Program or a representative designated to act for the State Historic Preservation Officer.

Stormwater: According to *Minnesota Rules*, Part 7090, stormwater is defined as storm water runoff, snow melt runoff, and surface runoff and drainage.

Strahler Order: A stream order system used to classify stream segments based on the number of tributaries upstream, with headwater streams being first-order streams.

Stream geomorphic monitoring: The monitoring of changes in stream geology or features over time.

Streamflow: The flow of water in streams, rivers, and other channels. A major element of the water cycle, it is one component of the runoff of water from the land to waterbodies, with the other component being surface runoff.

Structure (for cultural resources): Any human-built, aboveground object, which may include, but is not limited to, a building, bridge, road, railroad, etc. Although not exclusive, structures are generally considered to be from contact and post-contact periods, as opposed to archaeological sites, which are generally considered to be associated with the pre-contact period.

Subaqueous: Existing or situated under water.

Subsistence: The source from which food and other items necessary to exist are obtained.

Substrate: The type of material that rests at the bottom of a stream, river, lake, etc., which could include sand, gravel, mud, or boulders.

Sulfate: A negatively charged ion that can be produced when metal sulfides are oxidized, consisting of one atom of sulfur and four atoms of oxygen, SO_4.

Sulfide mineral: A class of minerals containing sulfides, many of which contain metals.

Sulfide: A form of sulfur that often is found in the environment bound to metals.

Surface right: The landowner's rights to the upper boundary (surface) of the land only, which does not include subsurface rights.

Surface water divide: The boundary between two adjacent surface water basins, often dictated by land topography.

Surficial aquifer: Shallow aquifers typically less than 50 feet.

Surficial glacial deposit: A collection of various sized rocks and debris deposited by glacial activity that is left on the earth's surface after the glacier recedes.

Surficial groundwater: Groundwater in surficial aquifers, which continuously is unconfined and moves along the hydraulic gradient from areas of recharge to streams and other places of discharge.

Surrogate: A method to statistically analyze using modified data.

Taconite: A low-grade iron ore, containing about 27 percent iron and 51 percent silica found as a hard rock formation in the Lake Superior region.

Tailings: Waste byproducts of mineral beneficiating processes other than heap and dump leaching, consisting of rock particles, which have usually undergone crushing and grinding, from which the profitable mineralization has been separated.

Tailings basin: Land on which is deposited, by hydraulic or other means, the material that is separated from the mineral product in the beneficiation or treatment of ferrous minerals including any surrounding dikes constructed to contain the material.

Take: To harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct, a threatened or endangered wildlife species. To pick, dig, collect, or destroy, or to attempt to engage in any such conduct, a threatened or endangered plant species.

Threatened Species: Any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range as defined in the Endangered Species Act.

Till: See Glacial Till.

Total dissolved solids (TDS): A measure of the total amount of ions (minerals, salts, or metals) that are dissolved in a given volume of water. See Hardness.

Total maximum daily load (TMDL): A calculation of the maximum amount of a pollutant that a water body can receive and still safely meet water quality standards.

Toxics Release Inventory (TRI): A USEPA maintained database containing data on disposal or other releases of over 650 toxic chemicals from thousands of United States facilities and information about how facilities manage those chemicals through recycling, energy recovery, and treatment.

Traditional Cultural Property (TCP): A property that is eligible for inclusion in the National Register because of its association with cultural practices or beliefs of a living community that are rooted in that community's history, and are important in maintaining the continuing cultural identity of the community.

Tribal Historic Preservation Officer (THPO): The tribal office or official appointed by the tribe's chief governing authority or designated by a tribal ordinance or preservation program who has assumed the responsibilities of the State Historic Preservation Officer for purposes of Section 106 compliance on tribal lands in accordance with section 101(d)(2) of the Act.

Trygg: John William Trygg was a land use consultant, appraiser of natural resources, and early surveyor of Minnesota in the 1950s. He developed a system used to make historical appraisals on behalf of various Indian tribes in the Midwest. The Trygg Composite Maps, like the General Land Office (GLO) maps, depict both Native American and Euro-American features.

Unconsolidated deposit: Sediment not cemented together; may consist of sand, silt, clay, and organic material.

Underdrain: A drain, installed in porous fill, for drawing off surface water or water from the soil, as under the slab of a structure.

Unique Biological Areas: This management area designation by the United States Forest Service is allocated to areas to preserve features with unique biological value within the Superior National Forest.

United States Forest Service Regional Foresters Sensitive Species (RFSS): A list developed by the Regional Forester that identifies sensitive species. Sensitive species are defined as "*plant and animal species identified by the Regional Forester for which population viability is a concern as evidenced by: (a) significant current or predicted downward trends in population numbers or density, and/or (b) significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution.*" Sensitive species are usually designated for an entire region, but independent "Forest Sensitive" lists are maintained by some individual National Forests.

United States Geological Survey (USGS) gaging station: Facilities used by hydrologists to automatically monitor streams, wells, lakes, canals, reservoirs, and or other water bodies. Instruments at these stations collect information such as water height, discharge, water chemistry, and water temperature.

Unsaturated overburden: All mineral overburden, including zones of soil formation, located above the water table.

Usufructuary: Pertains to a person or group who has the legal right to use resources within a property that is not owned by them. Specific to the NorthMet Project Proposed Action, this pertains to the rights—derived from treaties, statutes, agreements, executive orders, and the like—of the Bands to hunt, fish, and gather 1854 Treaty resources on lands within the 1854 Ceded Territory.

Virginia Formation: Geological sedimentary rock formation located above the Biwabik Iron Formation.

Volatile organic compound: Organic chemicals that have a high vapor pressure at ordinary, room-temperature conditions.

Voluntary Investigation and Cleanup (VIC) program: The Minnesota Pollution Control Agency's program to allow property transactions to move forward while promoting redevelopment of contaminated property and mitigating health or environmental risks. Program benefits to communities include new development, jobs, and an increased tax base in old industrial zones.

Waste rock: Rock without economic value that surrounds ore.

Wastewater treatment facility (WWTF): A facility at which chemical, biological, or mechanical procedures are applied to an industrial or municipal discharge to remove, reduce, or neutralize contaminants.

Wastewater treatment plant (WWTP): An industrial structure designed to remove biological or chemical waste products from water, thereby permitting the treated water to be used for other purposes.

Water appropriation permit: A permit from the Minnesota Department of Natural Resources required for all users withdrawing more than 10,000 gallons of water per day or 1 million gallons per year.

Water clarity: A measure of how far light penetrates through water. The deeper light penetrates, the clearer the water. How far down light penetrates through water depends on how many particles are suspended in the water. Suspended particles reduce water clarity by absorbing and scattering light.

Water quality standard: The foundation of the water quality-based pollution control program mandated by the Clean Water Act. Water quality standards define the goals for a water body by designating its uses, setting criteria to protect those uses, and establishing provisions such as antidegradation policies to protect waterbodies from pollutants.

Watershed: A geographic area from which water is drained by a river and its tributaries to a common outlet. A ridge or drainage divide separates a watershed from adjacent watersheds.

Wetland Conservation Act (WCA): Minnesota legislation, codified in *Minnesota Rules*, Part 8420, designed to achieve no net loss in the quantity, quality, and biological diversity of existing Minnesota wetlands, by avoiding impacts to them or restoring and enhancing diminished wetlands. This program is administered by local governments with oversight by the Board of Water and Soil Resources.

Wetland delineation: The act of establishing the boundary between wetlands and uplands (or non-wetlands) using soils, hydrology, and vegetation as indicators.

Wetland: Those areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and that, under normal circumstances, do support a prevalence or vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.

Wild rice: A tall aquatic annual grass (*Zizania palustris*) of North America, bearing edible grain that typically grows in shallow lakes or slow-moving rivers and streams.

Woodland period: A cultural period circa 2,500 to 850 years ago, or 500 B.C. to 1250 A.D.; characterized by the beginnings of modern tribes, clay pottery, agriculture, and ceremonial burial mounds.

XP-SWMM: Comprehensive modeling software for surface water systems.

Zoning ordinance: Locally adopted regulations that divide a town, city, village, or county into separate districts (e.g., residential, commercial, or industrial), define the permitted and prohibited land uses in those districts, and set forth specific development requirements (such as minimum lot size, height restrictions, etc.

NorthMet Mining Project and Land Exchange

Preliminary Final Environmental Impact Statement

June 2015

EXECUTIVE SUMMARY

Prepared by

Minnesota Department of Natural Resources
United States Army Corps of Engineers
United States Forest Service

This document is a working document. This document may change over time as a result of new information, further deliberation, or other factors not yet known to the Co-lead Agencies.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

PolyMet Mining, Inc. (PolyMet) is proposing to develop the NorthMet copper-nickel-platinum group elements (PGE) mine and associated processing facilities in northeastern Minnesota. A land exchange is also proposed with the United States Forest Service (USFS) to eliminate a conflict between PolyMet's desire to surface mine and the United States' surface rights, including USFS administration of National Forest System (NFS) land.

- The mining proposal is known as the *NorthMet Project Proposed Action* consisting of the Mine Site, Transportation and Utility Corridor, and Plant Site. The NorthMet Project Proposed Action would represent the first copper-nickel-PGE mine in Minnesota. Figure 1 shows the general location of the NorthMet Project area and its geographic relationship within the northeast Minnesota region.
- The land exchange proposal is known as the *Land Exchange Proposed Action* consisting of USFS conveyance of Superior National Forest lands encompassing the Mine Site and surrounding lands to PolyMet, and USFS acquisition from PolyMet of up to five tracts of private land within the Superior National Forest proclamation boundary. Figure 1 shows the general location of the Land Exchange area and its geographic relationship within the northeast Minnesota region.

This Executive Summary provides an overview of the Final Environmental Impact Statement (FEIS). The purpose of the FEIS is to describe the process undertaken to evaluate the issues related to and predicted effects of the NorthMet Project Proposed Action and Land Exchange Proposed Action and alternatives. For complete discussions and analyses related to the potential effects on environmental, cultural, and socioeconomic resources, please refer to their respective sections in the FEIS.

As Co-lead Agencies, the Minnesota Department of Natural Resources (MDNR), United States Army Corps of Engineers (USACE), and USFS have jointly prepared this FEIS under the National Environmental Policy Act (NEPA) for the two federal agencies and under the Minnesota Environmental Policy Act (MEPA) for the MDNR. The FEIS describes the process the Co-lead Agencies undertook to evaluate the effects of the NorthMet Project Proposed Action, the Land Exchange Proposed Action, and alternatives developed during the process.

The NorthMet Project Proposed Action would require a number of federal, state, and local permits, including a Department of the Army (DA) permit pursuant to Section 404 of the Clean Water Act (CWA) for the discharge of dredged or fill materials into waters of the United States. The USACE has determined that issuance of a DA permit for this project would be a major federal action that has the potential to significantly affect the quality of the human environment and, therefore, pursuant to NEPA, requires preparation of an EIS.

In addition, the NorthMet Project Proposed Action would require a Permit to Mine from the MDNR, which requires the preparation of a state EIS, with the MDNR as the Responsible Governmental Unit pursuant to MEPA. The State of Minnesota's environmental review process and ultimately the EIS are intended to inform the subsequent permitting and approval processes and describe mitigation measures that may be available.

NFS lands are owned by the United States of America and administered by the U.S. Department of Agriculture, Forest Service. The NorthMet Deposit containing copper-nickel-PGE minerals is located on NFS lands within the Superior National Forest. These mineral rights were reserved by the original private owner when the United States purchased the land for National Forest purposes under the authority of the Weeks Act. Those mineral interests remain privately owned and are now controlled by PolyMet. The USFS does not believe that the mineral reservation gives PolyMet a right to surface mine NFS land to access the minerals. In addition, allowing private surface mining would be inconsistent with USFS legal mandates for acquiring and managing these lands.

To eliminate this conflict between PolyMet's desire to surface mine and the United States' rights, including USFS administration of the NFS land, PolyMet proposed a land exchange with the USFS where it would acquire the NFS land (surface estate) in exchange for currently privately owned lands that would become part of the NFS. The Land Exchange Proposed Action would reunify the severed mineral and surface estates of the NorthMet Deposit (see Figure 1). Without this exchange, under the described conditions, the surface mining operation desired by PolyMet would not take place. For this reason, the Land Exchange Proposed Action is a connected action to the NorthMet Project Proposed Action and has been analyzed in this FEIS.

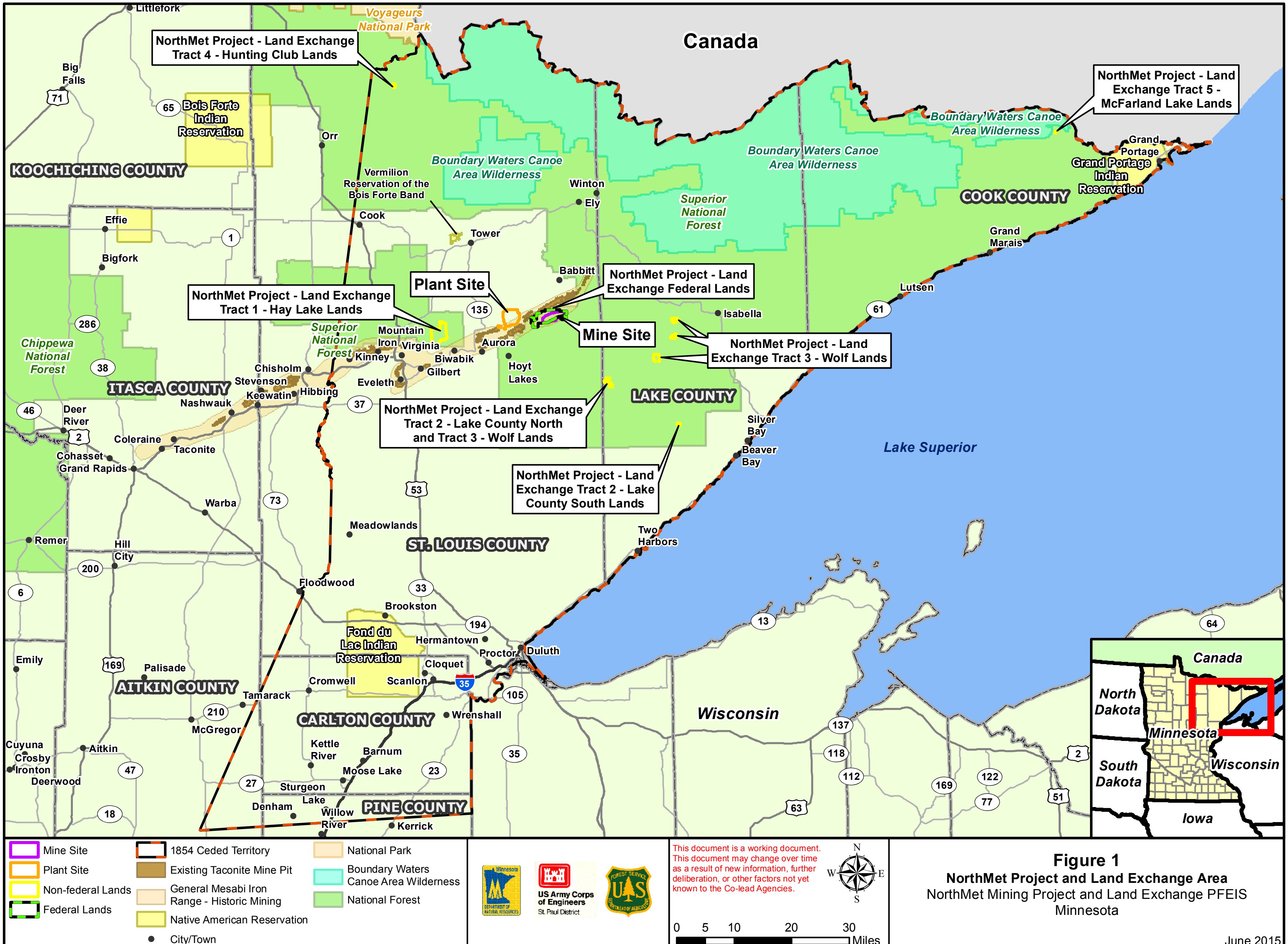

Figure 1
NorthMet Project and Land Exchange Area
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

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NEPA AND MEPA PROCESS

Development of the FEIS

As a major federal action and a project that meets or exceeds a state mandatory EIS threshold, the NorthMet Project Proposed Action and Land Exchange Proposed Action trigger the need for an EIS under NEPA and MEPA. The purpose of the EIS is to inform the public and decision-makers of the proposed actions, assess potential environmental consequences, identify potential mitigation measures and reasonable and feasible alternatives, and to address the no-action alternative. The NEPA/MEPA process provides for consultation and/or solicitation of comments from federal and state agencies, Native American Tribes, and the general public.

The Co-lead Agencies (the MDNR, USACE, and, as of 2010, USFS) have engaged in a joint federal-state process to consider PolyMet's project proposals as they have evolved over time based on external input and agency reviews of draft designs (see Figure 2).

Between 2005 and 2009, the USACE and MDNR evaluated PolyMet's original mining proposal. This process culminated in October 2009 with the publication of the NorthMet Project Draft EIS (DEIS) that analyzed the project as it was then proposed by PolyMet. After issuing the DEIS, the Co-lead Agencies—responding to public, other state and federal agencies' (including the United States Environmental Protection Agency [USEPA]), and tribal comments and concerns—developed an alternative in consultation with PolyMet that sought to resolve several major environmental concerns and permitting barriers raised during the DEIS process. This alternative was subsequently adopted by PolyMet and became the current NorthMet Project Proposed Action.

In 2010, the USFS joined as a third Co-lead Agency for the purpose of analyzing the Land Exchange Proposed Action as a connected action. Under state and federal regulations, multiple actions or projects that are connected actions must be considered in total in preparing an EIS. Coincident review of these connected actions prompted the Co-lead Agencies' decision to prepare a Supplemental Draft Environmental Impact Statement (SDEIS). The SDEIS included updated analysis of environmental impacts based on the revised NorthMet Project Proposed Action and added the Land Exchange. It was published in December 2013 and public comments were solicited during a 90-day comment period ending in March 2014.

This FEIS is being published to address public comments received on the SDEIS and to inform the completion of the Co-lead Agencies' EIS process under NEPA and MEPA.

Structure of the FEIS

This Executive Summary provides an overview of the FEIS, which includes a full description and analysis of the proposed NorthMet Mining Project and Land Exchange and alternatives, as outlined below:

- Chapter 1.0 (Introduction) provides an overview and descriptions of the purpose of and need for the NorthMet Project Proposed Action and the Land Exchange Proposed Action, the regulatory framework, agency roles and responsibilities, and the organization of the FEIS.

- Chapter 2.0 (EIS Development) describes the process undertaken by the Co-lead Agencies for the NorthMet Project Proposed Action and Land Exchange Proposed Action. It includes discussion on the scoping process; identification of issues; development of the NorthMet Project Proposed Action and Land Exchange Proposed Action and alternatives; public and agency participation; consultation and coordination undertaken to prepare the DEIS, SDEIS, and this FEIS; incorporation of the Land Exchange Proposed Action; reevaluation of DEIS alternatives; and impact analysis approach.
- Chapter 3.0 (Proposed Action and Alternatives) describes the NorthMet Project Proposed Action and Land Exchange Proposed Action and alternatives including the No Action Alternative, Land Exchange Alternative B, as well as alternatives considered but eliminated from detailed consideration in the EIS.
- Chapter 4.0 (Affected Environment) summarizes the existing conditions of the NorthMet Project area and the surrounding environment, as well as the proposed Land Exchange parcels, including the land and its physical, biological, cultural, socioeconomic, and recreational resources.
- Chapter 5.0 (Environmental Consequences) presents the direct and indirect environmental effects of the NorthMet Project Proposed Action and alternatives and the direct and indirect environmental effects of the Land Exchange Proposed Action and associated alternatives.
- Chapter 6.0 (Cumulative Effects) describes the cumulative effects of the NorthMet Project Proposed Action and Land Exchange Proposed Action when considered along with other past, present, and reasonably foreseeable future actions in the region.
- Chapter 7.0 (Comparison of Alternatives and Other Considerations) contains a comparison of the Proposed Connected Actions and alternatives, conclusions of the impacts (including human health), and Land Exchange Proposed Action public interest considerations, and also addresses other NEPA considerations including a discussion of agency-preferred alternatives.
- Chapter 8.0 (Major Differences of Opinion) describes the Tribal Cooperating Agencies' major differences of opinion with aspects of the EIS.
- Appendix A (Response to Comments on the NorthMet Mining Project and Land Exchange Draft and Supplemental Draft EIS) identifies the process for public engagement throughout the EIS and provides responses to comments received on the DEIS and SDEIS.
- Appendix B (Underground Mining Alternative Assessment for the NorthMet Mining Project and Land Exchange Environmental Impact Statement) describes the analysis that the Co-lead Agencies undertook in consideration of a potential Underground Mining Alternative.
- Appendix C (Tribal Agency Position Supporting Materials) includes verbatim comments and supporting documentation provided by the Tribal Cooperating Agencies.

- Appendix D (Biological Assessment and Biological Evaluation) identifies whether activities related to the NorthMet Proposed Action and Land Exchange Proposed Action may affect listed or proposed species and critical habitat as required under the Endangered Species Act.

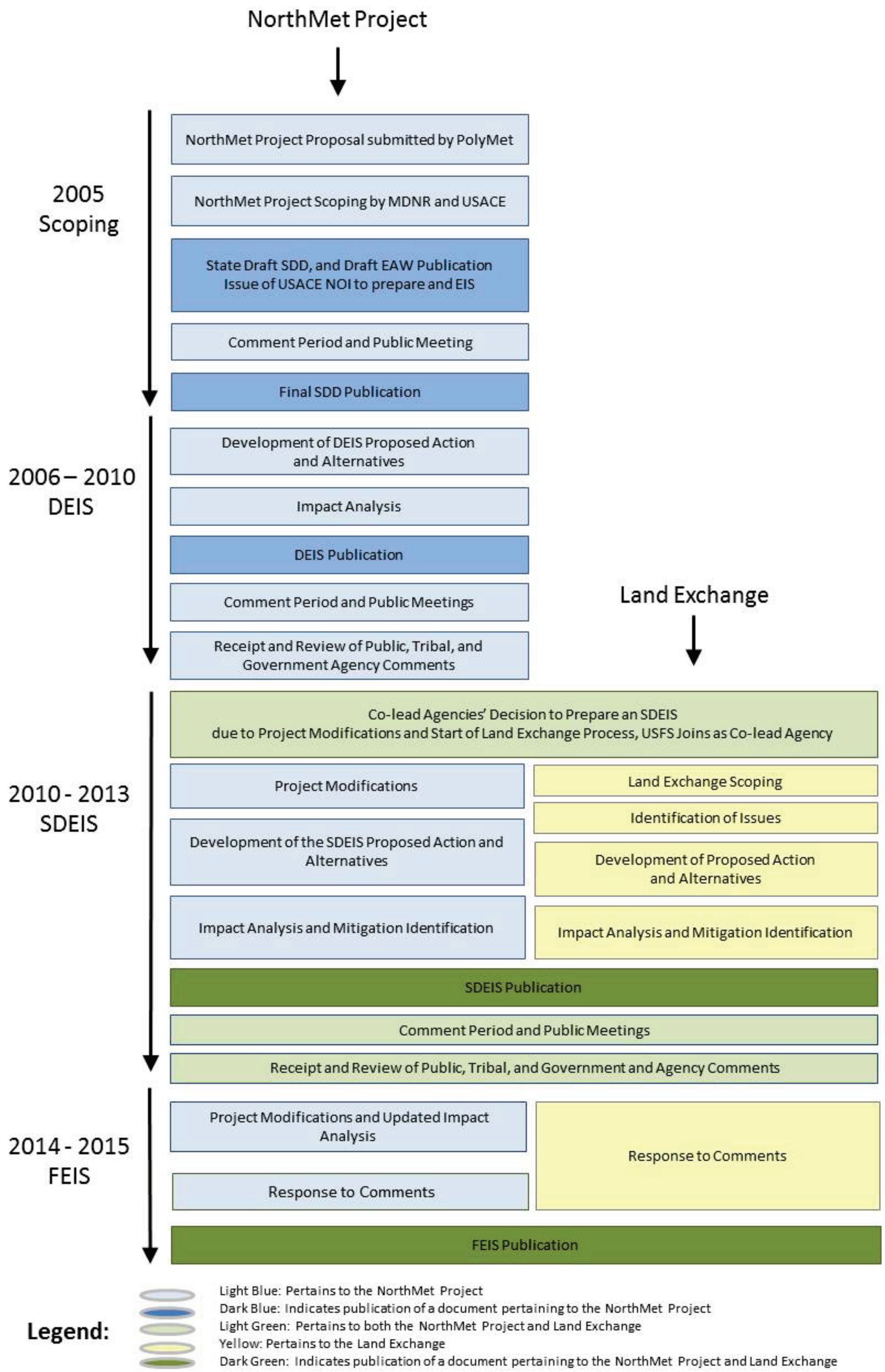

Figure 2 NEPA/MEPA Process, 2005 to Present

Agency Roles in the FEIS

Co-lead Agencies

The MDNR, USACE, and USFS are Co-lead Agencies for the joint state-federal EIS and, therefore, are responsible for the content of the FEIS and have final authority over the language used in the document.

Cooperating Agencies

The USEPA, under Section 309 of the Clean Air Act, is required to review and publicly comment on all federal EIS documents and publish its review in the public record.

Along with the USEPA, the Bois Forte Band of Chippewa, Grand Portage Band of Lake Superior Chippewa, and the Fond du Lac Band of Lake Superior Chippewa (the Bands) have been invited by the Co-lead Agencies to participate in the EIS process and agreed to participate as formal Cooperating Agencies under NEPA. The NorthMet Project area and Land Exchange parcels are located within the 1854 Ceded Territory, within which the Bands reserve hunting, fishing, and gathering (usufructuary) rights. The Great Lakes Indian Fish and Wildlife Commission and the 1854 Treaty Authority have assisted the Bands in addressing issues with the NorthMet Mining Project and Land Exchange.

Other Agencies

Other federal and state agencies participating in development of the FEIS include, but are not limited to, the Minnesota Pollution Control Agency (MPCA), the Minnesota Department of Health, and the United States Fish and Wildlife Service.

PURPOSE OF THE NORTHMET PROJECT AND LAND EXCHANGE

The purpose of the NorthMet Project and Land Exchange is multifaceted:

- PolyMet: The NorthMet Project and Land Exchange would allow the company to exercise its mineral lease rights to mine the NorthMet Deposit.
- USACE and MDNR: The NorthMet Project Proposed Action would produce base and precious metal precipitates and flotation concentrates from ore mined at the NorthMet Deposit by uninterrupted operation of the former LTV Steel Mining Company (LTVSMC) processing plant. The processed resources would help meet domestic and global demand by sale of these products to domestic and world markets.
- USFS: The Land Exchange Proposed Action is intended to resolve the conflict between the surface estate owned by the United States and the private mineral estate.

PROPOSED CONNECTED ACTIONS

The Proposed Connected Actions includes the NorthMet Project Proposed Action and the Land Exchange Proposed Action as described below.

NorthMet Project Proposed Action

Located on the eastern flank of the Mesabi Iron Range, the proposed NorthMet Mine would be located 6 miles south of the City of Babbitt and the processing plant would be 6 miles north of the City of Hoyt Lakes in St. Louis County, Minnesota. The Mesabi Iron Range region has been mined for iron ore and lower-grade iron ore called taconite for over 100 years (see Figure 3). The entire mine is within the municipal boundaries of the City of Babbitt and the processing plant is mostly located within the municipal boundaries of the City of Hoyt Lakes (see Figure 4). Several other communities, including Aurora, Virginia, Ely, Hibbing, Eveleth, and Biwabik that are located within St. Louis and Lake counties, are within 50 miles of the NorthMet Project area. In addition, the project is about 50 miles southeast of Voyageurs National Park and 20 miles south of the Boundary Waters Canoe Area Wilderness (BWCAW).

A substantial portion of the land required by the NorthMet Project Proposed Action would reuse a former mining plant site (LTVSMC processing plant) for mineral processing, and use the existing Tailings Basin for tailings disposal.

Mining would occur on what is referred to as the Mine Site, which is relatively undisturbed land; however, there is previously logged land nearby. The Mine Site would be connected to the processing facilities and tailings basin (Plant Site) by an existing (upgraded) rail line, the Dunka Road, and a water line, collectively referred to as the Transportation and Utility Corridor. The active Northshore Mine (taconite iron ore mine) is located about a mile north of the Mine Site.

There would be three distinct phases to the NorthMet Project Proposed Action:

- Construction would last for approximately 18 months and would include land clearing, building renovation and construction, stockpile preparation, and utility upgrades.
- Operations would last approximately 20 years, and would include ore mining and processing, continued construction, and progressive reclamation.
- Final land reclamation, closure, and post-closure maintenance would occur after mining and would include infrastructure removal, maintenance, and monitoring.

An overview of the NorthMet Project Proposed Action construction, operations, closure, and post-closure maintenance is provided below.

488

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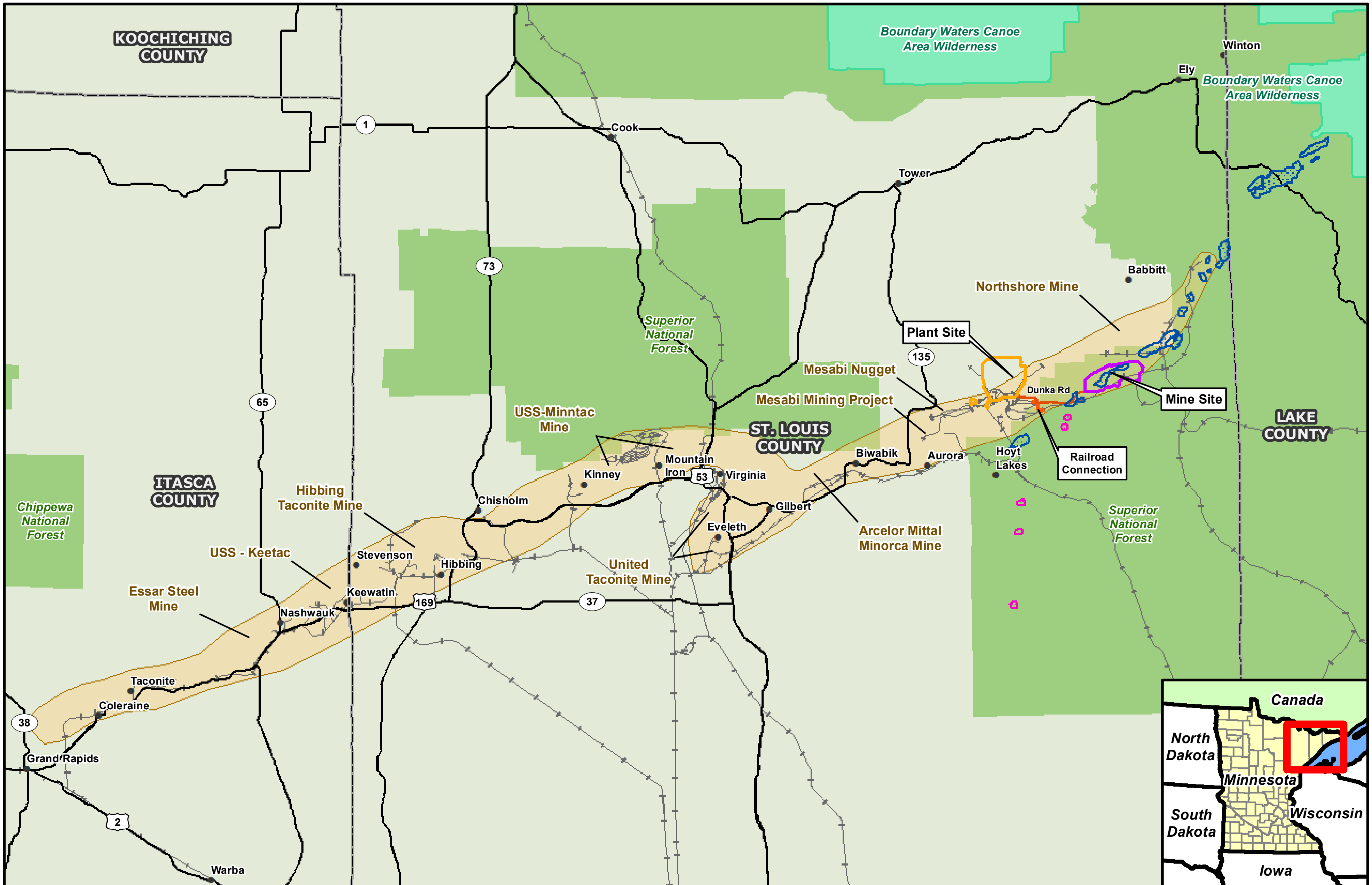

Plant Site
Mine Site
Transportation and Utility Corridor
Boundary Waters Canoe Area Wilderness
National Forest
General Mesabi Iron Range - Historic Mining
Duluth Complex Copper-Nickel Deposits
Duluth Complex Titanium-Iron Deposits
City/Town
Existing Road
Existing Railroad

US Army Corps of Engineers St. Paul District

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N E S W

0 2.5 5 10 Miles

Figure 3
Mesabi Iron Range Region
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

490

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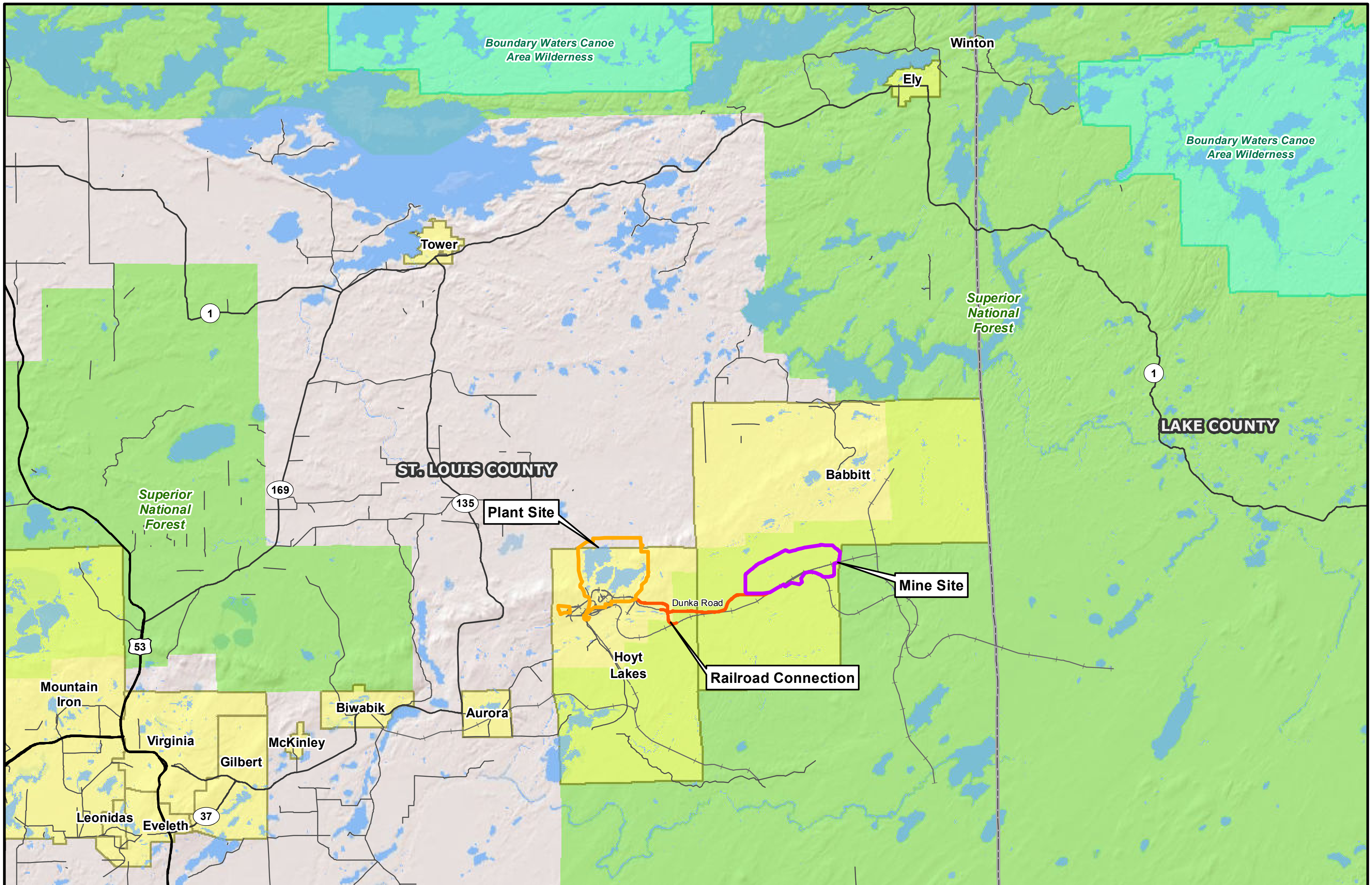

Plant Site
Mine Site
Transportation and Utility Corridor
Municipal Boundary
Boundary Waters Canoe Area Wilderness
National Forest
Existing Road
Existing Railroad

US Army Corps of Engineers St. Paul District

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N W E S

0 1.5 3 6 Miles

Figure 4
Area Municipalities
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

492 -Page Intentionally Left Blank-

Construction

Construction would begin after permitting and about 18 months before mining and processing. Geochemical characterization has identified four types of waste rock that would be managed based on their potential to oxidize and release various solutes (Category 1 being the lowest potential and Category 4 being the highest). In preparation for mining at the Mine Site, existing vegetation would be cleared and overburden (i.e., soils and rock) would be removed. Additionally, a Mine Site Wastewater Treatment Facility (WWTF), Category 1 Stockpile groundwater containment system, and liner systems for the Category 2/3 Stockpile and Category 4 Stockpile would be constructed. At the Transportation and Utility Corridor, an existing road, railroad, and utilities would receive minor upgrades. These transportation routes and utilities would connect the Mine Site to the Plant Site, which are about 8 miles apart.

At the Plant Site, existing buildings would be refurbished and new buildings would be constructed. A portion of the existing LTVSMC Tailings Basin would be used as the base for a new NorthMet Project Tailings Basin. A surface and groundwater containment system would be installed around the northern, western and eastern sides of the Tailings Basin to collect surface and groundwater coming from the Tailings Basin. The existing containment system along the southern side of Tailings Basin would be improved as necessary to meet performance requirements. The stability of the Tailings Basin would be enhanced by the addition of rock buttressing, and weaker material in the existing facility would be strengthened using cement deep soil mixing. A separate double-lined facility would be constructed to contain residue from the hydrometallurgical process. A mechanical Wastewater Treatment Plant (WWTP) (using reverse osmosis [RO]) or equivalently performing technology would be constructed.

Mining Operations

The mining operations would involve the use of conventional open-pit surface mining methods such as blasting and the excavation of rock from the NorthMet Deposit. The NorthMet Deposit is a low- to medium-quality copper-nickel-PGE deposit with low sulfide content. The Life of Mine (i.e., the duration of mining operations) would be 20 years, over which time approximately 533 million tons of waste rock and ore would be removed from the NorthMet Deposit. This includes a total of 225 million tons of ore and 308 million tons of waste rock. The average ore processing rate would be up to 32,000 tons per day.

Mining would be conducted in three open pits. The East Pit and West Pit would be mined simultaneously through the first 11 years of the mine life (see Figure 5). Mining would cease at the East Pit at approximately year 11 and continue at the West Pit until year 20 (see Figure 6). The Central Pit would be mined between years 11 and 16 and would ultimately be combined with the East Pit. The maximum depths of the pits below the original surface level would be 696 feet (ft) for the East Pit (at year 11), 356 ft for the Central Pit (at year 16), and 630 ft for the West Pit (at year 20).

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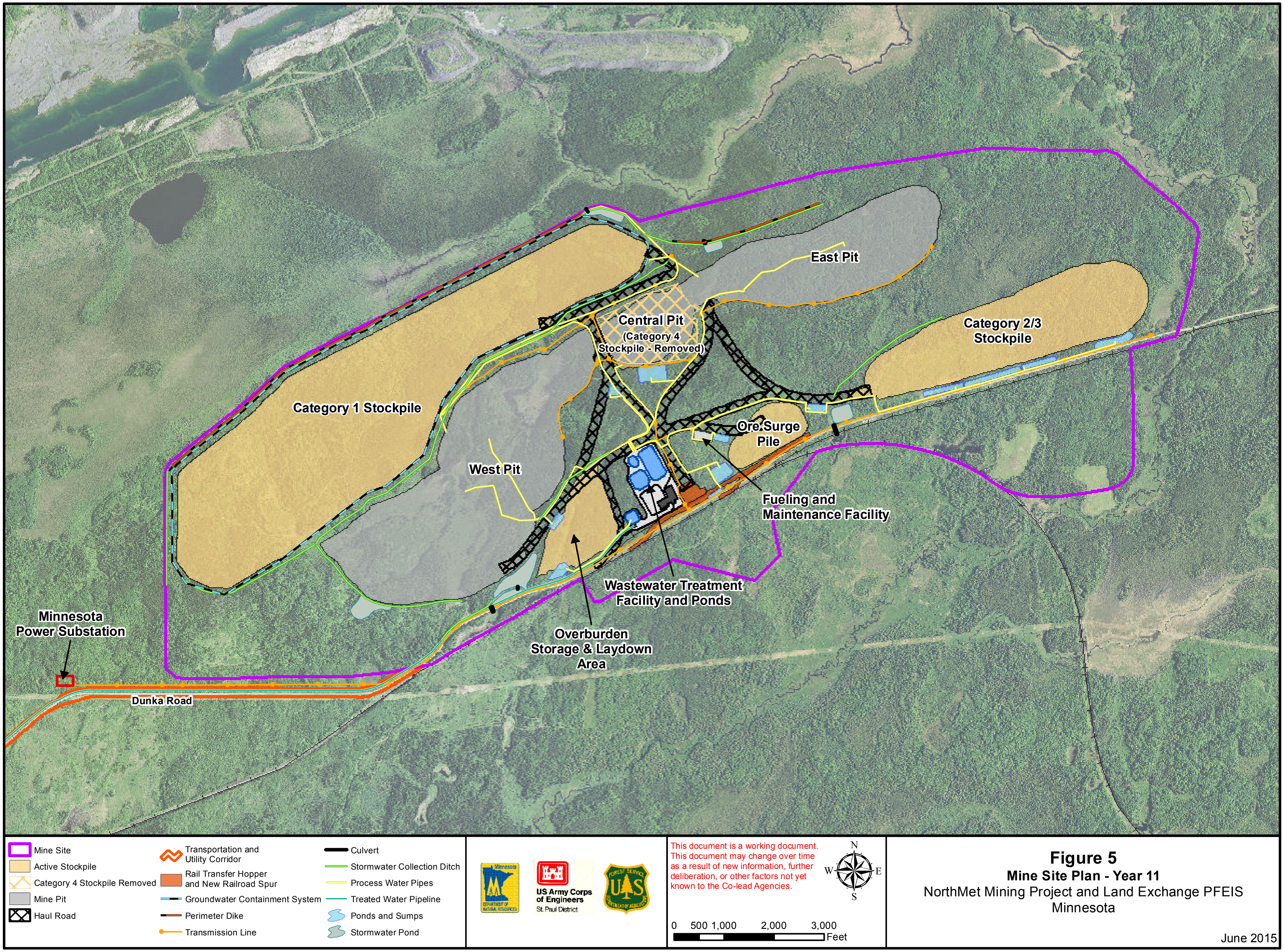

Figure 5

Mine Site Plan - Year 11

NorthMet Mining Project and Land Exchange PFEIS

Minnesota

June 2015

574

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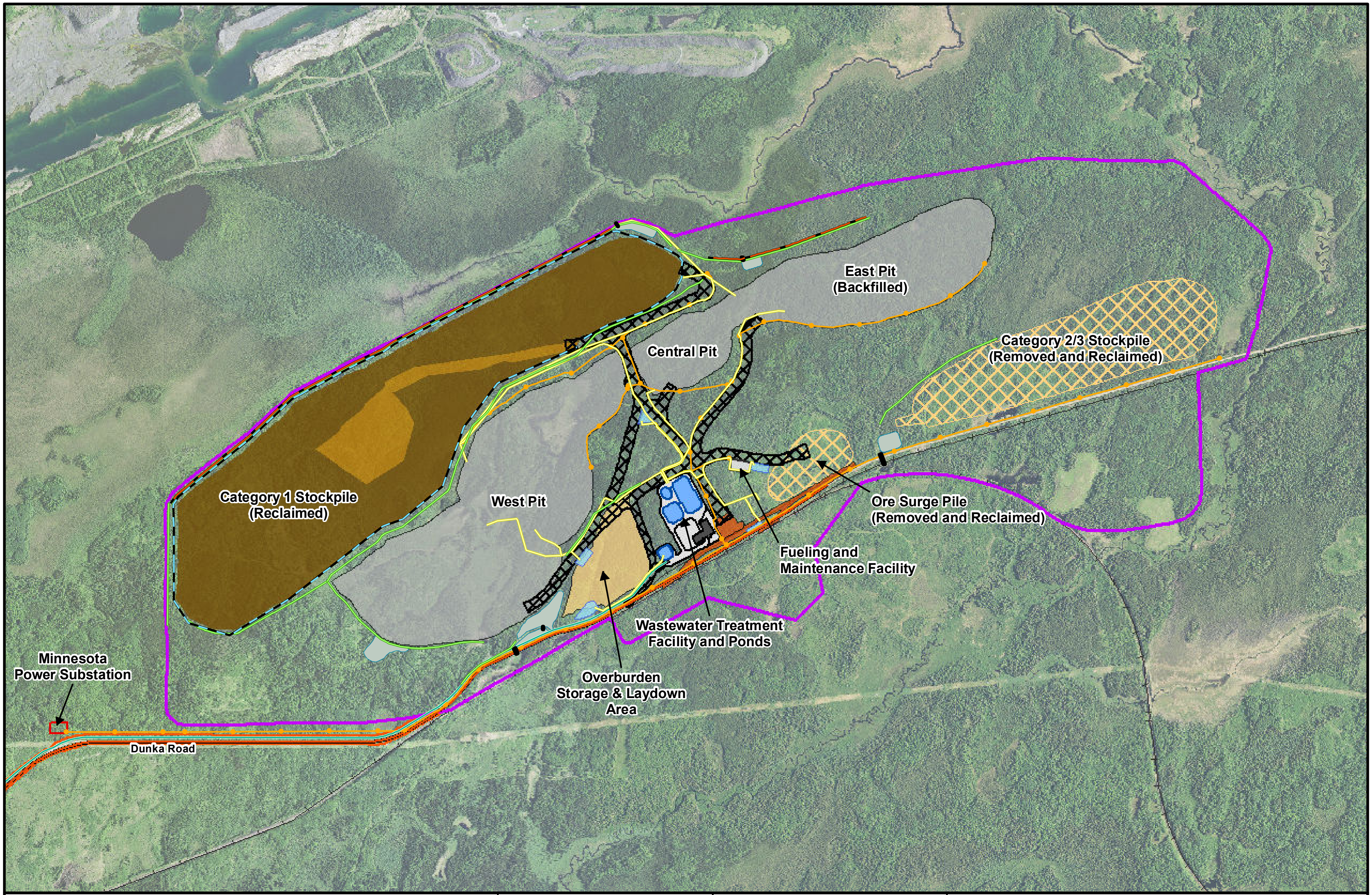

Mine Site
Mine Pit
Covered in Previous Years
Covered Upon Mine Closure
Active Stockpile
Removed and Reclaimed Stockpile
Haul Road
Transportation and Utility Corridor
Rail Transfer Hopper and New Railroad Spur
Groundwater Containment System
Perimeter Dike
Transmission Line
Culvert
Stormwater Collection Ditch
Process Water Pipes
Treated Water Pipeline
Ponds and Sumps
Stormwater Pond

Minnesota Department of Natural Resources
US Army Corps of Engineers St. Paul District
Forest Service U.S. Department of Agriculture

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N W E S

0 500 1,000 2,000 3,000 Feet

Figure 6
Mine Site Plan - Year 20
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

576 -Page Intentionally Left Blank-

Until the completion of mining in the East Pit (approximately year 11), waste rock would be hauled to one of the following stockpiles at the Mine Site:

- Permanent Category 1 Stockpile (surrounded by a water containment system and covered at closure);
- Temporary Category 2/3 Stockpile (lined); or
- Temporary Category 4 Stockpile (lined).

After mining planned at the East Pit ends by year 11, the waste rock in the temporary Category 2/3 and 4 stockpiles would be moved into the East Pit for subaqueous disposal. This option is the preferred method of disposal for the more reactive waste rock. Waste rock generated from ongoing mining in the West Pit and Central Pit after year 11 would be directly disposed of in the East Pit. Some Category 1 waste rock would continue to be placed on the Category 1 Stockpile until year 13. Mining operations would continue in the West Pit until year 20, while backfilling the combined East Central Pit with waste rock.

Water control systems would be constructed to capture water that has contacted surfaces disturbed by mining operations, water collected on stockpile liners, and water collected by the Category 1 Stockpile containment system (i.e., collectively referred to as process water). Process water would be treated at a mechanical WWTF located at the Mine Site and either pumped to the Plant Site Tailings Basin for use as process make-up water or to supplement flooding of the East Pit after backfilling with waste rock. No surface water would be discharged off site.

Processing Operations

Ore would be transported to the Plant Site (see Figure 7) by rail, for crushing and processing. Processing would involve concentration using a flotation method to separate metallic sulfide minerals (ore concentrate) from feldspar and other non-ore minerals (tailings).

Ore concentrate would either be dewatered and shipped off site as copper concentrate and nickel concentrate final products, or the nickel concentrate would be processed in an autoclave (oxidation and leaching method) at the Hydrometallurgical Plant and base/precious metal precipitates would be produced. These precipitates would be shipped off site and sold as final products. Based on the anticipated rate of mining, mineral processing of up to 32,000 tons per day of ore would yield annual production of about 113,000 tons of copper concentrate, 18,000 tons of mixed (nickel/copper) hydroxide, and 500 tons of PGE precipitate.

After passing through a secondary flotation cycle to remove as many sulfide minerals as possible, the tailings would be transferred as slurry to the Tailings Basin. Bentonite clay would be incorporated into the exposed outer side-slopes of the Tailings Basin as it is built up to create a barrier that would limit oxidation of sulfide minerals. This limiting of oxygen transfer would reduce pollutants generated from the Tailings Basin.

Water seepage from the Tailings Basin would be collected by the containment system and sent to either the Tailings Basin pond or the Plant Site WWTP for treatment. Treated water would be used to maintain flows (augmentation) in the streams that would otherwise receive reduced flows because of the Tailings Basin containment system.

Closure and Post-closure Maintenance

In general, the Mine Site area has been designed and would be operated to allow for progressive reclamation. After mining is completed, the West Pit would be filled with groundwater and surface water to become a pit lake (see Figure 8). The Mine Site mechanical WWTF would be upgraded to include RO or equivalently performing technology and would be maintained to treat pit lake water quality for as long as necessary. Other unnecessary buildings and infrastructure would be removed and reclaimed. The Plant Site would be closed by removing unnecessary buildings and infrastructure, capping the Hydrometallurgical Residue Facility (double-lined), and adding bentonite amendment and vegetation to the beaches and pond at the Tailings Basin. The Tailings Basin collection system and Plant Site WWTP (RO or equivalently performing technology) would be maintained to treat Tailings Basin seepage for as long as necessary.

Water quality modeling performed in support of the FEIS indicates that water treatment systems would be needed at the Mine Site and Plant Site indefinitely. The water objective of closure is to provide water treatment for as long as necessary to meet regulatory standards at applicable groundwater and surface water compliance points. The NorthMet Project Proposed Action includes long-term mechanical treatment (RO or equivalently performing technology) at both the Mine Site and Plant Site with a goal of transitioning to a non-mechanical water treatment technology requiring less maintenance over the long term. Pilot studies for non-mechanical treatment would be conducted during operations (and post-closure as necessary) to demonstrate the ability to transition to non-mechanical water treatment. Both mechanical and non-mechanical treatment would require periodic maintenance and monitoring activities for as long as treatment is required (indefinitely).

The water models constructed to assess the potential effects from the NorthMet Project Proposed Action were not designed to predict the duration of treatment nor do they capture all the factors that influence the duration of treatment. Therefore, the models cannot be used to predict when treatment would end. Actual treatment requirements would be assessed on a recurring basis throughout operations and closure based on results of ongoing discharges, performance, and water resource monitoring, ensuring continuous protection of groundwater and surface water quality and compliance with applicable water quality standards. This reassessment process would rely on measured monitoring results (evaluated through modeling) rather than the results of the predictive modeling included in the FEIS. Regardless of the precise duration of effects or water treatment at either the Mine Site or Plant Site, there are measures available to address impacts to natural resources.

Monitoring, Adaptive Management, and Mitigation

The monitoring and maintenance of geotechnical stability, water, wetland, vegetation, and other resources would continue for as long as necessary.

One of the key elements of the NorthMet Project Proposed Action is the inclusion of several management plans that detail how PolyMet would monitor environmental conditions to ensure that they would meet all applicable environmental goals set in the permits. Key among these plans is the Adaptive Water Management Plan, which describes how Mine Site and Plant Site water management would be managed and under what circumstances design changes to the following NorthMet Project Proposed Action facilities would be triggered:

- Category 1 Stockpile Cover System – PolyMet proposes to install a geomembrane cover system to reduce the load of constituents that reach the

West Pit via drainage from the Category 1 Stockpile. It is considered an adaptive engineering control as the cover system could be enhanced if monitoring identified the cover system was underperforming.

- Mine Site WWTF – the WWTF is considered adaptive engineering control as it would be upgraded to a RO or equivalently performing technology during closure and adjusted as needed to manage sulfate concentrations in the effluent.
- Plant Site WWTP – the WWTP would treat Plant Site process water. It is considered an adaptive engineering control because the operating configuration and requirements of the process units within the WWTP or the capacity of the WWTP could be modified to accommodate varying influent streams and discharge requirements.
- Tailings Basin Pond Bottom Cover System – PolyMet proposes to install a Tailings Basin pond bottom cover system during reclamation in order to reduce the diffusion of oxygen into the tailings. It is considered adaptive engineering control as additional bentonite could be added if the pond bottom cover system were under-performing.

Other proposed mitigation measures are also included in the FEIS and would be a part of the NorthMet Project Proposed Action. These may include measures to ensure geotechnical dam stability, reduce fugitive dust and noise, and effects on water quality, wetlands, cultural resources or historic properties, and other resources.

The FEIS describes these proposed measures and when they would be employed during construction, operations, and closure of the NorthMet Project Proposed Action. Monitoring and modeling would be used to determine the performance of the proposed measures and identify any needed revisions.

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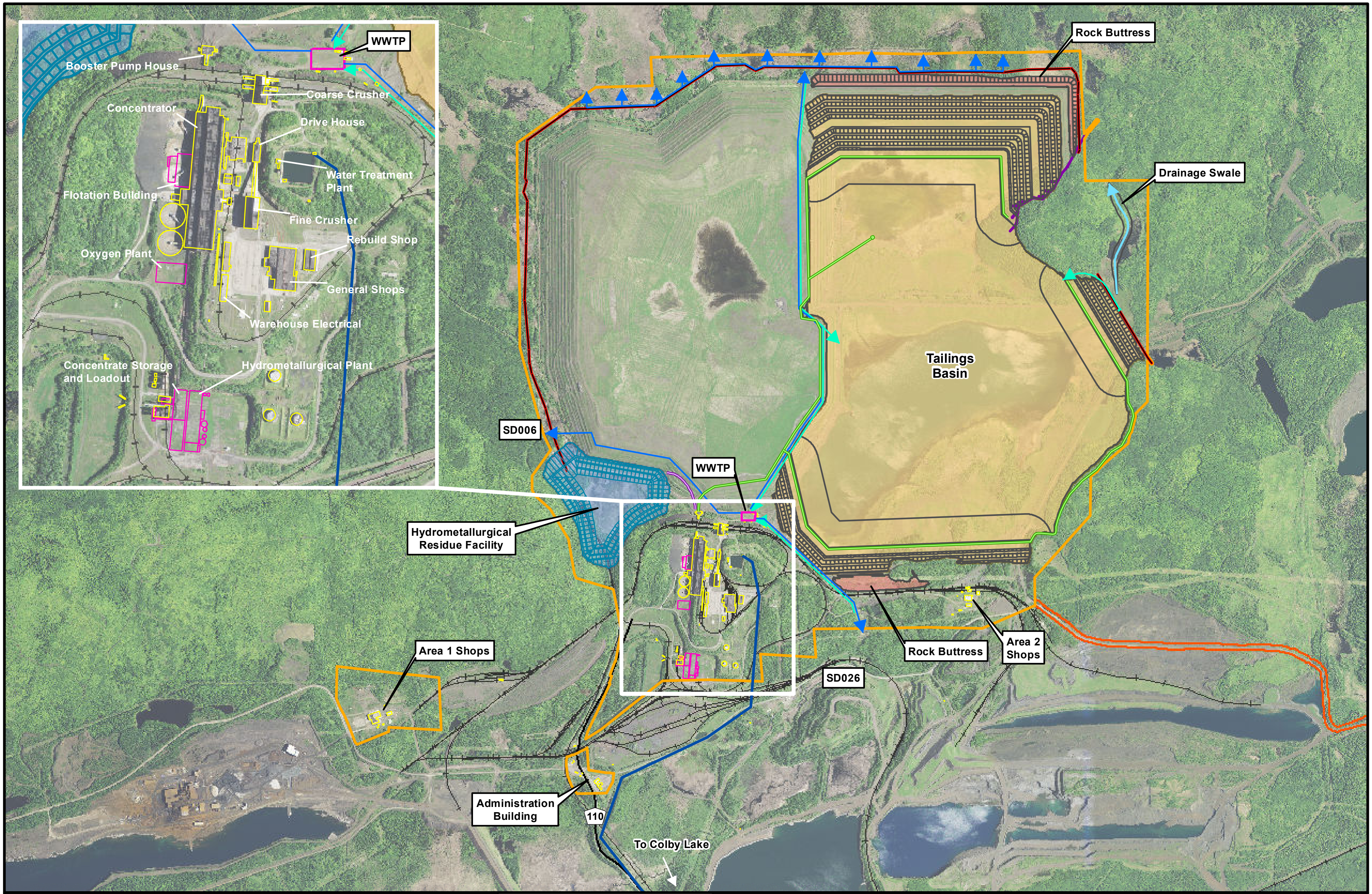

Plant Site
Tailings Basin
Proposed Building
Existing Building
Hydrometallurgical Residue Facility
Transportation and Utility Corridor
Rock Buttress
Containment System
Treated Water Discharge
Seepage Water Pipe
Colby Lake Water Pipeline Corridor
Drainage Flow Direction
Hydrometallurgical Residue Pipeline
Flotation Tailings Pipeline
Tailings Basin Emergency Overflow
Existing Railroad

US Army Corps of Engineers
St. Paul District

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N E S W

0 1,000 2,000 4,000 Feet

Figure 7
Plant Site Layout
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

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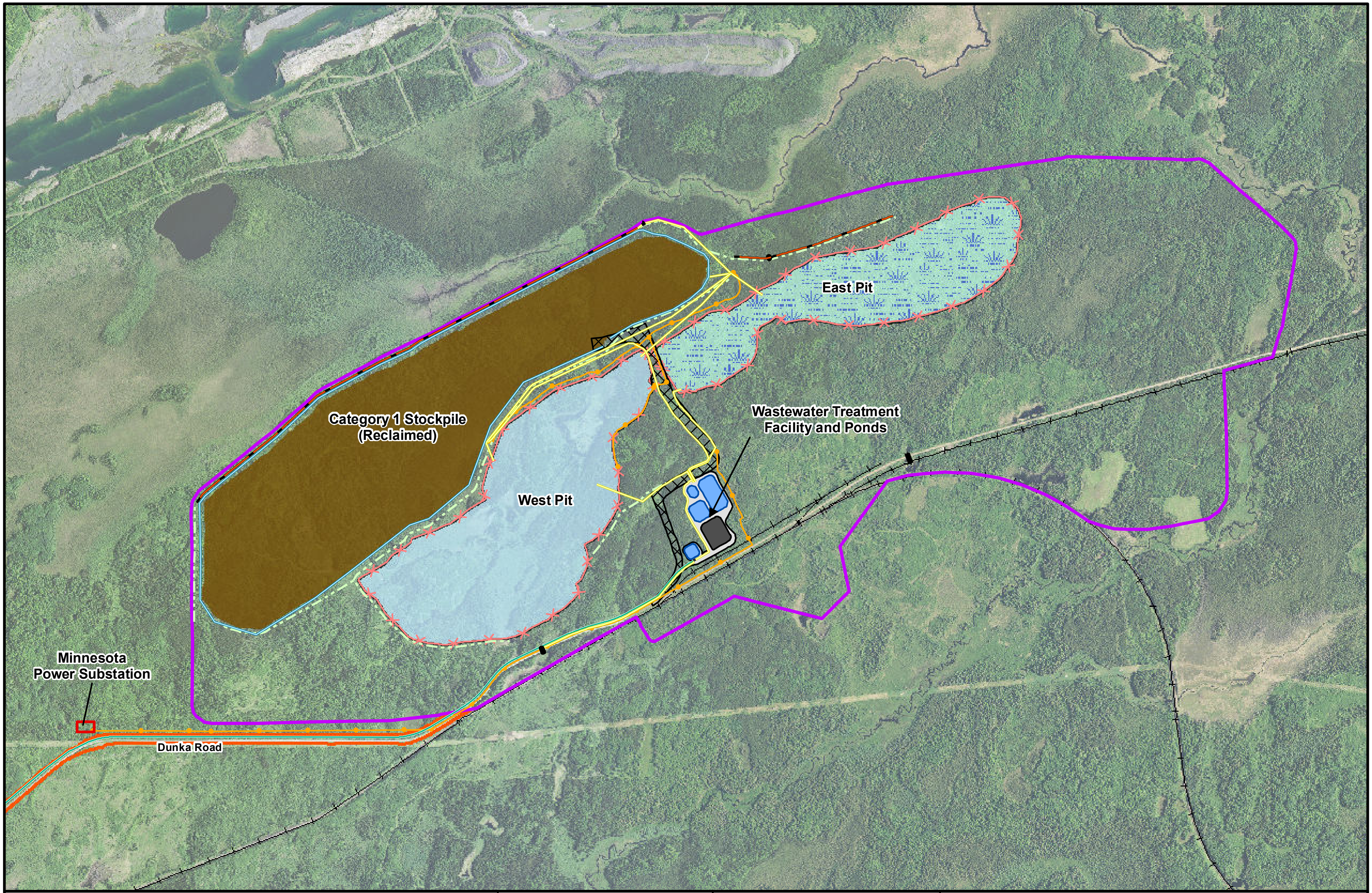

Mine Site
Pit with Backfill and Surface Wetland
Pit Lake
Covered in Previous Years
Haul Road
Transportation and Utility Corridor
Groundwater Containment System
Transmission Line
Stormwater Collection Ditch
Perimeter Dike
Process Water Pipes
Treated Water Pipeline
Fence
Culvert

US Army Corps of Engineers
St. Paul District

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Figure 8

Mine Site Plan - Long Term Closure

NorthMet Mining Project and Land Exchange PFEIS

Minnesota

June 2015

807

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Land Exchange Proposed Action

The Land Exchange Proposed Action would involve the transfer of 6,650.2 acres (General Land Office [GLO]) of federal lands from public to private ownership, and up to 6,722.5 acres (GLO) of land from private to public ownership (see Figure 9), depending upon the results of the environmental analysis and real estate appraisals. This information will be presented in the USFS Record of Decision (ROD). The ROD will require a current appraisal, approved by the USFS, to verify equal value.

Federal Lands

The federal lands proposed to transfer to PolyMet include a large black spruce, tamarack, and cedar wetland, and also contain Mud Lake. Yelp Creek and the Partridge River also flow through the property. These federal lands lie immediately south of the Superior National Forest proclamation boundary and are bounded on the south by the former LTVSMC railroad and Dunka Road, which are features of the NorthMet Project Proposed Action. Legal access to the federal lands is primarily via Dunka Road, which is privately owned and would require an approval for ingress and egress, and the former LTVSMC railroad.

The area includes other privately owned properties to the north and west of the federal lands, which have been surface mined over the years. There are mine pits, waste rock stockpiles, tailings basins, processing facilities, railroad grades, and other general mining facilities throughout the area. A 115-acre, privately owned in-holding within the exterior boundaries of the northwestern portion of the federal lands is not included in the Land Exchange Proposed Action.

Non-federal Lands

The Land Exchange Proposed Action would include up to five tracts (Tract 1 – Hay Lake lands, Tract 2 – Lake County lands, Tract 3 – Wolf lands, Tract 4 – Hunting Club lands, Tract 5 – McFarland Lake lands) of non-federal lands in St. Louis, Lake, and Cook counties that would comprise up to 6,722.5 acres (GLO); however, the final exchange, if approved, could include fewer than 6,722.5 acres (GLO) of non-federal land, depending on the results of the environmental analysis and real estate appraisals. All of the lands proposed for exchange are located within the 1854 Ceded Territory of northeastern Minnesota (see Figure 1). For more information regarding the 1854 Ceded Territory, please refer to the Predicted Environmental Consequences section below.

PolyMet currently owns a portion of the non-federal lands proposed for exchange; however, all rights, titles, and interests of the remaining non-federal lands proposed for exchange have been assigned to PolyMet. All of the non-federal lands except Tract 4 have severed mineral and surface ownership, which means that the mineral resources would not be acquired with the surface. There are no mining activities proposed on the non-federal lands as part of the Land Exchange Proposed Action. The lands acquired would become part of the Superior National Forest and would be managed under the 2004 Superior National Forest Land and Resource Management Plan (Forest Plan).

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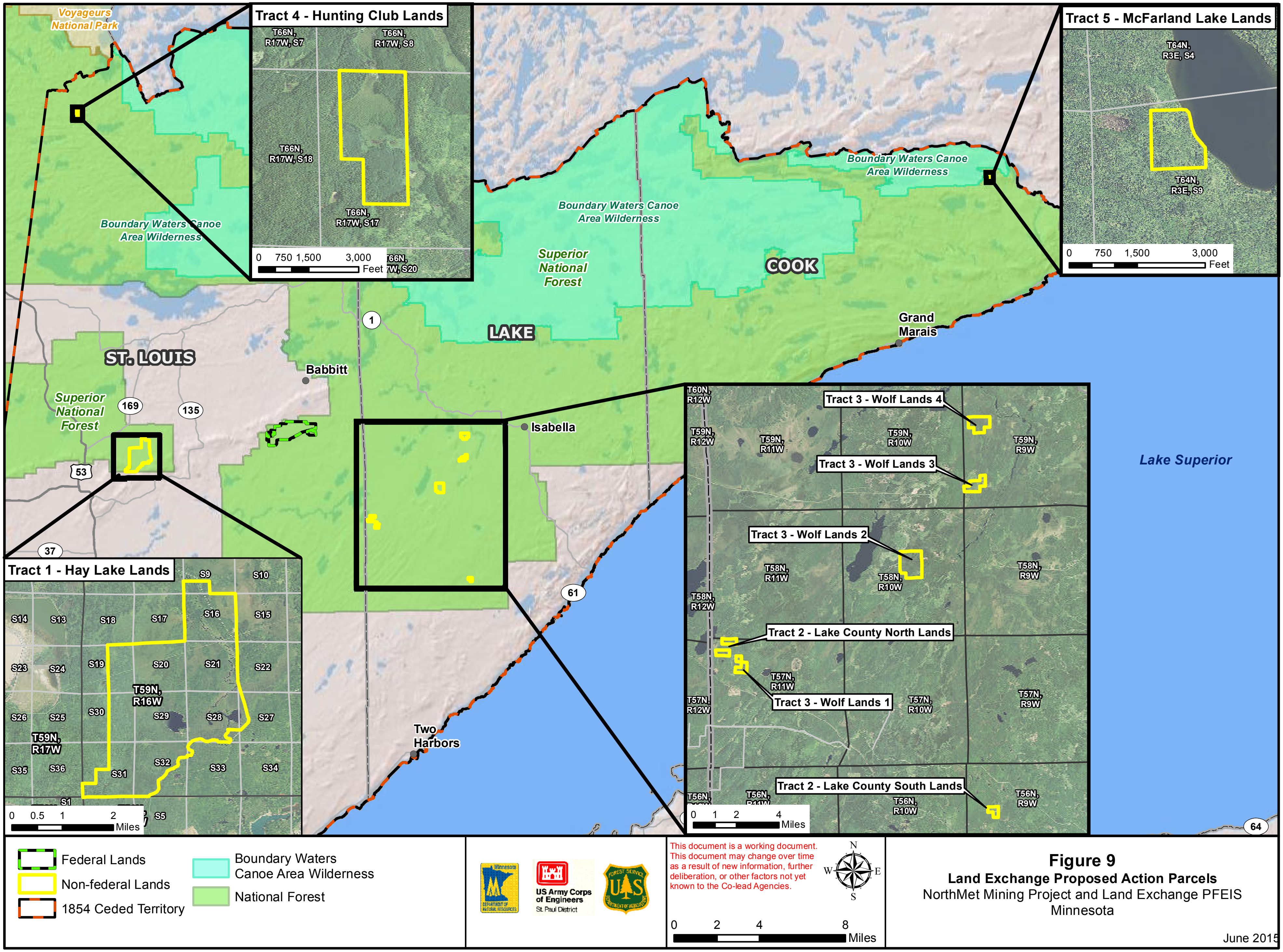

Figure 9
Land Exchange Proposed Action Parcels
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

890

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PREDICTED ENVIRONMENTAL CONSEQUENCES OF THE PROPOSED CONNECTED ACTIONS

Although the NorthMet Project Proposed Action would take place in a region that has been used for mining and timber production for over 100 years, it also contains many important recreational, cultural, and natural resources. The FEIS describes in detail those elements of the natural and human environment that would be affected by the NorthMet Project Proposed Action and Land Exchange Proposed Action. The following section briefly describes some of the critical environmental effects predicted as a result of the NorthMet Project Proposed Action and Land Exchange Proposed Action.

NorthMet Project Effects on Water Resources

The NorthMet Project Mine Site drains to the Partridge River and the Plant Site mostly drains to the Embarrass River with the exception of Second Creek (Partridge River Watershed). Both rivers are tributaries to the St. Louis River, which flows to Lake Superior. These rivers are not located within the Hudson Bay Basin and do not flow to, and would not affect the quality of, the waters of the BWCAW.

Engineering controls at the Mine Site and Plant Site would capture the majority affected water for treatment. Water leaving the NorthMet Project area would include non-contact stormwater, clean water from the WWTP and WWTF, and a small volume of groundwater water escaping the liners and containment systems.

Several groundwater, surface water, and water quality models (MODFLOW, XP-SWMM, and GoldSim, respectively) were used to predict the hydrologic and water quality effects of the NorthMet Project Proposed Action, as well for a Continuation of Existing Conditions scenario for comparison. The water quality model, which was run at monthly time steps for 200 years for the Mine Site and 500 years for the Plant Site, performs probabilistic simulations, taking into account the uncertainty around many of the model input assumptions. The Co-lead Agencies have selected the 90th percentile probability (P90) as its evaluation threshold in determining whether the model results meet established evaluation criteria. This means that there is at least a 90 percent probability that a constituent would not exceed the evaluation criteria.

With the proposed engineering controls, the water quality model predicts that the NorthMet Project Proposed Action would not cause any significant water quality impacts because: 1) exceedances of the P90 threshold did not occur, 2) the NorthMet Project Proposed Action concentrations were no higher than concentrations predicted for the Continuation of Existing Conditions scenario, and 3) the frequency of exceedances for NorthMet Project Proposed Action conditions was within an acceptable range or not attributable to NorthMet Project Proposed Action discharges or both.

The NorthMet Project Proposed Action would not result in significant changes to sulfate concentrations in the Partridge River, but would significantly decrease sulfate concentrations in the Embarrass River. Furthermore, the engineering controls would provide a high degree of reliability and flexibility to ensure that the NorthMet

Project Proposed Action would not cause or contribute to an exceedance of evaluation criteria for sulfate in the future.

Nearly all contact or process water at the NorthMet Project area would be treated at the Mine Site WWTF or Plant Site WWTP before release to the environment. At the Mine Site, about 10 gallons per minute of untreated water would be released during closure (all related to groundwater seepage), which represents less than 5 percent of total Mine Site water releases (including treated and untreated water). At the Tailings Basin, about 20 gallons per minute of untreated water would be released during closure (all related to Tailings Basin seepage that bypasses the groundwater containment system), which represents less than 1 percent of total Tailings Basin water releases (including treated and untreated water). The NorthMet Project Proposed Action is also not predicted to result in any significant changes to groundwater and surface water flows when compared to existing conditions.

Mercury is another constituent of concern, primarily because many of the lakes and rivers in the area are currently classified as "impaired waters" by the MPCA due to elevated mercury content in fish tissue. The NorthMet Project Proposed Action is located within the Lake Superior Basin and would be subject to the Great Lakes Initiative (GLI) mercury water quality standard of 1.3 nanograms per liter (ng/L). The NorthMet ore and waste rock contain trace amounts of mercury; however, the modeling and data suggest that the mercury concentration in the West Pit Lake, the only surface water discharge at the Mine Site, would stabilize below the GLI standard at approximately 0.9 ng/L. There would also be mercury in the tailings, where about 95 percent of the mercury in the ore is predicted to remain in the solids disposed of in the Tailings Basin and Hydrometallurgical Residue Facility. The mercury concentration in seepage from the Tailings Basin is anticipated to be below the GLI standard. Water from the NorthMet Project Proposed Action is predicted to increase mercury loadings in the Embarrass River Watershed (from 22.3 to 22.5 grams per year) but decrease mercury loadings in the Partridge River (24.2 to 23.0 grams per year). The net effect of these changes would be an overall reduction in mercury loadings to the downstream St. Louis River.

The BWCAW and Voyageurs National Park are located in a different watersheds than the NorthMet Project area, and lie 20 miles and 50 miles away, respectively. The NorthMet Project Proposed Action would not directly, indirectly, or cumulatively affect the water quality of these areas.

NorthMet Project Effects on Biological Resources

Direct and indirect effects to wetlands would result from mining operations. The NorthMet Project Proposed Action would directly affect 913.8 acres of wetlands located within the NorthMet Project area, mostly within the Mine Site, as a result of activities such as filling, excavation, and installation of a containment system within the wetland boundary, and, therefore, these wetlands would be permanently lost. Direct effects would occur on the following wetland types: coniferous bog, shrub swamp, coniferous swamp, shallow marsh, deep marsh, sedge/wet meadow, hardwood swamp, and open bog.

A wetland may be fragmented as the result of direct impacts that split a wetland resource area into multiple parts. These fragmented parts could potentially be isolated from other wetlands and would no longer have any adjacent upland watershed area, which could result in the loss of functions in the wetland fragments. The fragmented wetlands that were determined to lose their functions (26.9 acres) would be mitigated up front and included in the compensatory mitigation.

The overall wetland mitigation strategy for the NorthMet Project Proposed Action would be to compensate for unavoidable wetland impacts in-place (within the same 8-digit Hydrologic Unit Code), in-kind where possible, and in advance of impacts when feasible in order to replace lost wetland functions. The USACE St. Paul District has not made a final determination of the compensation ratios that would be required for the NorthMet Project Proposed Action. The final decision on compensatory mitigation ratios will be determined at the time of the decision on the DA permit and would be based on current District guidance. PolyMet would ultimately need to satisfy both the federal and state mitigation requirements. The number of mitigation credits to be earned by replacement wetlands will be determined during permitting by the appropriate agencies reviewing the wetland mitigation plan. This will be based on the extent to which the sites meet the target goals established during permitting. These include, among other things, restoration of wetland-appropriate hydrology and the establishment of a target plant community or type.

Compensatory mitigation would be required for the 913.8 acres of wetlands that would be directly affected. Depending on the location, type, and timing of compensatory mitigation, the minimum required amount of replacement wetlands for direct effects could potentially range from 913.8 acres up to 1,1827.6 acres (i.e., compensation ratios of 1:1 up to 2:1). In addition, compensatory mitigation for the 26.9 acres of wetland fragmentation would be provided up front. Due to both on- and off-site limitations and technical feasibility, it is not practicable to replace all affected wetland types with an equivalent area of in-kind wetlands.

Proposed off-site wetland compensation of 1,602.7 acres could provide 1,513.3 wetland mitigation credits. In addition, a total of 197.1 acres of upland buffer areas are proposed to be established with native vegetation around the wetland restoration areas. In accordance with USACE guidelines, credit for the upland buffer areas would be at a 4:1 ratio, resulting in an additional 49.3 credits. The total off-site mitigation could provide 1,562.5 wetland mitigation credits. Actual compensatory ratios determined during permitting may vary from these assumptions. The determination of final mitigation credits required to offset the effects of the NorthMet Project Proposed Action would be determined by the agencies during wetland permitting.

Financial assurances for the direct wetland impact mitigation would be required until success of the mitigation sites is assured. While this wetland mitigation would be expected to be approved and constructed in advance of any authorized wetland impacts, it is unclear whether these sites would be well-established enough for financial assurances to be waived. The USACE would also consider the application of financial assurances for potential indirect wetland effects and monitoring. Both the USACE and state would require consideration of financial assurances during the permitting process.

Wetlands that were not filled or excavated (permanently lost), but having a reduced function, would be considered indirectly affected. Indirect effects on wetlands from the NorthMet Project Proposed Action would result from one or more of the following six factors: 1) wetland fragmentation; 2) changes in wetland hydrology resulting from changes in watershed area; 3) changes in wetland hydrology due to groundwater drawdown resulting from open pit mine dewatering; 4) changes in wetland hydrology from groundwater drawdown resulting from operation of the Plant Site, including groundwater seepage containment; 5) changes in stream flow near the Mine Site and Plant Site and associated effects on wetlands abutting the streams; and 6) change in wetland water quality related to atmospheric deposition of dust and rail car spillage associated with Mine Site and Plant Site operations.

Wetland mitigation for potential indirect wetland effects would be determined by the agencies during permitting. If the NorthMet Project Proposed Action were to be permitted, mitigation for indirectly affected wetlands would be determined through monitoring. Additional compensation may be required if determined necessary based on monitoring results.

Wetland hydrology and vegetation monitoring would be conducted during the operations phase of the NorthMet Project Proposed Action to document indirect effects on wetlands. Prior to the start of the NorthMet Project Proposed Action, monitoring would be established based on permit conditions. The monitoring would describe the purpose, methods, and criteria to be implemented to document indirect effects on wetlands. A component of the monitoring plan would be based on those wetlands that would have a high likelihood of indirect effects as a result of groundwater drawdown. In the event that the required wetland monitoring identifies additional indirect effects, permit conditions would likely include a plan for adaptive management practices to be implemented, such as expanded monitoring and hydrologic controls. Additionally, compensatory mitigation would be required if indirect impacts were identified during annual reporting. Permit conditions would likely include an adaptive management plan to account for any additional impacts that may be identified in the annual monitoring and reporting.

For vegetation, the NorthMet Project Proposed Action would directly affect approximately 1,719 acres that are mapped by the MDNR as MBS Sites of High Biodiversity Significance. Within these Sites of High Biodiversity Significance, several native plant communities are mapped that would be affected by the NorthMet Project Proposed Action, including 698.2 acres with a conservation status rank of “imperiled-vulnerable” (conservation status rank S2 or S3) or “vulnerable” (conservation status rank S3), 92.6 acres with a conservation status rank of “apparently secure” (conservation status rank S4), and 178.9 acres with a conservation status rank of “widespread and secure” (conservation status rank S5). Disturbed areas would be reclaimed during operations and at closure. Reclamation objectives would include rapidly establishing a self-sustaining plant community, controlling air emissions, controlling soil erosion, providing wildlife habitat, and minimizing the need for maintenance. Seed mixes and methodologies would be designed to minimize the introduction of invasive species. Reclamation seed mixes would be approved during permitting.

There are no federally listed plant species in the NorthMet Project area. There are 10 state-listed plant species, all at the Mine Site; eight species would be directly affected and two would be indirectly affected by the NorthMet Project Proposed Action.

There are no federally or state-listed threatened or endangered fish or macroinvertebrate species known to occur in the NorthMet Project area. The NorthMet Project Proposed Action could potentially affect aquatic physical habitat via changes in streamflow, affect riparian and aquatic connectivity via construction activities within the riparian zone, and affect water quality by increasing solute concentrations above Class 2B (aquatic life) standards. As a result of these changes, the NorthMet Project Proposed Action could potentially affect special status species (i.e., federally or state-listed threatened and endangered species, Regional Forester Sensitive Species [RFSS], and MDNR Species of Greatest Conservation Need [SGCN]).

The NorthMet Project Proposed Action would reduce water flows in several tributary streams to the Partridge and Embarrass rivers, but the flows would remain within the range of annual natural variability. Therefore, changes in flow are not anticipated to result in any measurable effects on existing aquatic habitat in any streams downstream of the NorthMet Project area.

Water quality modeling predicts that the NorthMet Project Proposed Action would not cause an exceedance of the Class 2B (aquatic life) water quality standards, with the exception of aluminum and lead not attributable to process water from the NorthMet Project Proposed Action (i.e., attributable to non-contact stormwater runoff and Colby Lake water). In a few cases where solute concentrations naturally exceed the Class 2B standards in NorthMet Project area waters (i.e., aluminum, iron, and manganese), the NorthMet Project Proposed Action would either reduce or not measurably increase concentrations of these solutes.

Three federally listed wildlife species—the Canada lynx, gray wolf, and northern long-eared bat—may be affected by localized direct decrease and fragmentation of habitat and designated critical habitat. The Canada lynx and gray wolf may also be affected by the increased, but low, potential for incidental take resulting from vehicular collisions due to increased project-related traffic. The northern long-eared bat would likely be affected through loss of potential summer roost habitat and foraging areas. Restoration of disturbed areas as part of mine closure would potentially create lynx and wolf habitat, although this successional process could take decades. Thirteen additional state-listed species—including the moose, little brown bat, eastern brown bat, northern goshawk, boreal owl, eastern heather vole, wood turtle, yellow rail, Laurentian tiger beetle, taiga alpine butterfly, Freija's grizzled skipper butterfly, Nabokov's blue butterfly, and Quebec emerald dragonfly—may be affected by the NorthMet Project Proposed Action. RFSS, MDNR SGCN, and other wildlife species, including those considered culturally important, may be affected by increased human activity, noise and vibration, rail and vehicle traffic, or decrease of habitat.

Rulemaking was conducted with the intent to update the list of Endangered, Threatened, and Special Concern species (*Minnesota Rules*, parts 6134.0100 to 6134.0400), with new listings becoming effective on August 19, 2013. The FEIS considers any new listings, or changes in the previous listings, associated with the updated list.

NorthMet Project Effects on Cultural and Socioeconomic Resources

The NorthMet Project area is located within the territory ceded by the Chippewa of Lake Superior to the United States in 1854. The Chippewa reserve rights to hunt, fish, and gather on lands in the 1854 Ceded Territory. Harvest levels and other activities are governed by either individual tribal entities (in the case of the Fond du Lac Band) or the 1854 General Codes and subsequent Amendments under the 1854 Treaty Authority (in the case of the Grand Portage and Bois Forte bands).

Pursuant to Section 106 of the National Historic Preservation Act, the federal Co-lead Agencies identified several historic properties in consultation with the State Historic Preservation Office (SHPO), Bands, and PolyMet. The entities consulted regarding the eligibility of the Spring Mine Lake Sugarbush (maple sugar camp site); a segment of the *Mesabe Widjiu* (or Laurentian Divide, which is regarded as culturally significant to many Ojibwe Bands); a segment of the Beaver Bay to Lake Vermilion Trail; the Erie Mining Company Concentrator Building; the Erie Mining Company Administration Building; Erie Mining Company Railroad Mine and Plant Track, Main Line Segment, and Dunka Railroad Segment; Erie Mining Company Railroad Corridor Historic District; Duluth, Missabe, and Iron Range Segment; and the Erie Mining Company Landscape Historic District.

Effect determinations have been drafted by the federal Co-lead Agencies for review and comment by the Bands, SHPO, and PolyMet. The federal Co-lead Agencies believe that there would be no adverse effect on the Erie Mining Company Railroad Mine and Plant Track, Main Line Segment, and Dunka Railroad Segment; Erie Mining Company Railroad Corridor Historic District; Duluth, Missabe, and Iron Range Segment; or Erie Mining Company Administration Building. However, a segment of the *Mesabe Widjiu*, Spring Mine Lake Sugarbush, a segment of the Beaver Bay to Lake Vermilion Trail, the Erie Mining Company Concentrator Building, and the Erie Mining Company Landscape Historic District would be adversely affected by the NorthMet Project Proposed Action. These determinations will be used to facilitate ongoing consultation with the Bands, SHPO, and PolyMet pertaining to the application of adverse effect criteria to these properties. Mitigation measures to resolve adverse effects would be identified after consultation on the final effects determinations and consideration of any measures to avoid or minimize adverse effects.

Natural resources and the lands on which they are gathered are important to the Bands for a number of reasons, including their cultural, spiritual, and/or historic meanings, and will be considered under federal agency tribal trust responsibilities as outlined above and also as cultural resources under NEPA.

The Arrowhead region of northeastern Minnesota is home to communities that are economically dependent on the natural environment for their existence. Given the region's location in an historic mining district, many towns and cities have provided and continue to provide workers and services to the local mines. Other communities closer to the BWCAW and Voyageurs National Park primarily serve the needs of recreational users (see Figure 1).

According to PolyMet, the NorthMet Project Proposed Action would create up to 500 direct jobs during peak construction and 360 direct jobs during operations. These direct jobs would generate additional indirect and induced employment, estimated to be 332 additional construction-phase jobs and 631 additional operations-phase jobs. Indirect and induced effect employment numbers are calculated by IMPLAN and may include temporary, part-time, full-time, long-term, or short-term jobs. While some skilled workers would be involved only temporarily and would possibly relocate from outside the region, the majority of the NorthMet Project Proposed Action-related jobs are expected to be filled by those currently residing in the Arrowhead region.

Federal, state, and local taxes would total an estimated $80 million annually. During operations, there would be approximately $231 million per year in direct value added through wages and rents and $332 million per year in direct output related to the value of the extracted minerals. As with employment, these direct economic contributions would create indirect and induced contributions, estimated at $99 million in value added and $182 million in output.

Other Environmental Consequences of the NorthMet Project

In addition to the effects discussed above, the NorthMet Project Proposed Action would also affect other resources to a lesser degree. For instance, it would contribute criteria air pollutants during construction, mining, and processing activities, though they would be less than applicable Prevention of Significant Deterioration emission thresholds. The NorthMet Project Proposed Action would also contribute air pollutants with risk guideline values for assessing potential human health effects (air toxic pollutants) during construction, mining, and processing activities. These pollutants were all found to be below state and federal risk guidelines. Additionally, the NorthMet Project Proposed Action would not adversely affect visibility in nearby Class I areas, such as the BWCAW and Voyageurs National Park. The NorthMet Project Proposed Action would cause noise, affecting some sensitive receptors. Nearby residences or other permanent sensitive receptors would not be affected, and some wildlife may avoid the area at times.

Environmental Consequences of the Land Exchange

The non-federal parcels that would be part of the Land Exchange Proposed Action are largely undisturbed tracts that would be managed under the Forest Plan, which would allow for some timber harvesting under varying rotation periods. For the most part, however, the acquired lands would be left undeveloped and would be open for public use and enjoyment.

The federal lands acquired by PolyMet would largely be used for mining, and would eventually be restored in accordance with the NorthMet Project Reclamation Plan. There is no legal public access to the federal lands via land, so any current public use or exercise of usufructuary rights requires the permission of adjacent private landowners.

Cumulative Effects

In accordance with NEPA and MEPA, this FEIS contains an analysis of the cumulative effects of the NorthMet Project Proposed Action and Land Exchange Proposed Action. Cumulative effects are defined by the Council on Environmental Quality (CEQ) NEPA regulations as:

> the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other action. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. (40 Code of Federal Regulations [CFR] § 1508.7)

The Minnesota Environmental Quality Board's rules at *Minnesota Rules*, Chapter 4410.0200, subparts 11 and 11a, mirror the CEQ's definition of cumulative effects.

To assess cumulative effects, the Co-lead Agencies identified other past, present, and reasonably foreseeable future projects and activities in the region that, when combined with the NorthMet Project Proposed Action and Land Exchange Proposed Action, could incrementally cause cumulative effects.

Given the geographic and temporal scale of effects, each component of the NorthMet Project Proposed Action was analyzed.

For example, construction and mining operations would require stripping and excavation of the surface. These activities require heavy equipment and explosives, which would emit air pollutants and noise. The cumulative effects assessment focused on how air emissions travel and may interact with other sources. Air emissions can travel many miles before they are no longer detectable. Hence, the analysis includes the emissions from other projects and activities well beyond the boundaries of the NorthMet Project area. Noise effects from NorthMet Project Proposed Action activities, on the other hand, would dissipate much closer to their source and would not interact with other activities elsewhere in the area.

In summary:

- The Proposed Connected Actions would cause some additive effects on certain resources, such as loss of vegetation and wetlands in the NorthMet Project area, as well as changes in water quality and use, air quality, and increased economic activity for the life of the mine.
- There would be few cumulative effects from the NorthMet Project Proposed Action after proposed mitigation and adaptive management measures are applied. The affected resources included water quantity and quality, air quality, wetlands, and vegetation.
- No Endangered, Threatened, or Special Concern plant or animal species would be cumulatively affected.

ALTERNATIVES

Consistent with federal and state law, the EIS process identified and analyzed alternatives that could have resulted in improved environmental and socioeconomic benefits and still achieve the NorthMet Project's Purpose and Need. Alternatives offer decision-makers and the public options to the proposal and include a No Action Alternative that considers the effects that would occur if the proposed project was not implemented.

Alternatives were identified and screened in accordance with the requirements of NEPA (40 CFR 1505.1(e)) and/or Minnesota Environmental Quality Board Rules for MEPA (*Minnesota Statutes*, §§116D.04 and 116D.045, and *Minnesota Rules*, parts 4410.0200–4410.7500) to determine whether they met prescribed criteria to warrant further consideration in the FEIS. Screening criteria were developed to account for technical and economic feasibility and consistency with the NorthMet Project's Purpose and Need. The alternatives that met the screening criteria were evaluated in detail as part of the FEIS. A number of other potential alternatives were screened throughout the NEPA/MEPA process and were either incorporated into the NorthMet Project Proposed Action by PolyMet or were eliminated from detailed analysis because they did not meet the screening criteria. Early alternatives incorporated into the NorthMet Proposed Action included enhanced waste management at the Mine Site, where the most reactive waste would now be ultimately backfilled and covered with water in the East Central Pit, and enhanced engineering design to capture and treat affected water from the Mine Site and Tailings Basin.

Alternatives considered but eliminated from further consideration included alternative wet and dry closure options for the Tailings Basin, backfilling the West Pit with Category 1 waste rock, and underground mining.

Two alternatives to the Proposed Connected Actions are analyzed in detail in the FEIS:

- Proposed Connected Actions Alternative B, which would involve the NorthMet Project Proposed Action, but a smaller-scale land exchange component; and
- No Action Alternative, under which neither the NorthMet Project Proposed Action, nor the Land Exchange Proposed Action would occur.

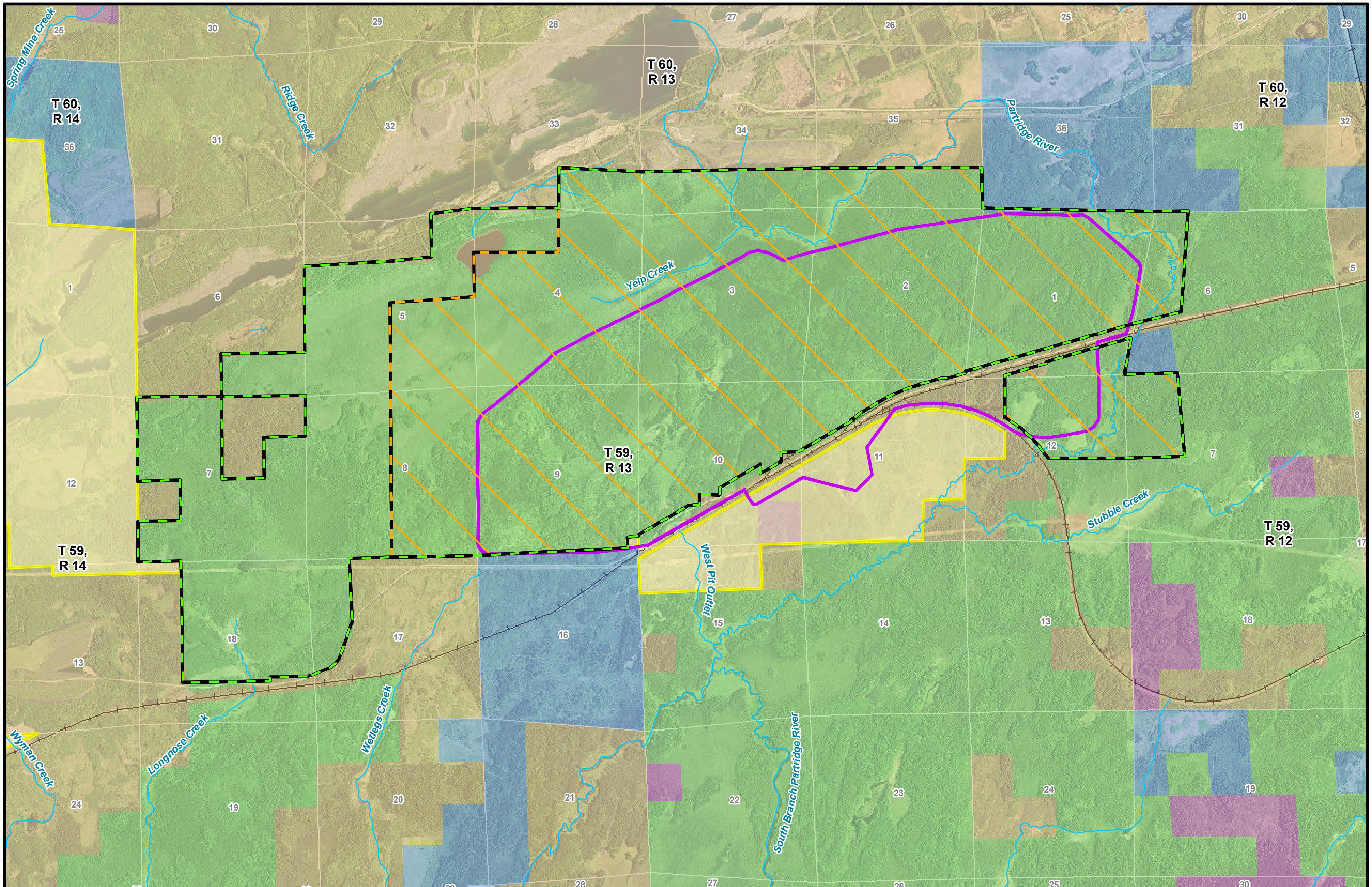
Proposed Connected Actions Alternative B

Proposed Connected Actions Alternative B would involve the NorthMet Project Proposed Action as previously described and a land exchange involving a smaller federal parcel (see Figure 10). Compared to the Land Exchange Proposed Action, Land Exchange Alternative B would convey fewer acres of federal land (4,833.7 [GLO] acres) for fewer acres of non-federal land (4,651.5 [GLO] acres contained within a single tract).

No Action Alternative

Under the No Action Alternative, the NorthMet Project Proposed Action would not be implemented and no land exchange would take place. The federal government would not exchange lands with PolyMet, and the USFS would continue to manage the lands in accordance with the Forest Plan. Private lands would not be acquired in exchange for the USFS lands at the Mine

Site. At the Mine Site, PolyMet would be required under existing exploration approvals to reclaim surface disturbance associated with exploratory and development drilling activities. No further upgrades or new segments would be constructed along the existing power transmission line, railroad, or Dunka Road, which would continue to be used by their private owners. At the former LTVSMC processing plant and Tailings Basin, the land owner, Cliffs Erie, would continue to complete closure and reclamation activities as specified under state permits and plans, and the Cliffs Erie Consent Decree.



Federal Lands
Alternative B
Mine Site
Stream/River
Section Label
National Forest Land
County Land
State of Minnesota Land
Other Land
PolyMet Owned/Leased Area

US Army Corps of Engineers
St. Paul District

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Figure 10

Land Exchange Alternative B

NorthMet Mining Project and Land Exchange PFEIS

Minnesota

June 2015

1646 -Page Intentionally Left Blank-

Comparison of Effects by Alternative

Table 1 provides a comparison of the effects on resources from the Proposed Connected Actions (NorthMet Project Proposed Action and Land Exchange Proposed Action), Proposed Connected Actions Alternative B, and the No Action Alternative. It is intended to be a brief description of the major effects under the alternatives and not an exhaustive list or in-depth analysis. Chapters 5 and 6 of the FEIS provide detailed explanations of the predicted direct, indirect, and cumulative effects under these alternatives.

In comparison to the Proposed Connected Actions, the Proposed Connected Actions Alternative B (NorthMet Project Proposed Action and Land Exchange Alternative B) would have the same effects as the NorthMet Project Proposed Action, but fewer lands would be conveyed through the land exchange. The No Action Alternative would not directly affect the existing environment and management of these lands would continue in accordance with their current permits. Compared to the Proposed Connected Actions and Proposed Connected Actions Alternative B, the No Action Alternative would result in active but different comprehensive management of water from the existing LTVSMC Tailings Basin. There would be no other measurable effects on other resources compared to their existing conditions.

Agency-Preferred Alternative

Consistent with the CEQ regulations, the federal Co-lead Agencies are required to identify an agency-preferred alternative in the FEIS, unless another law prohibits the expression of such a preference. For the USFS, the agency-preferred alternative is the Land Exchange Proposed Action. For the USACE, Appendix B of 33 CFR 325 supersedes the CEQ requirement to identify an agency-preferred alternative. These procedures state that, "*the Corps is neither an opponent nor a proponent of the applicant's proposal; therefore the applicant's final proposal will be identified as the 'applicant's preferred alternative' in the Final EIS*." No similar requirement to identify a preferred alternative exists for the MDNR under state law.

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1703 Table 1 Comparison of Effects by Alternative

Resource	Proposed Connected Actions	Proposed Connected Actions Alternative B	No Action Alternative
Land Use	• No effects on land use that would require changes in ordinances or comprehensive forest plans • Federal lands within the NorthMet Project area would be replaced with acreage of equal value through a land exchange	• Mostly similar effects as Proposed Connected Actions, with fewer federal acres exchanged	• Existing LTVSMC site would be reclaimed in accordance with the reclamation/closure plan
Water Resources	• Greater than 90 percent of groundwater and 100 percent of surface water at the Tailings Basin would be captured and treated to a concentration at or below applicable water quality evaluation criteria • The NorthMet Project Proposed Action would not cause any significant water quality impacts because: 1) exceedances of the P90 threshold would not occur; 2) the NorthMet Project Proposed Action concentrations would not be higher than concentrations predicted for the Continued Existing Conditions scenario; or 3) the frequency of exceedances for the NorthMet Project Proposed Action conditions would be within an acceptable range or not attributable to the NorthMet Project Proposed Action discharges or both • Mercury loadings to the Embarrass River would increase slightly, decrease slightly to the Partridge River, with an overall net decrease in NorthMet Project Proposed Action loadings to the downstream St. Louis River.	• Same as under Proposed Connected Actions	• Seepage water quality from the existing LTVSMC Tailings Basin would be expected to improve over time as a result of the Cliffs Erie Consent Decree, other permit requirements (e.g., Permit to Mine), and natural attenuation of contaminants

Resource	Proposed Connected Actions	Proposed Connected Actions Alternative B	No Action Alternative
	Discharges from the Plant Site WWTP and Mine Site WWTF would be at or below the GLI water quality standard of 1.3 ng/L • Sulfate concentrations would remain unchanged in the Partridge River and would be significantly reduced in the Embarrass River • Plant Site WWTP effluent would be used to augment flows to tributary streams and wetlands downgradient from the Tailings Basin to offset groundwater seepage captured in the containment system and the south surface seepage management system for water quality reasons		
Wetlands and Floodplains	• 913.8 acres of wetlands in NorthMet Project area would be directly affected • 6,568.8 to 7,694.2 acres of wetlands in NorthMet Project area would be indirectly affected • 940.7 acres of directly affected and fragmented wetlands to be mitigated up front • 1,602.7 acres of compensatory off-site wetlands • Wetland mitigation plan would be implemented to offset increased CO_2 emissions to extent practicable • 505.5-acre net increase of wetlands to the federal estate (through Land Exchange Proposed Action); therefore, Land Exchange Proposed Action conforms to EO 11990 • 376.2-acre net increase of mapped floodplain but would result in a 1,226.0-acre net decrease of floodplain	• Same direct and indirect effects and compensatory mitigation at NorthMet Project area as under Proposed Connected Actions • 69.9-acre net increase of wetlands to the federal estate (through Land Exchange Alternative B); therefore, Land Exchange Alternative B conforms to EO 11990 • 376.2-acre net increase of mapped floodplain but would result in a 861.7-acre net decrease of floodplains to the federal estate (through Land Exchange Alternative B); however, no decrease in regulatory floodplains, no increase in flood damage potential, and no change in ecological function of floodplain; therefore, Land Exchange Alternative B conforms to EO 11988	• No change in wetland or floodplain acreage

Resource	Proposed Connected Actions	Proposed Connected Actions Alternative B	No Action Alternative
	area to the federal estate (through Land Exchange Proposed Action); however, no decrease in mapped floodplains, no increase in flood damage potential, and no change in ecological function of floodplain. Therefore, Land Exchange Proposed Action conforms to EO 11988		
Vegetation (includes habitat and Special Status Species)	• 4,028.5-acre decrease in vegetation in the NorthMet Project area • Special concern plant species: eight directly affected, two indirectly affected in the NorthMet Project area • 579.6-acre net increase of vegetation land cover types to federal estate (through Land Exchange Proposed Action) • Decrease of 10 plant species, increase of three different plant species to the federal estate (through Land Exchange Proposed Action)	• Same decrease of vegetation in NorthMet Project area as under Proposed Connected Actions • Same effects on plant species in the NorthMet Project area as under Proposed Connected Actions • 173.6-acre net increase of vegetation land cover types to the federal estate (through Land Exchange Alternative B)	• No effects on vegetation
Wildlife (includes Special Status Species)	• 4,028.5-acre decrease of wildlife habitat in the NorthMet Project area • Localized population decrease and fragmentation of critical habitat of the gray wolf and Canada lynx • Localized population decrease and loss of habitat for northern long-eared bat • Low potential for incidental take resulting from vehicular collisions due to increased NorthMet Project Proposed Action-related traffic • Special status species, including SGCN, RFSS, and other wildlife species (such as those considered tribally or culturally significant) may	• Same as under Proposed Connected Actions at the NorthMet Project area • 173.6-acre net increase of vegetation land cover types for wildlife habitat to the federal estate (through Land Exchange Alternative B)	• No effects on wildlife

Resource	Proposed Connected Actions	Proposed Connected Actions Alternative B	No Action Alternative
	be affected by human activity, noise and vibration, rail and vehicle traffic, and decrease of habitat • Wildlife corridors at and adjacent to the NorthMet Project area would be affected through the reduction of access to these corridors • 579.6-acre net increase of vegetation land cover types for wildlife habitat to the federal estate (through Land Exchange Proposed Action)		
Aquatic Species	• No effects from changes in stream flow, which would remain within natural variability • No decrease in the Riparian Connectivity Index • Would not directly exceed or increase existing exceedances of Class 2B water quality standards, with the exception of aluminum that is not attributable to process water from the NorthMet Project Proposed Action (i.e., is attributable to non-contact stormwater runoff • No effect on federally or state-listed aquatic species	• Same as under Proposed Connected Actions	• Seepage water quality from the existing LTVSMC Tailings Basin would be expected to improve over time as a result of the Cliffs Erie Consent Decree, other permit requirements (e.g., Permit to Mine), and natural attenuation of contaminants
Air Quality (includes Greenhouse Gases and Global Climate Change)	• Increased emissions of criteria air pollutants, but below Prevention of Significant Deterioration major source thresholds • Amphibole mineral fiber emissions minimized by installing best available particulate emission control equipment and preventing fugitive dust generation • The air quality of the BWCAW would not be adversely affected by the	• Same as under Proposed Connected Actions	• Continued air (fugitive dust) effects at LTVSMC site until remediation occurs under closure/reclamation plan

Resource	Proposed Connected Actions	Proposed Connected Actions Alternative B	No Action Alternative
	NorthMet Project Proposed Action		
Noise and Vibration	• Added noise emissions and vibration. However, in all cases, the NorthMet Project Proposed Action, during the operations phase, would comply with the applicable state standards • Noise, ground vibration, and air blast impact area/zone would be limited to 11,456, 11,334, and 11,469 acres, respectively. The BWCAW, which is 20 miles away, is outside the maximum area of audibility (247,612 acres)	• Same as under Proposed Connected Actions	• No effects
Cultural Resources & Historic Properties	• Adverse direct and indirect effects on the Mesabe Widjiu (Laurentian Divide), Spring Mine Lake Sugarbush, Beaver Bay to Lake Vermilion Trail Segment, Erie Mining Company Concentrator Building, and Erie Mining Company Landscape Historic District due to loss of sites and proximity to proposed activities • Direct effects, but no adverse effects, on the Erie Mining Company Railroad Mine and Plant Track, Main Line Segment, and Dunka Railroad Segment; Erie Mining Company Railroad Corridor Historic District; DM&IR Segment; and Erie Mining Company Administration Building due to refurbishment and new construction • Potential to affect 1854 Treaty resources by potential limitation or elimination of access to public lands within the 1854 Ceded Territory and potential loss of 1854 Treaty resources	• Same as under Proposed Connected Actions	• No effects
Socioeconomics (includes	• Up to 500 new direct jobs (maximum during construction), plus additional	• Same as under Proposed Connected Actions	• No effects

Resource	Proposed Connected Actions	Proposed Connected Actions Alternative B	No Action Alternative
Environmental Justice)	indirect and induced jobs • Millions of dollars revenue for State of Minnesota and federal taxes • Environmental Justice (Native American) populations affected by changes in subsistence uses and potential increased living costs		
Recreation and Visual Resources	• Net increase to the federal estate of recreational land on acquired tracts through Land Exchange Proposed Action • Visual effects would occur, but would not exceed USFS standards	• Fewer federal lands conveyed at NorthMet Project Mine Site under Land Exchange Alternative B • Remaining federal lands at Mine Site would not have public access • Fewer acres acquired through Land Exchange Alternative B • Same visual resources effects as under Proposed Connected Actions	• No effects
Wilderness and Special Designation Areas	• No effects on Wilderness or Special Designation Areas • The air quality of the BWCAW would not be adversely affected by the NorthMet Project Proposed Action	• Same as under Proposed Connected Actions	• No effects
Hazardous Materials	• Potential effects from spills and use of explosives during operations	• Same as under Proposed Connected Actions	• No effects
Geotechnical Stability	• Waste rock stockpiles, Tailings Basin, and Hydrometallurgical Residue Facility would be constructed in accordance with applicable State of Minnesota standards • Monitoring and adaptive management would maintain geotechnical stability	• Same as under Proposed Connected Actions	• Tailings Basin would be subject to closure and reclamation activities in accordance with MDNR requirements

1704

NEXT STEPS

Agency Use of the FEIS in Decision-making

The USACE will use the FEIS as the basis for its ROD whether to issue a DA permit for impacts to waters of the United States associated with the NorthMet Project Proposed Action. Similarly, the USFS will use the FEIS as the basis for its ROD for the Land Exchange Proposed Action. The MDNR will determine if the FEIS adequately provides the necessary analysis for state and local agencies to issue their respective permits and take resulting actions.

The Land Exchange is subject to the pre-decisional objection regulations at 36 CFR 218 effective March 27, 2013. Individuals and entities who provide specific written comment, as defined in § 218.2, during scoping or the comment period will be eligible to participate in the objection process.

Financial Assurance

State law requires that PolyMet provide financial assurance before a Permit to Mine can be granted. Financial assurance instruments covering the estimated cost of reclamation, should the mine be required to close for any reason at any time, must be submitted and approved by the MDNR. There are no applicable federal financial assurance requirements that would be incorporated into the Permit to Mine, but the USACE would consider the application of financial assurances for potential indirect wetland effects and monitoring.

Financial assurance could be required indefinitely and could include self-sustaining instruments. The level of engineering design and planning required to calculate detailed financial assurance amounts is not currently available, but would be evaluated in detail during the permitting process.

Both the USACE and state would require consideration of financial assurances during the permitting process and these requirements would be reviewed and updated on an annual basis.

Permits and Approvals

PolyMet would be required to obtain the required federal, state, and local permits and approvals summarized in Table 2 below.

Table 2 Key Government Permits or Actions

Agency	Permit/Action	Reason Permit or Action is (or may be) Needed
Federal		
USACE	Department of the Army Permit	For affected waters within the jurisdiction of the USACE under the CWA, 40 CFR Part 230: Section 404(b)(1)
	Section 106 NHPA Compliance (Minnesota Historic Preservation Office)	Necessary due to the NorthMet Mining Project and Land Exchange being a federal undertaking, 36 CFR Part 800
U.S. Fish and Wildlife Service	Section 7 Endangered Species Act (ESA) Compliance	Necessary due to the NorthMet Mining Project and Land Exchange being a federal undertaking, 50 CFR 402
USFS	Land Exchange	To resolve the conflict between surface and mineral estates
	Section 106 NHPA Compliance (Minnesota Historic Preservation Office)	Necessary due to the NorthMet Mining Project and Land Exchange being a federal undertaking, 36 CFR Part 800
State		
MDNR	Permit to Mine	Required for all nonferrous metallic mining operations, *Minnesota Rules,* chapter 6132
	Endangered Species Taking Permit (if required)	If there are state-listed species that may be taken by the NorthMet Project Proposed Action, *Minnesota Rules,* parts 6212.1800-6212.2300 and 6134
	Water Appropriations Permit for plant make-up water	For withdrawal of water from Colby Lake for plant make-up water; for mine dewatering; for stream augmentation; *Minnesota Rules*, part 6115
	Dam Safety Permit	For the Tailings Basin, Hydrometallurgical Residue Facility, and potentially the water retention dikes at the Mine Site (e.g., water treatment plant pond dikes), *Minnesota Rules,* parts 6115.0300-6115.0520
	Permit for Work in Public Waters	For possible modifications and diversions of local streams in constructing the West Pit outfall; *Minnesota Rules,* part *6115*
	Wetland Replacement Plan approval under WCA	For affected wetlands within the scope of the WCA or that constitute "public wetlands"
	Burning Permit (if required)	If vegetative material would need to be burned on site during times with no snow cover

Agency	Permit/Action	Reason Permit or Action is (or may be) Needed
MPCA	Section 401 Water Quality Certification/Waiver	Required in conjunction with the DA Permit (Section 404 Permit)
	National Pollutant Discharge Elimination System and State Disposal System (NPDES/SDS) Permits	For construction and industrial activity that would disturb 1 acre or more of land, and the management, treatment and/or discharge of process wastewater to surface water or groundwater
	Solid Waste Permit	For construction debris
	Air Emissions Permit (Part 70 Permit)	For emissions of regulated air pollutants
	Waste Tire Storage Permit	For storage of waste tires generated from NorthMet Project-related vehicles (if required)
	General Storage Tank Permit	For multiple NorthMet Project Proposed Action aboveground storage tanks
MDH	Radioactive Material Registration	For measuring instruments
	Permit for Non-Community Public Water Supply System and a Wellhead Protection Plan (if proposed)	Existing Plant Site potable water treatment plant to be refurbished
	Permit for Public On-site Sewage Disposal System	For sewage waste generated during construction and operation that would be disposed of on site
Local		
City of Hoyt Lakes	Zoning Permit	To acknowledge NorthMet Project Proposed Action is an allowable use within the zoned district
City of Babbitt	Building Permit	New construction would occur on portions of the NorthMet Project area within the incorporated limits of the City of Babbitt
St. Louis County	Zoning Permit	To acknowledge NorthMet Project Proposed Action is an allowable use within the zoned district

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1.0 INTRODUCTION

1.1 OVERVIEW

The Minnesota Department of Natural Resources (MDNR), U.S. Army Corps of Engineers (USACE), and U.S. Forest Service (USFS) have prepared a joint state-federal Final Environmental Impact Statement (FEIS) for the proposed NorthMet Mining Project and Land Exchange (see Figure 1.1-1). This FEIS follows the DEIS (2009) and SDEIS (2013). For more information on development of the FEIS, see Chapter 2.

PolyMet Mining, Inc. (PolyMet) is proposing to develop the NorthMet copper-nickel-platinum group elements (PGE) mine and associated processing facilities in northeastern Minnesota. A land exchange is also proposed with the United States Forest Service (USFS) to eliminate a conflict between PolyMet's desire to surface mine and the United States' surface rights, including USFS administration of National Forest System (NFS) land. Because the Land Exchange is closely related to the NorthMet Project, it is considered a connected action, and, as such, is included in the analysis of environmental effects.

Under state and federal regulations, multiple actions or projects that are connected actions must be considered in total in preparing an EIS. For the FEIS, the NorthMet Project Proposed Action and the Land Exchange Proposed Action constitute the Proposed Connected Actions, which comprise two major components (see Figure 1.1-1):

- The NorthMet Project Proposed Action consisting of:
  - Mine Site: A new surface mine, which would include development of mine pits, permanent and temporary waste rock stockpiles, an overburden storage and laydown area, a Wastewater Treatment Facility (WWTF), water collection and conveyance pipelines, a Central Pumping Station (CPS), and a Rail Transfer Hopper.
  - Transportation and Utility Corridor: Expansion of existing and construction of new infrastructure to connect the Mine Site and the Plant Site including upgrades to Dunka Road, water pipelines, transmission lines, and new railroad connections.
  - Plant Site: Existing facilities remaining from the former LTV Steel Mining Company (LTVSMC), which closed in 2001, would be refurbished and reused. Two new facilities would be constructed, one for beneficiation and one for hydrometallurgical processing. Associated with these would be the expansion of the existing LTVSMC Tailings Basin to accommodate NorthMet Project tailings, construction of a Hydrometallurgical Residue Facility, water collection and conveyance pipelines, and construction of a new Wastewater Treatment Plant (WWTP).
- The Land Exchange Proposed Action consisting of:
  - USFS conveyance of Superior National Forest lands encompassing the proposed NorthMet Mine Site and the lands surrounding the Mine Site to PolyMet.
  - USFS acquisition of up to five tracts of private land that lie within the Superior National Forest proclamation boundary that are currently owned or would be acquired by PolyMet.

The final proposed configuration of land would be determined after the market value of the parcels is determined by appraisals and would be presented in the Record of Decision (ROD).

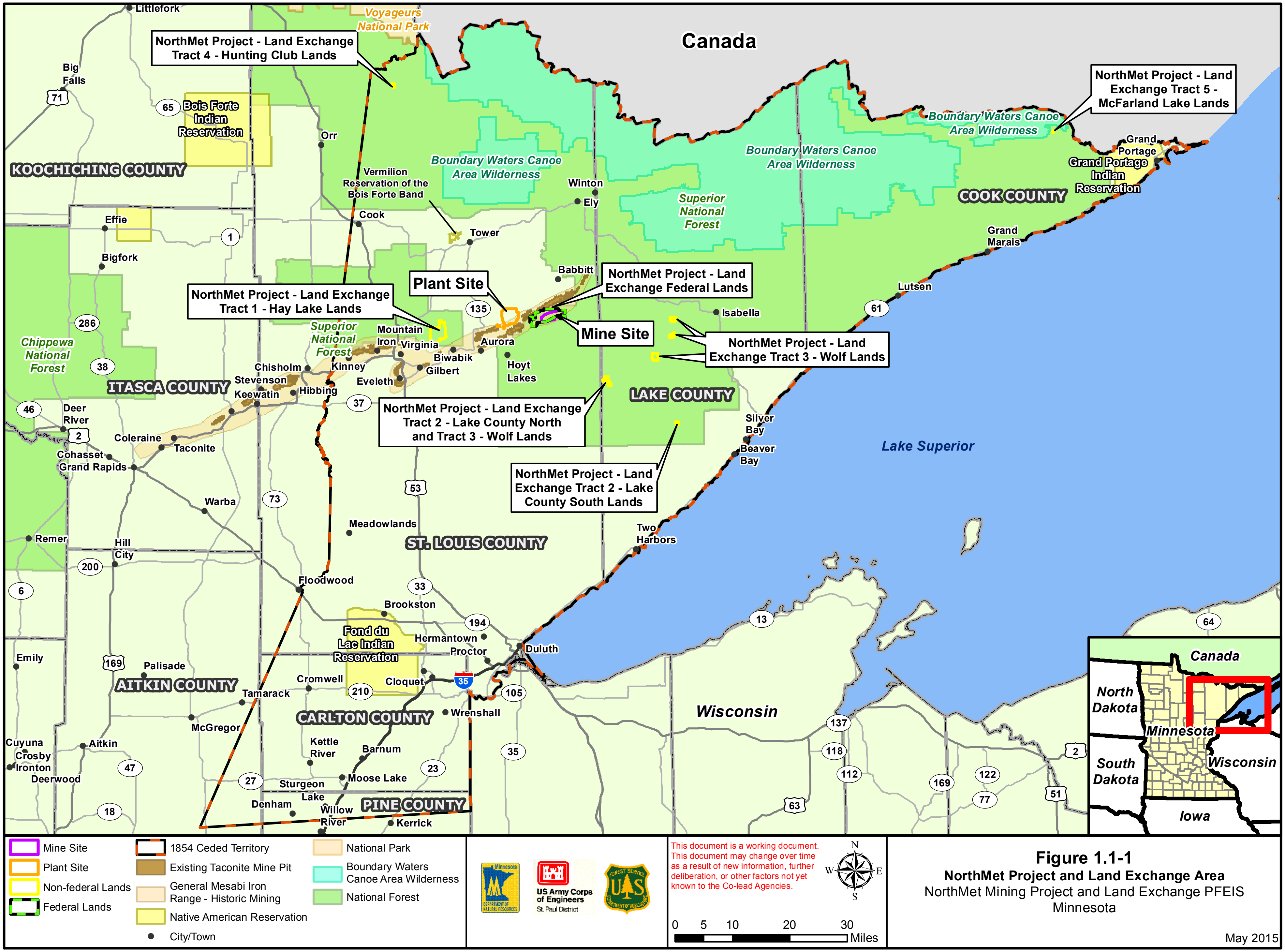

Figure 1.1-1
NorthMet Project and Land Exchange Area
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

May 2015

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1.1.1 NorthMet Project

The NorthMet Project area, including the Mine Site, Plant Site, and connecting infrastructure, would be located in St. Louis County, Minnesota, and situated at the eastern end of the Mesabi Iron Range (see Figure 1.1-2). The NorthMet Project area is located within the St. Louis River Watershed and is not hydrologically connected to the Boundary Waters Canoe Area Wilderness (BWCAW). The Mine Site is an area of the Superior National Forest that has not previously been mined. It is located approximately 6 miles south of the City of Babbitt and directly south of the Northshore Mining Company's Northshore Mine, which is an active taconite/iron mine.

The Plant Site would be approximately 6 miles north of the City of Hoyt Lakes at the former LTVSMC processing plant. This facility would be refurbished and would include a new Beneficiation Plant and Hydrometallurgical Plant.

When operational, surface mining and processing of copper-nickel-PGE ore would take place over an approximately 20-year mine life and have the following outputs:

- Approximately 73,068 tons per day (tpd) of rock, including up to 32,000 tpd of ore from a surface mine with three pits (i.e., East Pit, Central Pit, and West Pit);
- Approximately 15 million tons of waste rock annually;
- Approximately 11.3 million tons of tailings from the Beneficiation Plant annually;
- Residues from the Hydrometallurgical Plant, up to 313,000 tons annually (dependent upon factors such as feedstock, markets, etc.); and
- 113,000 tons of copper concentrate, 18,000 tons of mixed nickel/cobalt hydroxide, and 500 tons of PGE precipitate annually (based on an average mining rate).

Generally, facilities in the NorthMet Project area would be concurrently reclaimed, leaving a smaller portion of the NorthMet Project area to be reclaimed at closure. At the end of mining, PolyMet would first remove all infrastructure and facilities not approved for potential future use, followed by reclamation of disturbed lands. Post-reclamation activities would include monitoring and maintenance of reclamation and water quality until the various facility features were deemed environmentally acceptable, in a self-sustaining and stable condition. See Section 3.2 for a detailed description of the NorthMet Project Proposed Action.

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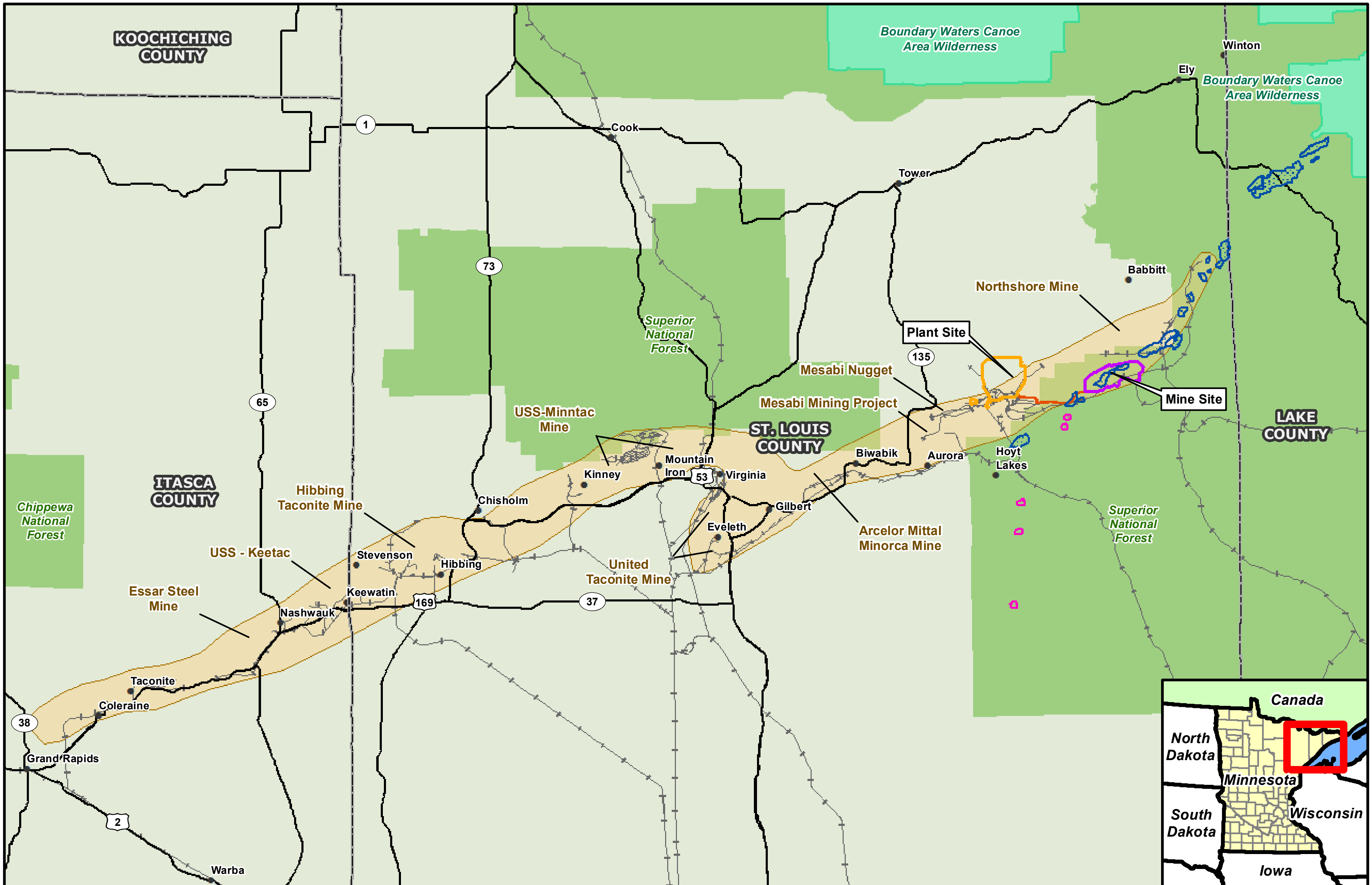

Plant Site
Mine Site
Transportation and Utility Corridor
Boundary Waters Canoe Area Wilderness
National Forest
General Mesabi Iron Range - Historic Mining
Duluth Complex Copper-Nickel Deposits
Duluth Complex Titanium-Iron Deposits
City/Town
Existing Road
Existing Railroad

US Army Corps of Engineers
St. Paul District

This document is a working document. This document may change over time as a result of new information, further deliberation, or other factors not yet known to the Co-lead Agencies.

N W E S

0 2.5 5 10 Miles

Figure 1.1-2
Mesabi Iron Range Region
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

May 2015

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1.1.2 Land Exchange

The Land Exchange Proposed Action is considered a "connected action" to the NorthMet Project Proposed Action (40 Code of Federal Regulations [CFR] part 1508.25). It is included in the analysis of environmental effects as part of the Proposed Connected Actions. The proposed NorthMet Mine Site would affect federal lands for which PolyMet leases the private subsurface mineral rights. The area affected by the Mine Site was acquired by the United States, for National Forest purposes, under the authority of the Weeks Act of 1911 (16 United States Code [USC] § 515) and is managed by the USFS.

The Land Exchange Proposed Action would involve the transfer of 6,650.2 acres (General Land Office [GLO]) of federal lands from public to private ownership, and up to 6,722.5 acres (GLO) of land from private to public ownership, depending on the results of the environmental analysis and real estate appraisals. See Section 3.3.2 for a detailed description of the Land Exchange Proposed Action.

GLO acres represent the acreages associated with the legal descriptions of the parcels based on original surveys performed by the GLO surveyors between 1858 and 1907. As such, GLO acreages are being used as part of the project description and would also be used to define the real estate transaction if the Land Exchange Proposed Action were approved. The analyses of effects presented in Chapters 5 and 6 are based upon Geographic Information System (GIS) data. GIS values indicate the size of the Land Exchange Proposed Action parcels as computed geometrically using mapping software, which may be different than the GLO legal acreage. Unless noted as GLO acres, all values shown in the document are GIS values.

The Land Exchange Proposed Action would allow use of parts of the federal lands for the NorthMet Project Proposed Action mining activities. PolyMet has indicated that management of the exchanged federal lands outside of the proposed mining development could include some upland timber management to enhance wildlife habitat; however, there are no current proposed disturbances to this area. There are no activities proposed on the non-federal lands as part of the Land Exchange Proposed Action.

1.2 EIS ROLES AND RESPONSIBILITIES

1.2.1 Co-lead Agencies

Since both USACE and USFS have federal actions pertaining to the NorthMet Project and Land Exchange, these agencies have elected to become Co-lead federal Agencies for the implementation of the National Environmental Policy Act (NEPA) and the preparation of the FEIS. The USACE is responsible for determining if a project is in the public's interest and complies with the Section 404 (33 USC § 1344) guidelines before issuing a Department of the Army permit pursuant to the Clean Water Act (CWA). The NorthMet Project Proposed Action also requires preparation of a mandatory State Environmental Impact Statement (EIS) under the Minnesota Environmental Policy Act (MEPA) and *Minnesota Rules,* part 4410.4400(8)(C), which designate the MDNR as the Responsible Governmental Unit (RGU) or lead state agency.

MDNR, USACE, and USFS are Co-lead Agencies for the joint state-federal EIS and, therefore, are responsible for the content of the FEIS and have final authority over the language used.

1.2.2 Cooperating Agencies

Under Section 309 of the Clean Air Act (CAA) (42 USC § 7609), the Administrator of the United States Environmental Protection Agency (USEPA) is directed to review and comment publicly on the environmental impacts of federal activities, including actions for which EISs are prepared. In addition to the USEPA's responsibilities under the CAA, the USEPA also participated in the NorthMet Mining Project and Land Exchange EIS as a Cooperating Agency.

The USEPA submitted comments on the DEIS on February 18, 2010 and assigned the DEIS a rating of EU-3 (Environmentally Unsatisfactory – Inadequate Information). Following the DEIS, USEPA agreed to become a Cooperating Agency pursuant to NEPA for development of the SDEIS in order to participate in resolving issues identified in USEPA's comment letter on the NorthMet Project's initial DEIS. The USEPA was engaged on specific issues and was provided the opportunity to review a preliminary version of the SDEIS. The USEPA submitted comments on the SDEIS on March 12, 2014, and noted that the Co-lead Agencies had adequately addressed the USEPA's comments on the preliminary SDEIS (committing to work further with USACE and MPCA on permit-related issues) and assigned the SDEIS an improved rating of EC-2 (Environmental Concerns – Insufficient Information).

Along with the USEPA, the Bois Forte Band of Chippewa (Bois Forte), Grand Portage Band of Lake Superior Chippewa (Grand Portage), and Fond du Lac Band of Lake Superior Chippewa (Fond du Lac) (collectively, "the Bands") have been invited by the Co-lead Agencies to participate as Cooperating Agencies. The Mine Site, Plant Site, federal lands, and non-federal lands as part of the Land Exchange Proposed Action are all located within the 1854 Ceded Territory where the Bands reserve usufructuary rights (i.e., for hunting, fishing, and gathering). A Memorandum of Understanding (MOU) was signed on February 23, 2005 (with a revision on March 15, 2005) between the USACE, MDNR, Bois Forte, Fond du Lac, and PolyMet. The MOU discussed the roles and procedures in which the signatories would interact as Co-lead and Cooperating agencies. The MOU was again revised on May 19, 2008, to include Grand Portage. Following the addition of the USFS as a Co-lead Agency and the decision to prepare an SDEIS, this MOU was terminated and a Coordination and Communication Plan (CCP) was developed. The CCP was produced jointly by the MDNR, USACE, USFS, and Bands to guide interactions during preparation of the SDEIS. The Great Lakes Indian Fish & Wildlife Commission (GLIFWC) and the 1854 Treaty Authority have assisted the Bands in their roles as Cooperating Agencies. The federal Co-lead Agencies are conducting a parallel process with Section 106 of the National Historic Preservation Act (NHPA) of 1966 (16 USC § 470 et seq.), along with NEPA.

The USEPA and the Bands participated as Cooperating Agencies based on regulatory authority and/or subject matter expertise. All Cooperating Agencies were provided the opportunity to review preliminary versions of the SDEIS and FEIS prior to publication. While the Cooperating Agencies provided input on specific issues during the development of the FEIS, the Co-lead Agencies are solely responsible for the final content of the FEIS.

1.2.3 Other Agencies

While not Co-lead or Cooperating Agencies, other federal and state agencies have important roles on the project. The Minnesota Pollution Control Agency (MPCA) and Minnesota Department of Health (MDH) are assisting the MDNR pursuant to *Minnesota Rules*, part

4410.2200. The United States Fish and Wildlife Service (USFWS) reviewed the Biological Assessment (BA) and provided a Biological Evaluation (BE), which are included as Appendix D to the FEIS.

1.3 PURPOSE AND NEED

1.3.1 Applicant's Purpose and Need Statement

The applicant's stated purpose of the NorthMet Project is to exercise PolyMet's mineral lease to continuously mine, via open pit methods, the known ore deposits (NorthMet Deposit) containing copper, nickel, cobalt, and PGEs to produce base and precious metal precipitates and flotation concentrates by uninterrupted utilization of the former LTVSMC processing plant.

The purpose of the proposed Land Exchange is to consolidate the surface and mineral ownership of the lands involved at the Mine Site. PolyMet has a lease to mine the minerals on its NorthMet Deposit, which is surrounded by active and abandoned taconite mines near Hoyt Lakes. The surface of these lands is owned by the United States.

The need for the NorthMet Project is driven by domestic and global demand of these products. Demand continues to rise for these metals due to the expansion of the green economy and rising demand from developing countries like India, China, and Brazil. Based on the closure of LTVSMC and other job losses in northeastern Minnesota, there is also a need for jobs and economic development in the area.

1.3.2 Co-lead Agencies' Purpose and Need Statements

1.3.2.1 NorthMet Project and Land Exchange Purpose and Need Statement

The Purpose and Need for the Proposed Connected Actions is:

- For PolyMet to utilize its leased mineral rights and recover commercial quantities and quality of semi-refined metal concentrates, hydroxides, and precipitates from the NorthMet ore body in northern Minnesota, and to process the recovered ore by reutilizing the former LTVSMC processing plant.
- To extract metals in a safe, environmentally responsible, energy-efficient, and economically feasible manner subject to mitigation measures designed to avoid or minimize environmental effects to the extent practicable.
- To extract and process metals in a technically and economically feasible manner, such that there would be sufficient income to cover: operating cost (which includes but is not limited to the cost of mining, processing, transportation, and waste management), capital cost (needed to build and sustain facilities), an adequate return to investors, reclamation, and closure costs and taxes.
- To eliminate the conflict between PolyMet's desire to surface mine and the USFS ownership and management of NFS lands, by exchanging federal lands for non-federal lands that have equal or greater value.

1.3.2.2 United States Forest Service

The purpose for the USFS is to meet desired conditions in the Superior National Forest Land and Resource Management Plan (Forest Plan) (USFS 2004b), including ensuring the proposed land exchange Proposed Action eliminates existing conflict and ensuring mineral resources are produced in an environmentally sound manner contributing to economic growth.

In regards to desired conditions for land exchange and mineral development, the Superior National Forest's Forest Plan includes the following direction:

> "D-LA-1 – The amount and spatial arrangement of National Forest System land within the proclamation boundary of the Forest are sufficient to protect resource values and interests, improve management effectiveness, eliminate conflicts, and reduce the costs of administering landlines and managing resources." (Forest Plan, Land Adjustment, pg. 2-51)

> "D-MN-2 – Ensure that exploring, developing, and producing mineral resources are conducted in an environmentally sound manner so that they may contribute to economic growth and national defense." (Forest Plan, Minerals, pg. 2-9)

PolyMet intends to exercise private mineral rights that were reserved when lands were conveyed to the United States and has proposed the development of a surface mine. This land was purchased by the USFS, for National Forest purposes, under the authority of the Weeks Act. The USFS has taken the position that the mineral rights that were reserved do not include the right to surface mine as proposed by PolyMet. PolyMet disagrees with the USFS position and argues that the mineral rights it seeks to utilize provide for access to the minerals by any mining method, including open pit or surface mining. Rather than the possibility of litigation that has no certain outcome, a land exchange is being considered to resolve the fundamental conflict.

The USFS has determined that allowing private surface mining would be inconsistent with USFS legal mandates for acquiring and managing these land and that the USFS needs to resolve this fundamental conflict. See Section 2.3.3 for more information.

1.3.2.3 United States Army Corps of Engineers

The Purpose and Need of the Proposed Action is to produce base and precious metals precipitates and flotation concentrates from ore mined at the NorthMet Deposit by uninterrupted operation of the former LTVSMC processing plant. The processed resources would help meet domestic and global demand by sale of these products to domestic and world markets.

1.3.2.4 Minnesota Department of Natural Resources

The Purpose and Need of the Proposed Action is to produce base and precious metals precipitates and flotation concentrates from ore mined at the NorthMet Deposit by uninterrupted operation of the former LTVSMC processing plant. The processed resources would help meet domestic and global demand by sale of these products to domestic and world markets.

1.4 REGULATORY FRAMEWORK

1.4.1 National Environmental Policy Act

1.4.1.1 Overview

NEPA requires that federal agencies consider the potential environmental consequences of proposed actions in their decision-making process. The law's intent is to protect, restore, or enhance the environment through well-informed federal decisions. The CEQ was established under NEPA for the purpose of implementing and overseeing federal policies as they relate to this process.

In 1978, the CEQ issued regulations for implementing NEPA (40 CFR parts 1500-1508). Section 102(2)(c) of NEPA, 42 USC § 4332(2)(C), mandates that federal agencies shall include a "detailed statement" in "proposals for legislation and other major Federal actions significantly affecting the quality of the human environment" that addresses, among other things, the environmental effects of the proposed action. Such projects include: any actions under the jurisdiction of the federal government or subject to federal permits; actions requiring partial or complete federal funding; actions on federal lands or affecting federal facilities; continuing federal actions with effects on land or facilities; and new or revised federal rules, regulations, plans, or procedures. Any major federal action significantly affecting the human environment requires the preparation of an EIS and a ROD. The USACE permit decision, including its evaluation under the 404(b)(1) guidelines and the Public Interest Review, will be documented in the USACE ROD, which will be issued following issuance of the FEIS. The USACE will use the FEIS to support the ROD documenting its decision on the CWA Section 404 Permit application. The USFS will implement NEPA per 36 CFR part 220, and would use the FEIS to support the ROD documenting its decision on the Land Exchange Proposed Action.

The USACE, during its review of PolyMet's permit application, determined that the NorthMet Project Proposed Action would require the preparation of an EIS in accordance with the requirements of NEPA and the CEQ regulations. To comply with other relevant environmental statutes described below, in addition to NEPA, the decision-making process for the Proposed Connected Actions involves a thorough examination of all pertinent environmental issues per 40 CFR 1505.

1.4.1.2 Alternatives

NEPA requires that a "range of alternatives" must be discussed in the environmental documents prepared for a proposed action (40 CFR 1502.14). This includes all practicable alternatives, which must be rigorously explored and objectively evaluated, as well as those other alternatives, which are eliminated from detailed study with a brief discussion of the reasons for eliminating them. The emphasis is on what is "practicable" rather than on whether a proponent or applicant prefers or is itself capable of carrying out a particular alternative. NEPA also requires consideration of the No Action Alternative, in which the proposed project would not proceed.

1.4.2 Minnesota Environmental Policy Act

1.4.2.1 Overview

In addition to the federal NEPA process, *Minnesota Statutes*, Chapter 116D requires environmental review. The MEPA environmental review process is an information collection and disclosure tool for state agencies. It informs the subsequent permitting and approval processes and describes mitigation measures that may be available. The MEPA process operates according to rules adopted by the Minnesota Environmental Quality Board (MEQB). However, the actual reviews are usually conducted by a local governmental unit or a state agency. The organization responsible for conducting the review is referred to as the RGU. The MEQB staff advises the RGU and state agencies on the proper procedures for environmental review and monitors the effectiveness of the process in general. By rule, the MDNR is the designated RGU for the NorthMet Project. Pursuant to MEPA, the RGU will determine the adequacy of the FEIS. If the FEIS is determined to be adequate, then final decisions can be made by the appropriate governmental units on state permits.

Minnesota Rules, part 4410.4400, subpart 8 dictates that an EIS shall be prepared because the NorthMet Project exceeds the threshold listed for construction of a new metallic mineral mining and processing facility. Under MEPA, the FEIS must be consistent with *Minnesota Rules*, part 4410.0200 to part 4410.7800 and the scoping determination. The adequacy of the FEIS is governed by *Minnesota Rules*, part 4410.2800.

1.4.2.2 Alternatives

MEQB statutes and rules (*Minnesota Statutes*, chapter 116D, sections 04 and 045; and *Minnesota Rules*, part 4410, subpart 0200 through 7500) require that an EIS include at least one alternative in each of the following categories (in addition to the No Action Alternative):

- Alternative sites,
- Alternative technologies,
- Modified designs or layouts,
- Modified scale or magnitude, and
- Alternatives incorporating reasonable mitigation measures identified through comments received during the comment periods for EIS scoping or for the DEIS.

If no alternative is included for any given category, an explanation must be provided in the EIS. An alternative may be excluded if it fails to meet the underlying need for or purpose of the project, is unlikely to have any significant environmental benefit compared to the project as proposed, or another alternative would likely have similar environmental benefits but substantially less adverse economic, employment, or sociological effects.

1.4.3 Land Exchange Requirements

Most of the public lands involved in the NorthMet Project Proposed Action were acquired by the United States under the authority of the Weeks Act of 1911. Other authorities that would govern the Land Exchange Proposed Action between PolyMet and the United States include the Federal Land Policy and Management Act of 1976 (43 USC §§ 1716-1717) (FLPMA) and the Federal

Land Exchange Facilitation Act of 1988. Regulations promulgated to implement FLPMA are found in 36 CFR 254, Subpart A (36 CFR 254).

Land exchanges are discretionary, voluntary real estate transactions between federal and non-federal parties. Regulations provide that the Forest Supervisor "may complete an exchange only after a determination is made that the public interest will be well served" (36 CFR 254.3(b)). Factors that must be considered include: the opportunity to achieve better management of federal lands and resources, to meet the needs of state and local residents and their economies, and to secure important objectives, including but not limited to: protection of fish and wildlife habitats, cultural resources, watersheds, and wilderness and aesthetic values; enhancement of recreation opportunities and public access; consolidation of lands and/or interests in lands, such as mineral and timber interests, for more logical and efficient management and development; consolidation of split estates; expansion of communities; accommodation of existing or planned land use authorizations; promotion of multiple-use values; implementations of applicable Forest Land and Resource Management Plans; and fulfillment of public needs. See 36 CFR 254.3(b) and 254.4(c)(4). Table 7.3.5-1 in Chapter 7 of the FEIS presents a comparison of how the alternatives address these factors.

Under the FLPMA, a land exchange involves the transfer of equal valued land. If land values are not equal, every effort is made to equalize values by adding or deleting land. Cash equalization may then be paid by either party up to 25 percent of the value of the federal land. See 36 CFR 254.12.

The Land Exchange Proposed Action must comply with two Executive Orders (EOs) that are related to wetlands and floodplains. EO 11990 was signed by President Jimmy Carter on May 24, 1977, "*in order to avoid to the extent possible the long and short term adverse impacts associated with the destruction or modifications of wetlands*…." This order applies to land exchanges such that, as much as practicable, the exchange does not result in the loss of wetland resources. EO 11988 was also signed by President Jimmy Carter on May 24, 1977 "*in order to avoid to the extent possible the long and short term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct or indirect support of floodplain development wherever there is a practicable alternative*…." This order applies to land exchanges such that, as much as practicable, the exchange does not result in an increase in the flood damage potential.

USFS policy (Forest Service Handbook 5409.13 § 33.43c) provides that the following list of three conditions satisfy the requirements of EOs 11990 and 11988:

The value of the wetlands or floodplains for properties received and conveyed is equal (balancing test) and the land exchange is in the public interest.

Reservations or restrictions are retained on the unbalanced portion of the wetlands and floodplains on the federal lands when the land exchange is in the public interest but does not meet the balancing test.

The federal property is removed from the exchange proposal when the conditions described in the preceding paragraphs 1 or 2 cannot be met.

The USFS is also required, by EOs 11988 and 11990, to reference in a conveyance those uses that are restricted under identified federal, state, or local wetland and floodplain regulations. In Minnesota, the CWA (USACE/USEPA/MPCA), Protected Waters Permit Program (MDNR), and the Wetland Conservation Act (WCA), Board of Water and Soil Resources regulate certain activities in wetlands. Under WCA provisions, wetlands must not be impacted as part of a project for which a Permit to Mine is required, except as approved by the commissioner (*Minnesota Rules*, part 8420.0930). Floodplain management ordinances are administered at the local (county) level.

The Land Exchange Proposed Action would be designed to be consistent with the goals and objectives of the Forest Plan (USFS 2007c) including G-LA-2 and G-LA-3 (Forest Plan, pages 2-51 and 2-52, see FEIS Section 3.3.1.1). The non-federal lands for Land Exchange Proposed Action would need to be incorporated within the adjacent federal ownership and managed in accordance with the Forest Plan direction for the particular management area.

As part of the USFS decision to be made, the Responsible Official has the responsibility to determine if the proposed exchange serves the public interest and supports the direction and guidance in the forest land management plan. The public interest determination must show that the resource values and the public objectives of the non-federal lands equal or exceed the resource values and the public objectives of the federal lands and that the intended use of the conveyed federal land would not substantially conflict with established management objectives on adjacent federal lands, including Indian trust lands. The findings and supporting rationale shall be made part of the decision (Forest Service Handbook 5409.13, section 34.1; 36 CFR 254.3(b)). The ROD will contain the findings and supporting rationale for the selected alternative and how the public interest is served under 36 CFR 254.3(b), as well as provide information for compliance with USFS requirements and the Forest Plan.

1.4.4 Other Permits and Requirements

In accordance with *Minnesota Rules*, part 4410.3900, which seeks to reduce duplication to the fullest extent between the Minnesota Statutes and NEPA, a joint state-federal EIS has been prepared to comply with both NEPA and MEPA regulations. In addition, PolyMet must obtain the required federal, state, and local permits and approvals summarized in Table 1.4.4-1 below.

Table 1.4.4-1 Government Permits and Approvals for the Proposed Connected Actions

Agency	Permit/Action	Reason Permit or Action is (or may be) Needed
Federal		
USACE	Department of the Army Permit	For affected waters within the jurisdiction of the USACE under the CWA, 40 CFR Part 230: Section 404(b)(1)
	Section 106 NHPA Compliance (Minnesota Historic Preservation Office)	Necessary due to the NorthMet Mining Project and Land Exchange being a federal undertaking, 36 CFR Part 800
USFWS	Section 7 Endangered Species Act (ESA) Compliance	Necessary due to the NorthMet Mining Project and Land Exchange being a federal undertaking, 50 CFR 402
USFS	Land Exchange	To resolve the conflict between surface and mineral estates

Agency	Permit/Action	Reason Permit or Action is (or may be) Needed
	Section 106 NHPA Compliance (Minnesota Historic Preservation Office)	Necessary due to the NorthMet Mining Project and Land Exchange being a federal undertaking, 36 CFR Part 800
State		
MDNR	Permit to Mine	Required for all nonferrous metallic mining operations, *Minnesota Rule*s, chapter 6132
	Endangered Species Taking Permit (if required)	If there are state-listed species that may be taken by the NorthMet Project Proposed Action, *Minnesota Rules,* parts 6212.1800-6212.2300 and 6134
	Water Appropriations Permit for plant make-up water	For withdrawal of water from Colby Lake for plant make-up water; for mine dewatering; for stream augmentation; *Minnesota Rule*s, part 6115
	Dam Safety Permit	For the Tailings Basin, Hydrometallurgical Residue Facility, and potentially the water retention dikes at the Mine Site (e.g., water treatment plant pond dikes), *Minnesota Rules,* parts 6115.0300-6115.0520
	Permit for Work in Public Waters	For possible modifications and diversions of local streams in constructing the West Pit outfall; *Minnesota Rules,* part 6115
	Wetland Replacement Plan approval under WCA	For affected wetlands within the scope of the WCA or that constitute "public wetlands"
	Burning Permit (if required)	If vegetative material would need to be burned on site during times with no snow cover
MPCA	Section 401 Water Quality Certification/Waiver	Required in conjunction with the DA Permit (Section 404 Permit)
	National Pollutant Discharge Elimination System and State Disposal System (NPDES/SDS) Permits	For construction and industrial activity that would disturb 1 acre or more of land, and the management, treatment and/or discharge of process wastewater to surface water or groundwater
	Solid Waste Permit	For construction debris
	Air Emissions Permit (Part 70 Permit)	For emissions of regulated air pollutants
	Waste Tire Storage Permit	For storage of waste tires generated from NorthMet Project-related vehicles (if required)

Agency	Permit/Action	Reason Permit or Action is (or may be) Needed
	General Storage Tank Permit	For multiple NorthMet Project Proposed Action aboveground storage tanks
MDH	Radioactive Material Registration	For measuring instruments
	Permit for Non-Community Public Water Supply System and a Wellhead Protection Plan (if proposed)	Existing Plant Site potable water treatment plant to be refurbished
	Permit for Public On-site Sewage Disposal System	For sewage waste generated during construction and operation that would be disposed of on site
Local		
City of Hoyt Lakes	Zoning Permit	To acknowledge NorthMet Project Proposed Action is an allowable use within the zoned district
City of Babbitt	Building Permit	New construction would occur on portions of the NorthMet Project area within the incorporated limits of the City of Babbitt
St. Louis County	Zoning Permit	To acknowledge NorthMet Project Proposed Action is an allowable use within the zoned district

1.4.5 Financial Assurance

Financial assurance is required by state law. *Minnesota Rules* part 6132.1200 requires that before a Permit to Mine can be granted, financial assurance instruments covering the estimated cost of reclamation should the mine be required to close for any reason at any time must be submitted and approved by the MDNR. The financial assurance requirements would be reviewed and updated on an annual basis. Financial assurance is discussed in further detail in Sections 2.5 and 3.2.2.4.

1.5 PURPOSE OF THE FEIS

The purpose of this FEIS is to provide an analysis of effects that would result from the NorthMet Project and Land Exchange, consider USEPA and Tribal Cooperating Agency concerns and public comments, describe alternatives considered, and disclose PolyMet's project refinements identified through the EIS process. The FEIS discusses key themes, which include air, wetlands, geotechnical stability, socioeconomics, water resources, cultural resources, and alternatives.

1.6 ORGANIZATION OF THE FEIS

This FEIS follows the CEQ's recommended organization (40 CFR 1502.10) and MEPA content requirements (*Minnesota Rules*, part 4410.2300).

Chapter 1.0 (Introduction) provides an overview and descriptions of the purpose of and need for the NorthMet Project Proposed Action and the Land Exchange Proposed Action, regulatory framework, agency roles and responsibilities, and the organization of the FEIS.

Chapter 2.0 (EIS Development) describes the EIS development process for the NorthMet Project Proposed Action and Land Exchange Proposed Action. Discussion includes scoping, identification of issues, development of the NorthMet Project Proposed Action and Land Exchange Proposed Action and alternatives, public and agency participation, consultation and coordination undertaken to prepare the DEIS, SDEIS, and FEIS, incorporation of the Land Exchange, reevaluation of DEIS alternatives, and impact analysis process.

Chapter 3.0 (Proposed Action and Project Alternatives) describes the NorthMet Project Proposed Action and Land Exchange Proposed Action and alternatives including the No Action Alternative, Land Exchange Alternative B, and Alternatives Considered but Eliminated from detailed consideration.

Chapter 4.0 (Affected Environment) summarizes the existing conditions of the NorthMet Project Proposed Action and the surrounding environment and the Land Exchange parcels including the land and its physical, biological, cultural, socioeconomic, and recreational resources.

Chapter 5.0 (Environmental Consequences) presents the direct and indirect environmental consequences of the NorthMet Project Proposed Action and associated alternatives and the direct and indirect environmental consequences of the Land Exchange Proposed Action and associated alternatives.

Chapter 6.0 (Cumulative Effects) describes the cumulative effects on the surrounding environment and uniquely affected communities with regard to the NorthMet Project Proposed Action and the alternatives for the Land Exchange.

Chapter 7.0 (Comparison of Alternatives and Other Considerations) contains a comparison of the Proposed Connected Actions and alternatives, conclusions of the impacts (including human health), Land Exchange public interest considerations, and also addresses other NEPA considerations.

Chapter 8.0 (Major Differences of Opinion) describes the Tribal Cooperating Agencies' major differences of opinion with aspects of the EIS.

Appendix A (Response to Comments on the NorthMet Mining Project and Land Exchange Draft and Supplemental Draft EIS) identifies the process for public engagement throughout the EIS and provides responses to comments received on the DEIS and SDEIS.

Appendix B (Underground Mining Alternative Assessment for the NorthMet Mining Project and Land Exchange Environmental Impact Statement) describes the analysis that the Co-lead Agencies undertook in consideration of a potential Underground Mining Alternative.

Appendix C (Tribal Agency Position Supporting Materials) includes verbatim comments and supporting documentation provided by the Tribal Cooperating Agencies.

Appendix D (Biological Assessment and Biological Evaluation) identifies whether NorthMet Mining Project and Land Exchange-related actions may affect listed or proposed species and critical habitat as required under the ESA.

1.7 CONSTITUENTS OF INTEREST

Key constituents of interest are discussed in various chapters of the FEIS. Below is a list of the major constituents referenced within this FEIS. A number of additional constituents were also analyzed; however, this list represents those that are of most significance to the FEIS.

- Carbon monoxide (CO): May cause fatigue, chest pain, headaches, confusion, nausea, and dizziness.
- Greenhouse gases (GHGs): Increased GHGs in the atmosphere can change climate conditions.
- Hazardous Air Pollutants (HAPs): Group of toxic constituents known or suspected to cause significant health effects, such as cancer.
- Mercury, mercury compounds (Hg): Elemental metal, high-level exposure may harm the brain, gastrointestinal tract, nervous system, and kidneys.
- Metals/Metalloids (arsenic, cobalt, copper, nickel, antimony): Depending on constituent and exposure, can affect the skin, heart, kidneys, liver, and/or gastrointestinal tract.
- Methylmercury: Organic mercury, bioaccumulates in fish and animals, can be transmitted to humans that consume contaminated fish and game, may harm the fetal nervous system and brain.
- Nitrogen dioxide (NO2): May cause respiratory effects.
- Nitrogen oxides (NOx): May form nitric acid and create acid rain, which can alter water and soil pH. May also affect regional visibility conditions (haze).
- Particulate matter (PM): Particles smaller than 10 micrometers (PM10) may enter the lungs or bloodstream, particles smaller than 2.5 micrometers (PM2.5) affect regional visibility conditions (haze).
- Sulfate (SO4): Can contribute to methylation of mercury, may affect wild rice.
- Sulfur dioxide (SO2): Acute exposure may cause respiratory effects such as bronchoconstriction or increased asthma symptoms. May also affect regional visibility conditions (haze).

Table 1.7-1 below describes the FEIS chapters in which the above constituents and related topics are discussed. Potential impacts on human health is addressed in Section 7.3.4.

Table 1.7-1 Constituents of Interest Discussed in the FEIS

Constituent	Topic	FEIS Section
Carbon monoxide (CO)	Air emissions effects	5.2.7.1.3
Greenhouse gases (GHGs)	Air emissions effects	5.2.7.2.4, 5.2.7.4.1
	Climate change – cumulative effects	6.2.3.8.10
Hazardous Air Pollutants (HAPs)	Air emissions effects	5.2.7.1.3
Mercury, mercury compounds (Hg)	Air emissions effects	5.2.7.2.5
	Mercury balance, TMDL	5.2.7.2.5
	Aquatic species/bioaccumulation effects	5.2.2.3.4
	Wild rice/water effects	5.2.2.1.2, 5.2.2.3.4
Metals/Metalloids (arsenic, cobalt, copper, nickel, antimony)	Air emissions effects	5.2.7.2.3
	Surface water and groundwater effects	5.2.2.3.2, 5.2.2.3.3
Methylmercury	Aquatic species/bioaccumulation effects	5.2.2.3.4
Nitrogen dioxide (NO_2)	Air emissions effects	5.2.7.2.3, 6.2.3.8.5
Nitrogen oxides (NOx)	Air emissions effects	5.2.7.1.3, 5.2.7.2.3, 6.2.3.8.5
Particulate matter (PM)	Air emissions effects	5.2.7.1.3, 5.2.7.2.1, 6.2.3.8.4
	Class I and Class II areas – regional haze effects	5.2.7.1.4, 5.2.7.2.1, 5.2.7.2.2, 6.2.3.8.9
Sulfate (SO_4)	Air emissions/deposition effects	6.2.3.8.5
	Surface and ground water effects	5.2.2.1.1, 5.2.2.3.1, 5.2.2.3.2, 5.2.2.3.3
	Effects to wild rice	5.2.2.1.2, 5.2.2.3.2, 5.2.2.3.3, 5.2.2.3.4
	Aquatic species effects	5.2.6.2.1, 6.2.3.7.2
	Mercury methylation effects	5.2.2.3.4
Sulfur dioxide (SO_2)	Air emissions effects	5.2.7.2.1

TMDL = Total Maximum Daily Load

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2.0 EIS DEVELOPMENT

2.1 INTRODUCTION

This section describes the development of the EIS for the NorthMet Project from when it was first proposed in 2005, through development of this FEIS. It includes a discussion of the EIS development from scoping to publishing; public, tribal, and government agency comments; the Co-lead Agencies' deliberations and decisions; incorporation of the Land Exchange Proposed Action as a connected action, and subsequent development of the SDEIS and FEIS. An overview of this process is shown in Figure 2.1-1.

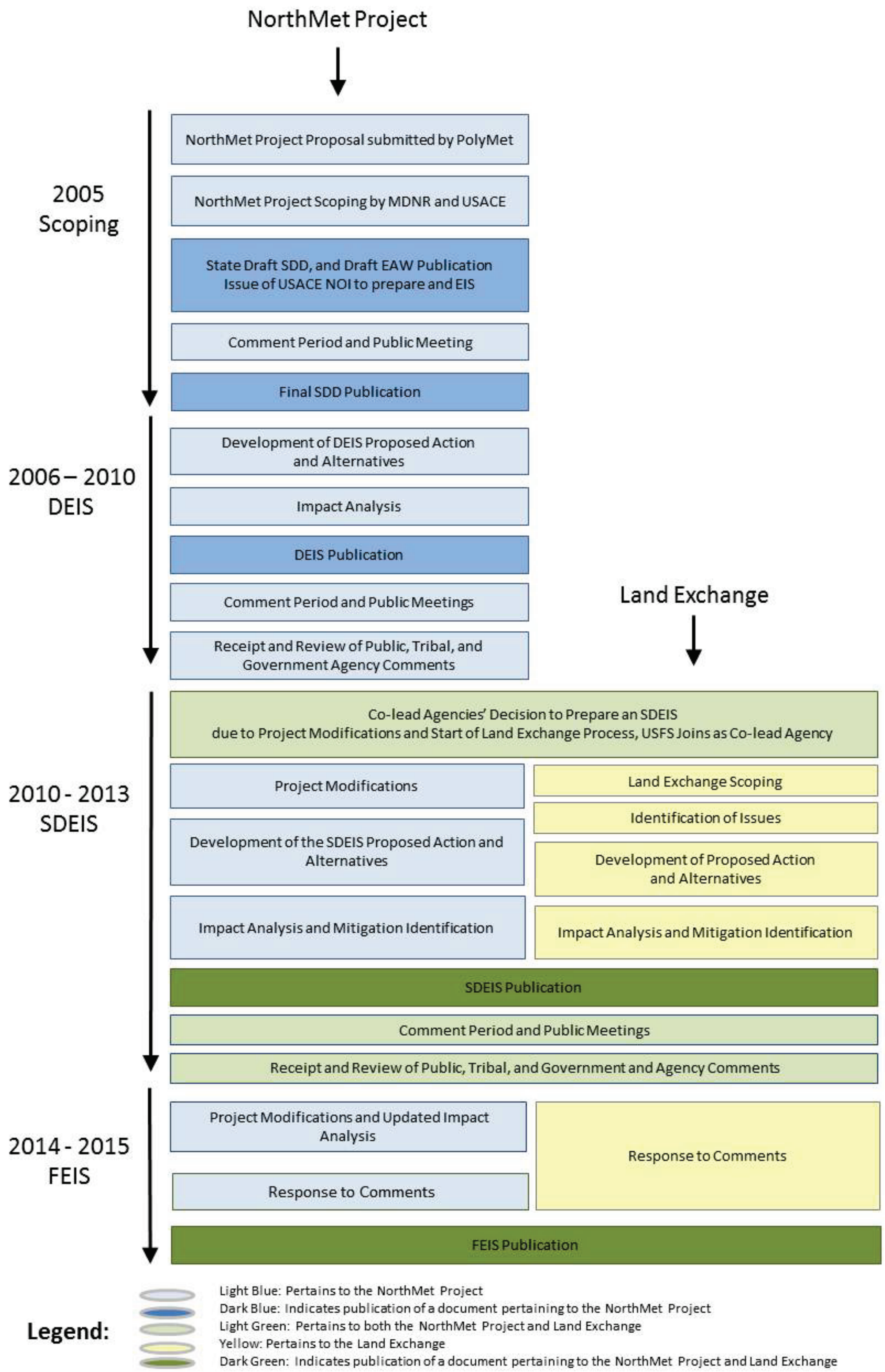


Figure 2.1-1 NorthMet Mining Project and Land Exchange EIS Development Process

2.2 DEIS DEVELOPMENT

2.2.1 NorthMet Project Scoping

In early 2005, the USACE received a permit application from PolyMet to discharge fill material to waters of the United States, including wetlands, in order to develop the NorthMet Project, requiring the preparation of an EIS pursuant to NEPA. The preparation of a state-level MEPA EIS would also be mandatory for the NorthMet Project.

Scoping is required by both NEPA and MEPA. The scoping process in Minnesota includes all procedural and substantive requirements to satisfy scoping for preparation of a federal EIS under NEPA. As the RGU for this EIS, the MDNR was responsible for administering the state's scoping process.

The DEIS scoping for the NorthMet Project, as originally proposed, involved the preparation of the following three documents:

- the state Scoping Environmental Assessment Worksheet (EAW);
- the state Draft Scoping Decision Document (SDD); and
- the state Final SDD.

After the Draft SDD and EAW were issued via the Environmental Quality Board (EQB) Monitor on June 6, 2005, comments were collected during a 30-day comment period that concluded on July 6, 2005. A public scoping meeting was held in Hoyt Lakes, Minnesota, on June 29, 2005. This meeting was hosted by the MDNR and USACE. Comments were addressed in the Response to Public Scoping Comments issued with the Final SDD on October 25, 2005. The USACE issued a Notice of Intent (NOI) to prepare an EIS in the Federal Register on July 1, 2005 (Volume 70, Number 126).

2.2.2 Identification of Issues

The scoping process was used to identify potentially significant issues that would trigger the analysis of effects and the development of potential alternatives and mitigation measures.

As discussed in the Final SDD, potentially significant effects included those on fish and wildlife resources, threatened and endangered species, water resources, water appropriations, surface water runoff and erosion/sedimentation, wastewater, and solid waste, as well as cumulative impacts. These impacts required a more detailed discussion than had been provided in the EAW; as a result, they were discussed in detail in the DEIS.

Other issues identified during scoping that were discussed in detail in the DEIS included vegetation cover types, point and non-point source air emissions, noise, cultural resources, visibility, compatibility with land use plans and regulations, infrastructure, asbestiform fibers, and tribal concerns regarding access to lands within the 1854 Ceded Territory.

Additional issues were also considered but eliminated from detailed analysis in the DEIS because they were determined to have no significant predictable effect or had been adequately discussed in the EAW. These issues included land use conflicts, water-related land use management, surface water use, geologic hazards and soil conditions, traffic, and odors.

2.2.3 DEIS Proposed Action and Alternatives

The proposed action analyzed in the DEIS called for surface mining and mineral processing of approximately 228 million (short) tons of copper-nickel-PGE ore over an approximate 20-year mine life. Proposed mining would occur at the NorthMet Deposit, which is located on undeveloped federal land. Existing infrastructure would be utilized to transport the ore approximately 8 miles to the west for processing at the former LTVSMC processing plant, which would be refurbished if necessary.

In accordance with NEPA and MEPA, a number of project alternatives were identified through scoping. After consideration, the following were evaluated in the DEIS (refer to Section 3.2.3):

- Proposed Action,
- No Action Alternative,
- Mine Site Alternative, and
- Tailings Basin Alternative.

The DEIS included provisions for a surface use permit from the USFS to use its lands for the mine. PolyMet and the USFS had been exploring options to avoid a conflict between the use of the surface (federal) and subsurface (private) estates. One option was to exchange the federally owned surface land necessary for the proposed mine with other private lands in the area. However, no agreement was reached and the DEIS did not include a land exchange.

2.2.4 Impact Analysis

Potential effects of the NorthMet Project Proposed Action and alternatives were determined using baseline data, predictive modeling programs, GIS and spatial data analysis, and other impact assessment methods both qualitative and quantitative. The predicted effects and potential mitigation measures were discussed in Chapter 4 of the DEIS.

2.2.5 DEIS Publication

The DEIS was made available to the public through notification in the November 2, 2009 EQB Monitor (Volume 33, Number 22) and November 6, 2009 (Volume 74, Number 214) Federal Register (FR). The notification informed the public that paper copies of the DEIS were available for review at MDNR offices and public libraries in Grand Rapids, Hibbing, Hoyt Lakes, Duluth, Minneapolis, and St. Paul. Summary versions of the document and compact disks containing the full version of the DEIS were provided upon request, and the entire document was also made available via the MDNR's website. Summary versions or full copies on paper or disk were distributed to parties on the MEQB distribution list as well as additional interested parties.

2.2.6 Comment Period and Public Meetings

The MEQB notification also identified that the 90-day comment period would end on February 3, 2010. Instructions and contact information were provided for submittal of public comments.

Following the release of the DEIS, public meetings were held in Aurora, Minnesota, on December 9, 2009 and Blaine, Minnesota, on December 10, 2009, to gather public comments on the DEIS.

2.2.7 Receipt and Review of Public and Agency Comments

Public and agency comments on the DEIS were collected during the 90-day comment period. Submissions came from government agencies (federal, state, and local), tribal entities, local businesses, non-governmental organizations, private individuals, and PolyMet. Approximately 3,800 comment submissions were received.

The comments were analyzed, and the key issues identified included effects on cultural resources, air quality, wetlands, geotechnical stability, socioeconomics, and water resources. Topic-focused workgroups were assembled from members of the Co-lead and Cooperating Agencies to further consider these issues.

2.3 SDEIS DEVELOPMENT

2.3.1 Co-lead Agency Decision to Prepare an SDEIS

In mid-2010, the Co-lead Agencies decided to prepare an SDEIS that would incorporate a Land Exchange (see Section 2.3.1.1), Cooperating Agency and public comments, evolving MPCA guidance, and project refinements made by PolyMet (see Section 2.3.2.1). The USACE and USFS published a NOI on October 13, 2010 in the FR (Volume 75, Number 197) indicating the intent to prepare the SDEIS. The NOI identified that scoping would be conducted only for the Land Exchange, with no additional scoping for the proposed NorthMet Project because the issues regarding the mine had not changed. The MDNR published a Notice of Amendment to the Scoping Decision in the EQB Monitor on November 1, 2010.

The SDEIS included analyses of both the NorthMet Project Proposed Action and the Land Exchange Proposed Action as a connected action.

2.3.1.1 Addition of the Land Exchange

The USFS determined that an EIS would be required to analyze the Land Exchange Proposed Action. Since the Land Exchange constitutes a connected action to the NorthMet Project Proposed Action, it has been incorporated into the NorthMet Mining Project EIS. The USFS subsequently joined the USACE and MDNR as a Co-lead Agency.

2.3.2 NorthMet Project

2.3.2.1 Project Modifications

Several key decisions made by the Co-lead Agencies following the DEIS prompted PolyMet to make project modifications, which further supported the need for an SDEIS to assess effects resulting from the proposed NorthMet Project.

Starting in January 2010, PolyMet made a number of modifications to the original mine plan. These modifications addressed issues identified in DEIS comments and during agency deliberations. The changes were detailed in a series of documents prepared by PolyMet for Co-lead Agency consideration.

In June 2010, the MPCA issued staff recommendations on the site-specific application of the wild rice standard, which states that 10 milligrams per liter (mg/L) of sulfate be applied to waters used for the production of wild rice; this standard applies from April 1 to August 31 each year for the Partridge and Embarrass river systems. The recommendations were updated in March and June 2011. The MPCA guidance also included Tailings Basin performance requirements regarding seepage discharges, limitations to sulfate contributions in surface waters, and monitoring requirements. In August 2012, the recommendations were updated to apply the seasonal application to just the Partridge River. The recommendations also suggest continuation of monitoring of wild rice.

Topic-focused workgroups were established to discuss key issues that needed to be closely examined in the SDEIS. Workgroup participation was varied and included representatives from the Co-lead Agencies, other regulating agencies, and/or the Cooperating Agencies and PolyMet. These groups participated in the impact assessment planning (IAP) process, which led to the development of work plans for data packages and management plans (MDNR et al. 2011). The workgroups discussed evaluation criteria, methodologies for analysis, potential effects, and possible mitigation measures. Topics addressed by the workgroups included geotechnical stability, wetlands, air resources, and water resources. The water resources group was further divided into four subgroups to address evaluation criteria, groundwater issues, surface water issues, and geochemistry. A socioeconomics workgroup was also established to address tribal concerns regarding potential socioeconomic effects on the Bands from the NorthMet Project Proposed Action.

A Co-lead Agencies workgroup was also established to discuss issues related to the project modifications, alternatives (predominantly the Mine Site and Tailings Basin Alternatives addressed in the DEIS), the wild rice standard, and various mitigation measures identified by the topic-focused workgroups. The discussions, in consultation with PolyMet, resulted in development of the Draft Alternative. In January 2011, the Co-lead Agencies briefed the Cooperating Agencies and other involved agencies on the Draft Alternative. Due to changes in the project, the Draft Alternative was updated, recirculated, and released again in March 2011 and October 2011.

In October 2011, PolyMet incorporated the Draft Alternative into its Proposed Action for the NorthMet Project. As discussed in Section 3.2.3, a full range of reasonable alternatives was evaluated in developing the Draft Alternative.

2.3.2.2 Revised Proposed Action and Alternatives

As described in Section 2.3.2.1 above, the NorthMet Project Proposed Action was modified following the DEIS as a result of input from the public, Cooperating Agencies, and the Co-lead Agencies via the workgroups, and additional modeling and impact analyses. Project modifications incorporated additional mitigation measures designed to meet applicable regulatory standards over the life of the mine.

Given the changes to the NorthMet Project Proposed Action, some previously considered alternatives were deemed no longer valid because:

- they have been incorporated into the current NorthMet Project Proposed Action;
- they do not correspond to the current design of the NorthMet Project Proposed Action; or
- they do not correspond to effects under the current NorthMet Project Proposed Action.

Thus, only those previously considered alternatives that were still relevant were rescreened in the SDEIS. The Underground Mining Alternative and backfilling the West Pit with Category 1 waste rock were deemed necessary for reconsideration and are discussed in Section 3.2.3. Other previously considered alternatives screened throughout the EIS process including during scoping, the DEIS, and the SDEIS are also discussed in Section 3.2.3.

2.3.2.3 Impact Analysis

Similar to the analysis in the DEIS, potential effects of the revised NorthMet Project were determined using probabilistic and/or deterministic modeling programs, GIS and spatial data analysis, and other impact assessment calculations. These predicted effects are described in Chapter 5.

2.3.3 Land Exchange

The USFS and PolyMet developed a Land Exchange proposal by which the federal surface lands at the proposed Mine Site would be transferred to PolyMet ownership in exchange for non-federal lands (to be owned by PolyMet) that would meet the USFS criteria identified in the Forest Plan. Alternatives to the Land Exchange proposal, including the No Action Alternative, were developed and analyzed in the SDEIS.

A feasibility analysis, completed by the USFS in November 2009, assessed the potential for a land exchange between the USFS and PolyMet that would involve the federally owned parcel on which the NorthMet Project Mine Site is proposed. The feasibility analysis evaluated one federal tract (encompassing much of the proposed Mine Site) and two non-federal tracts for conformance with the Forest Plan, which included current and future uses of the land tracts. A preliminary monetary valuation indicated that additional parcels would be needed to bring the market value of federal and non-federal lands within the limits required for an exchange. The analysis also determined that additional parcels would be needed to supplement the amount of wetland acres being exchanged in order to meet the requirements of EO 11990. Three non-federal tracts were subsequently added for consideration in the Land Exchange Proposed Action. These tracts were evaluated for conformance by the same criteria used in the feasibility analysis.

2.3.3.1 Land Exchange Scoping

As discussed in Section 2.3.1, the USACE and USFS published an NOI to prepare an SDEIS; this NOI discussed both the intent to prepare an SDEIS, which would supplement the DEIS, and the inclusion of the Land Exchange Proposed Action as a connected action. The NOI identified that the comment period would be held for 45 days and provided notification that scoping comments were limited to the Land Exchange Proposed Action.

Open house scoping sessions were held in Aurora, Minnesota on October 26, 2010 and in New Brighton, Minnesota, on October 27, 2010. At each open house, representatives from the USFS, USACE, MDNR, PolyMet, and the Co-lead Agencies' third-party consultant provided information on the NEPA process, the NorthMet Project Proposed Action and Land Exchange Proposed Action, and how to provide scoping comments.

2.3.3.2 Identification of Issues

Similar to the scoping for the DEIS, the Land Exchange scoping process was used to identify potentially significant issues, less significant issues, and issues considered but eliminated from further consideration as discussed in Appendix G of the May 2011 Detailed Scoping Report for the PolyMet Land Exchange (USFS 2011n).

Potentially significant issues identified included the development of exchange alternatives, tribal access rights, and federal trust obligations. These issues are discussed in detail in Chapter 5 of the FEIS.

Other issues identified in scoping for the Land Exchange included air quality, climate change, cultural/tribal concerns, cumulative effects, ecological functions and values, forest resources, hazardous materials, market value and legal implications, conformance with the Forest Plan, socioeconomics, threatened and endangered species, vegetation and wildlife habitat, water resources, and wetland effects.

Issues considered but eliminated from further consideration included mining-related effects, as these would be discussed as part of the mining action; corporate profits resulting from the Land Exchange; land value disclosures; and adequacy of scoping materials.

2.3.3.3 Proposed Action and Alternatives

A Proposed Action for the Land Exchange was developed that identified potential lands for exchange (see Section 3.3.2 for a description of the federal and non-federal parcels).

Several alternatives to the Land Exchange Proposed Action were identified, including the No Action Alternative required by NEPA and MEPA. The USFS evaluated these alternatives for detailed analysis in the SDEIS based on criteria including conformance with the Purpose and Need statements from the project proponent and Co-Lead Agencies, technical and economic feasibility, land availability, and potential environmental benefits. Further detail on the screening process is available in Section 3.3.3.

Along with the No Action Alternative, only the Land Exchange Alternative B met these criteria and is fully analyzed in the FEIS. The remaining alternatives—exchange of a single contiguous non-federal parcel, underground mining and other alternative methods of mineral extraction, exchange of other non-federal parcels, and full land exchange with deed restrictions—did not meet these criteria and were eliminated from detailed analysis in the EIS.

2.3.3.4 Impact Assessment

The USFS identified resource topic-specific issues, effects, area(s) of analysis, impact indicators, data needs, and analysis methods for assessment of the Land Exchange. These topics, along with assessment results, are discussed in Chapter 5.3 of the FEIS.

2.3.4 SDEIS Publication

The SDEIS was made available to the public through notification in the December 9, 2013 EQB Monitor (Volume 37, Number 25) and December 13, 2013 (Volume 78, Number 240) Federal Register (FR). The notification informed the public that paper copies of the SDEIS were available for review at MDNR offices and public libraries in Grand Rapids, Hibbing, Hoyt

Lakes, Babbitt, Duluth, Minneapolis, and St. Paul. Executive Summaries of the document and compact disks containing the full version of the SDEIS were provided upon request, and the entire document was also made available via the MDNR's website. Executive Summaries or full copies on paper or disk were distributed to parties on the MEQB distribution list as well as additional interested parties.

2.3.5 Comment Period and Public Meetings

The MEQB notification also identified that the 90-day comment period would end on March 13, 2014. Instructions and contact information were provided for submittal of public comments.

Following the release of the SDEIS, public meetings were held in Duluth, Minnesota, on January 16, 2014, Aurora, Minnesota, on January 22, 2014 and St. Paul, Minnesota, on January 28, 2014, to gather public comments on the SDEIS.

2.3.6 Receipt and Review of Public and Agency Comments

Public and agency comments on the SDEIS were collected during the 90-day comment period. Submissions came from federal, state, and local government agencies, tribal entities, local businesses, non-governmental organizations, private individuals, and PolyMet. Approximately 58,000 comment submissions were received by the Co-lead Agencies during the 90-day comment period.

Each submission was reviewed and individual unique comments were identified. The comments were then grouped into relevant topic areas and further categorized into comment themes. This process is described in more detail in Appendix A.

2.4 FEIS DEVELOPMENT

2.4.1 Consideration of Public Comments Received on the SDEIS

The SDEIS comments were considered and addressed through FEIS text edits and clarifications, project design modifications, and updated analysis where deemed appropriate. The comment themes and each individual Cooperating Agency comment received were also responded to. A description of the process taken to consider, manage, and respond to the submissions, comments, and themes, as well as copies of the comments, themes, and responses are provided in Appendix A.

2.4.2 NorthMet Project Modifications

Comments received on the SDEIS highlighted some areas where project modifications could be made to enhance the environmental performance of the NorthMet Project Proposed Action. Under advisement from the Co-lead Agencies, PolyMet made several engineering design modifications to the NorthMet Project Proposed Action based on updated business needs, and to address comments received on the SDEIS. The project modifications were:

- adding a water containment system on the east side of the Tailings Basin to capture potential future seepage in that area;
- adding in semi-autonomous grinding (SAG) mill to the plant site for more energy efficient ore grinding process;

- adding cement deep soil mixing component to strengthen the existing LTVSMC Tailings Basin prior to using that facility for the NorthMet tailings;
- removing the coal ash landfill located within the proposed Tailings Basin footprint; and
- treating water from Colby Lake prior to its use as stream augmentation.

These project modifications were considered by the Co-lead Agencies as being generally beneficial to the environmental performance of the NorthMet Project Proposed Action and did not represent a significant change in the project design.

2.4.3 Changes to the SDEIS and Preparation of the FEIS

Consistent with NEPA and MEPA, the Co-lead Agencies revised the SDEIS to address substantive comments received on the draft statement and minor project modifications made by the proposer, described in Section 2.4.2, which resulted in updated data and analyses for the FEIS. These changes, however, are not considered to be substantial and have not resulted in new conclusions or resulted in any new significant impacts. The methodology used for the analysis was consistent with that in the SDEIS. These predicted effects are described in Chapter 5 for direct and indirect impacts of the NorthMet Project Proposed Action and Land Exchange Proposed Action and in Chapter 6 for cumulative impacts. Appendix A of the FEIS contains the SDEIS public comments, comment themes, and theme responses, as well as the responses to the DEIS comment themes.

2.5 ADEQUACY DETERMINATION/RECORDS OF DECISION

Following release of the FEIS:

- The MDNR will make a determination on the adequacy of the FEIS, per *Minnesota Rules*, Part 4410.2800. This determination will be included in the MDNR's Adequacy Decision.
- The USACE will issue a ROD on the applicant's Department of the Army (DA) permit application pursuant to Section 404(b)(1) of the CWA. Under NEPA, per 33 CFR 230.19(d), comments on the FEIS will be addressed in the USACE ROD only if substantive issues are raised which have not been addressed in the FEIS.
- The USFS will issue a ROD on the Land Exchange once any objections filed per 36 CFR 218 (updated from the previous appeals process per 36 CFR 215) are resolved. Individuals and entities who provide specific written comment as defined in § 218.2 during scoping or the comment period will be eligible to participate in the objection process. For more information on the objection process, see www.fs.usda.gov/goto/superior/projects.

2.6 PROJECT PERMITTING

Information (data, analyses, and assessments) being generated during the EIS process is an integral part of the permitting process. There may be multiple permit applications for the NorthMet Project and they would be processed in various timeframes and under various procedures, often including detailed information beyond that required in an EIS. Although permits may be publicly noticed during the EIS process, deeming an EIS adequate does not guarantee issuance of the permits. In general, once the permitting authority receives its complete permit application, permits are public noticed for review. Following public comment periods, meetings and/or hearings, permit determinations could be made by the permitting authorities.

Permits and approvals for the NorthMet Project would involve detailed review of regulatory compliance with local, state, and federal rules, statutes, and guidance. Below are some of the major permitting efforts and coordination and consultation processes required for the NorthMet Project:

- MDNR:
  - Permit to Mine
  - Water Appropriations
  - Dam Safety
  - Wetland Replacement Plan
- MPCA:
  - NPDES/SDS Permit covering the Mine Site and Plant Site that addresses state and federal permitting rules, that at a minimum includes the following components:
    - "reasonable potential" analyses for applicable discharges;
    - development of effluent limits for applicable discharges taking into account applicable water quality standards for immediate receiving waters and downstream waters;
    - a non-degradation analysis, where applicable;
    - monitoring requirements for wastewater discharges, groundwater, surface water, and internal wastewater streams, as appropriate;
    - Industrial stormwater requirements; and
    - an evaluation of state and federal rules related to the transfer of portions of existing Cliffs Erie (former LTVSMC) permits.
  - Air Emission Permit
  - NPDES Construction Storm Water Permit
  - Storage Tank Permit
  - Solid Waste Permit
  - Section 401 Certification (water quality)
- USACE:
  - Section 404 CWA Permit (wetlands)
  - Section 106 Consultation
  - Section 7 Endangered Species Act

- USFS:
  - Land Exchange
  - Section 106 NHPA Consultation
- USFWS:
  - Section 7 Endangered Species Act

2.7 FINANCIAL ASSURANCE

Per the State Permit to Mine, financial assurance would be required to ensure a source of funds that could be used by the MDNR in the event that PolyMet fails to complete closure and reclamation activities. Reclamation and post-reclamation cost estimates must be updated on an annual basis to account for the activities completed during the previous year. Estimates must be made for the contingency funds required in the event of unplanned closure during the course of the year.

Per *Minnesota Rules*, part 6132.1200, subparts 4 and 5, the financial assurance instruments for the NorthMet Project Proposed Action must be approved by the MDNR and be available to the MDNR when needed. The level of engineering design and planning required to calculate detailed financial assurance amounts is typically made available during the permitting process. Section 3.2.2.4.2 provides further discussion on the applicable financial assurance for the NorthMet Project.

Additionally, financial assurance for wetland mitigation may be required. Section 5.2.3 presents additional information relative to such mitigation measures.

3.0 PROPOSED ACTION AND ALTERNATIVES

3.1 INTRODUCTION

The NorthMet Project and Land Exchange areas are located in northeastern Minnesota (see Figure 1.1-1). The NorthMet Project area is located on the Mesabi Iron Range in St. Louis County. The Boundary Waters Canoe Area Wilderness (BWCAW) and Voyageurs National Park are approximately 20 miles north and 50 miles northwest, respectively, of the NorthMet Project area. The NorthMet Project area is within the St. Louis River (Lake Superior) Watershed, which ultimately drains to Lake Superior. This area is located on lands acquired by the United States on September 30, 1854, when the Chippewa of Lake Superior ceded ownership of the land to the United States. These lands are often referred to today as the 1854 Ceded Territory.

Current land use in the region includes mining, forestry, urban development, and recreation on a mixture of private and public land. The NorthMet Project Proposed Action would be the first copper-nickel-PGE mine in Minnesota, though feasibility studies are underway for other potential copper-nickel-PGE mines. However, as shown in Figure 1.1-2, commercial mining has been undertaken in northeastern Minnesota since the late of the 19th century when iron ore (hematite and later taconite) was discovered on the Vermilion, Mesabi, and Cuyuna ranges. The development of open pit mines and processing facilities, supported by the development of many small towns, has facilitated continued iron ore/taconite mining over the last century. Today, only the Mesabi Range is actively mined for iron ore/taconite, though several copper/nickel mines are undergoing feasibility studies in this area.

Section 3.1 summarizes the NorthMet Project Proposed Action and alternatives as well as the Land Exchange Proposed Action and alternatives. The NorthMet Project Proposed Action is described in detail in Section 3.2.2, and the alternatives, including reconsideration of alternatives from the DEIS, are described in Section 3.2.3. The Land Exchange Proposed Action is described in Section 3.3.2, and the alternatives are described in Section 3.3.3. The affected environment and the potential environmental consequences are addressed in subsequent chapters in this FEIS.

3.1.1 *NorthMet Project Overview*

The NorthMet Project Proposed Action has three major components: a Mine Site, a Transportation and Utility Corridor, and a Plant Site comprising the following three phases:

- Construction, which would last for approximately 18 months and would include land clearing, building renovation and construction, stockpile construction, and utility upgrades.
- Operations, which would last approximately 20 years and would include ore mining and processing, continued construction, and progressive reclamation (at the same time as mining).
- Reclamation, closure, and post-closure maintenance, which would last for an unknown duration and would occur after mining, and would include infrastructure removal and final land reclamation, maintenance, monitoring, and transitioning from mechanical to non-mechanical water treatment if or when proven effective.

An overview of the NorthMet Project Proposed Action layout, operations, closure, and alternatives is provided below.

3.1.1.1 *Site Preparation and Construction Overview*

In preparation, existing vegetation would be cleared from sites where mining would take place and where infrastructure would be built. Overburden (i.e., the soils and rocks overlying bedrock or ore) would be removed from the mine pits and as required from foundations of stockpiles, infrastructure, and haul roads. Buildings and infrastructure would be constructed on site.

Existing facilities at the former LTVSMC processing plant would be refurbished to working order. New processing buildings would be constructed to further refine the copper-nickel-PGE ores—a process different from that utilized for taconite previously processed at the facility. Construction would occur for approximately 18 months prior to the start of mining.

3.1.1.2 *Mine Site Layout Overview*

The NorthMet Project Proposed Action includes several new facilities necessary to manage the material removed from three mine pits: the East Pit, Central Pit, and West Pit. Infrastructure at the Mine Site would include haul roads, a temporary ore storage pile, a rail-loading facility, water-containment systems, a Waste Water Treatment Facility (WWTF), temporary and permanent waste rock stockpiles, and an overburden stockpile. Waste rock that has a low potential to contaminate water would be stored mostly in a permanent stockpile, with some being backfilled into the empty mine pits when they become available. Waste rock with a high potential to contaminate water would be temporarily stored in lined stockpiles, then moved permanently into the empty East and Central pits.

3.1.1.3 *Mine Operations Overview*

The mining operations would involve the use of conventional surface mining methods, such as blasting and excavating rock from the NorthMet Deposit, a low to medium quality copper-nickel-PGE deposit with a low sulfide content. The East Pit and West Pit would be mined simultaneously through the first 11 years of the mine life. Mining would cease at the East Pit at approximately year 11 and continue at the West Pit until year 20. The Central Pit would be mined between years 11 and 16 and would ultimately combine with the East Pit. The maximum depths of the pits below the original surface level would be 696 ft for the East Pit (at year 11), 356 ft for the Central Pit (at year 16), and 630 ft for the West Pit (at year 20).

The ore, waste rock, and overburden would be transported by truck within the Mine Site via a series of haul roads. Ore would be hauled to a rail-loading facility for transport to the Plant Site. The waste rock would be sorted into four categories based on its potential to contaminate water—Category 1 waste rock would have a low potential and Category 4 waste rock would have a high potential.

Until the completion of mining in the East Pit (approximately year 11), waste rock would be hauled to the following stockpiles at the Mine Site:

- Permanent Category 1 Stockpile;
- Temporary Category 2/3 Stockpile; or
- Temporary Category 4 Stockpile.

After year 11 (that is, at the completion of mining at the East Pit), the waste rock in the temporary stockpiles would be moved into the East Pit. Waste rock generated from ongoing mining in the West Pit and Central Pit after year 11 would be directly disposed of in the East Pit. Some Category 1 waste rock would continue to be placed on the Category 1 Stockpile until year 13.

Water control systems would be constructed to capture water that has contacted surfaces disturbed by mining operations, as well as water collected on stockpile liners (i.e., process water). Process water would be treated at a treatment facility located at the Mine Site and either pumped via a Central Pumping Station to the Plant Site for discharge to the Tailings Basin, or used to supplement flooding of the East Pit after year 11.

3.1.1.4 *Transportation and Utility Corridor Overview*

The Mine Site would be connected to the Plant Site, located approximately 7 to 8 miles to the west, by an approximately 7- to 8-mile-long Transportation and Utility Corridor that would contain the following:

- A private railroad consisting of new spurs that would connect the Mine Site and Plant Site to the existing Cliffs Erie, LLC (Cliffs Erie) private railroad and would be used to transport ore from the Mine Site to the Plant Site;
- An existing segment of the private Dunka Road that would provide vehicle access between the Mine Site and the Plant Site (separate from the railroad);
- New water pipeline that would be constructed along Dunka Road to transport water between the Mine Site and the Plant Site; and
- New transmission lines that would be constructed along a portion of Dunka Road near the Mine Site.

3.1.1.5 *Plant Site Layout Overview*

Some facilities at the former LTVSMC processing plant would be refurbished and new facilities would be added for the Plant Site. The existing infrastructure at the Plant Site includes roads, railroads, maintenance facilities (shops), electrical transmission lines, sanitary and potable water treatment facilities, coarse- and fine-crusher buildings, and a concentrator building. New construction would include the Hydrometallurgical Plant, oxygen plant, flotation buildings, pipelines, concentrate dewatering, storage and load out buildings, and a Waste Water Treatment Plant (WWTP).

The existing LTVSMC Tailings Basin would be used as the base for NorthMet Project Proposed Action tailings disposal. The existing LTVSMC Tailings Basin consists of three areas: Cell 1E, Cell 2E, and Cell 2W. Cell 2W, the most built-up cell, is located on the western half of the existing LTVSMC Tailings Basin and is not proposed for use as part of the NorthMet Project Proposed Action. A containment system would be installed around the northern, western, and portions of the eastern sides of the Tailings Basin. Improvements would be made to the existing containment system to the south. To enhance stability of the existing tailings prior to the placement of NorthMet tailings, cement pillars would be installed (i.e., CDSM) in the existing tailings and peat layers in the northern dams of the LTVSMC Tailings Basin. Additionally, the northern embankment of Cell 2E and southern embankments of Cell 1E of the existing LTVSMC Tailings Basin would be reinforced with a rock buttress.

A Hydrometallurgical Residue Facility would be constructed to contain residue from hydrometallurgical processing. This facility would be built at the existing LTVSMC Emergency Basin, immediately southwest of Cell 2W at the Tailings Basin. The Hydrometallurgical Residue Facility would have a double geomembrane liner, with a leachate collection system between the liners. A Geosynthetic Clay Liner would be installed above the lower geomembrane liner.

3.1.1.6 *Plant Operations Overview*

Once mined, the ore would be shipped to the Plant Site by rail, to be crushed and processed. Processing would involve concentration in a new flotation building to separate metallic sulfide minerals (ore concentrate) from feldspar and other non-ore minerals (tailings).

Then, the ore concentrate either would be dewatered and shipped off-site as copper and nickel concentrate final products, or the nickel concentrate would be processed in an autoclave at the Hydrometallurgical Plant and base/precious metal precipitates would be produced; these precipitates would be shipped off-site as final products. Based on the anticipated rate of mining, annual production post-processing would total about 113,000 short tons of copper concentrate, 18,000 short tons of mixed (nickel/cobalt) hydroxide, and 500 short tons of gold and PGE precipitate.

After passing through a scavenger flotation cycle to remove as many sulfide minerals as possible, the tailings would be transferred as slurry to the Tailings Basin. The tailings would be deposited on top of Cell 1E and Cell 2E at the existing LTVSMC Tailings Basin and, at completion, would be approximately the same height as the existing Cell 2W. Bentonite would be incorporated into the exposed outer side-slopes of the Tailings Basin as it would be built up to create a barrier that would limit oxidation. This limiting of oxygen transfer would reduce pollutants generated from the Tailings Basin.

Water seepage from the Tailings Basin would be collected by the containment system and sent to either the Tailings Basin pond or the Plant Site WWTP. Treated water from the WWTP would be discharged to maintain flows in the streams that would be affected by the Tailings Basin containment system. The waste (residue) from the Hydrometallurgical Plant would be transferred to the lined Hydrometallurgical Residue Facility. Water captured by the liner system during operations would be returned to the Hydrometallurgical Residue Facility pond.

3.1.1.7 *Project Closure Overview*

In general, proposed facilities have been designed and would be operated to allow for concurrent reclamation, which would include backfilling the East Pit once it was exhausted (after year 11 of mining) using waste rock generated through mining beyond year 11 and relocating waste rock from the temporary waste rock stockpiles. Undertaking reclamation concurrently with mining would reduce the effort and cost of final closure and is required by rule. The Category 1 Stockpile would also be covered starting in year 14, after it is completed in year 13.

Mining is expected to be completed approximately 20 years after operations begin. In anticipation, PolyMet would prepare a mining and reclamation plan as part of the Permit to Mine application. The mining and reclamation plan would include planned scheduling and costing for closure and post-closure activities. At closure, PolyMet would first remove all unnecessary infrastructure and facilities, then reclaim disturbed lands. Reclamation objectives would include rapidly establishing a self-sustaining plant community, controlling dust, controlling soil erosion, providing wildlife habitat, and minimizing the need for maintenance. Post-closure activities would include monitoring and maintenance of reclamation and operation of mechanical water-treatment infrastructure until facility features were deemed environmentally acceptable in a self-sustaining and stable condition (refer to Sections 3.2.2.1.10, 3.2.2.3.12, and 3.2.2.4).

The water quality objective of closure is to provide mechanical or non-mechanical treatment for as long as necessary to protect regulatory standards at applicable groundwater and surface water compliance points. Water quality modeling performed in support of this FEIS indicates that water treatment systems would be needed indefinitely at the Mine Site and Plant Site. The water models constructed to assess the potential effects from the NorthMet Project Proposed Action were not designed to predict the duration of treatment nor do they capture all the factors that influence the duration of treatment (e.g., potential future regulatory and technological changes). Therefore, the models cannot be used to predict when treatment would end. Actual treatment requirements would be assessed on a recurring basis throughout operations, reclamation, and closure considering influent and effluent water quality and monitoring results. Those periodic assessments would be carried out to ensure continuous protection of groundwater and surface water quality and compliance with water quality-based effluent limits. The periodic assessment process would rely on monitoring results coupled with predictive modeling rather than the results of the predictive modeling alone. Regardless of the precise duration of effects or water treatment at either the Mine Site or Plant Site, there are measures available to address impacts to natural resources, such as those identified in the Adaptive Water Management Plan (PolyMet 2015d) and permit conditions. PolyMet would be held accountable for maintenance and monitoring required under the permit and would not be released from financial assurance until all permit conditions have been met. PolyMet would be required to provide financial assurance to MDNR (managed independently) for closure and maintenance costs as a contingency if PolyMet or the operating company at that time were unable to fulfill the obligations under the Permit to Mine.

3.1.1.8 *NorthMet Project Proposed Action Alternatives Overview*

The NorthMet Project Proposed Action incorporates activities and environmental impact mitigation measures that have been evaluated through the EIS process. In addition, a number of alternatives and mitigation measures were identified and considered through the EIS process and were either:

- Incorporated into the NorthMet Project Proposed Action as they offered benefits to the outcomes of the NorthMet Project Proposed Action; or
- Eliminated from detailed evaluation because they did not offer measurable or substantial environmental benefits over other alternatives (including the NorthMet Project Proposed

Action), they were not reasonable (i.e., they were not economically or technically feasible in accordance with CEQ guidelines), or would not meet the Purpose and Need.

As a result of screening and analysis, the NorthMet Project No Action Alternative (i.e., the NorthMet Project Proposed Action would not occur) is the only alternative evaluated in detail in this FEIS.

3.1.2 *Land Exchange Overview*

The Land Exchange Proposed Action includes undertaking a land exchange of 6,650.2 (GLO) acres of federal land with up to 6,722.5 (GLO) acres of privately owned land of a combined equal value, located within the 1854 Ceded Territory in Minnesota.

The federal land for the Land Exchange Proposed Action consists of a single contiguous area of land located within the Laurentian Ranger District approximately 6 miles south of the City of Babbitt in St. Louis County in northeastern Minnesota. It was acquired by the United States under the authority of the Weeks Act of 1911 and is managed by the USFS.

The federal lands are located adjacent to historic mining projects on the Mesabi Iron Range and are mostly surrounded by privately held land used for mining and other industrial purposes; portions of the east and southwest areas of the federal lands are bordered by Superior National Forest lands. The surface lands are located above the NorthMet Deposit. PolyMet leases the NorthMet Deposit's private subsurface mineral rights. However, under the Weeks Act of 1911, the USFS is restricted from allowing, by decision, surface mining on federal land, such as that proposed by PolyMet. The Land Exchange Proposed Action would unite surface and mineral rights on the federal lands and is therefore considered to be a connected action to the NorthMet Project Proposed Action. Please refer to Section 1.3.2.2 for more information on the USFS Purpose and Need for the Land Exchange Proposed Action.

The Land Exchange Proposed Action would include up to five tracts of non-federal lands in St. Louis, Lake, and Cook counties that would comprise up to 6,722.5 acres (GLO); however, the final exchange, if approved, could include fewer than 6,722.5 acres (GLO) of non-federal land depending on the results of the environmental analysis and real estate appraisals. All of the lands proposed for exchange are located throughout the 1854 Ceded Territory of northeastern Minnesota. Appraisal reports completed in 2013 indicate that the Land Exchange Proposed Action would meet federal value requirements if all five non-federal land tracts (6,722.5 (GLO) acres) offered by PolyMet would be exchanged for 6,650.2 (GLO) acres of federal land. If the ROD approves the Land Exchange Proposed Action, a current appraisal approved by the USFS would be required to verify equal value. Appraisals must conform to Uniform Appraisal Standards for Federal Land Acquisitions and the Uniform Standards of Professional Appraisal Practice of the Appraisal Foundation. The final proposed configuration of land would be determined after the market value of the parcels is determined by appraisals and the environmental analysis has been completed. This information would be presented in the ROD.

3.1.2.1 *Land Exchange Proposed Action Alternatives Overview*

Two alternatives to the Land Exchange Proposed Action, the Land Exchange Alternative B and Land Exchange No Action Alternative, are evaluated in detail in this FEIS. Land Exchange Alternative B would convey fewer acres of federal lands for fewer acres of non-federal land. Other alternatives were considered but eliminated from further analysis because they did not meet the screening criteria. These included a direct purchase alternative, exchange of a single contiguous federal parcel, exchange of other non-federal lands, exchange of only the federal lands needed for the NorthMet Project Proposed Action, exchange of lands with use restrictions, and underground mining for the NorthMet Project Proposed Action, which would eliminate the need for a land exchange.

3.2 NORTHMET PROJECT DETAILED DESCRIPTION

3.2.1 *Overview*

The NorthMet Project Proposed Action includes three major components: a Mine Site, Transportation and Utility Corridor, and a Plant Site. These areas are shown in Figure 3.2-1. Figure 3.2-2 shows a schematic diagram of the main activities and flow of material. The NorthMet Project Proposed Action would incorporate activities and environmental impact mitigation measures that have been evaluated through the EIS process with the benefit of public review and comment. The NorthMet Project Proposed Action would involve the following:

- Development of a 20-year open pit mine at the NorthMet Deposit (Mine Site).
- Copper-nickel-PGE ore processing at an upgraded former LTVSMC processing plant (Plant Site).
- Transportation of ore and other materials using existing road, existing and new rail infrastructure, and a new water pipeline between the Mine Site and Plant Site (Transportation and Utility Corridor).
- Construction of permanent features, including the following, described in post-reclamation state:
  - One backfilled pit (filled with the most reactive rock for underwater storage);
  - One flooded mine pit;
  - One capped waste rock stockpile;
  - A reclaimed Hydrometallurgical Residue Facility (over an existing brownfield site); and
  - A bentonite-covered Tailings Basin with pond (over an existing Tailings Basin).
- Construction of temporary features that would be removed and/or reclaimed before or at closure, including:
  - Two lined waste rock stockpiles (removed and reclaimed);
  - An Overburden Storage and Laydown Area (reclaimed); and
  - Roads and other ancillary infrastructure (removed and/or reclaimed).
- Engineered water management controls including:
  - Fixed liners on temporary stockpiles;
  - Fixed containment systems and surface seepage management systems encompassing a permanent stockpile and Tailings Basin to capture groundwater and surface seepage from those facilities;

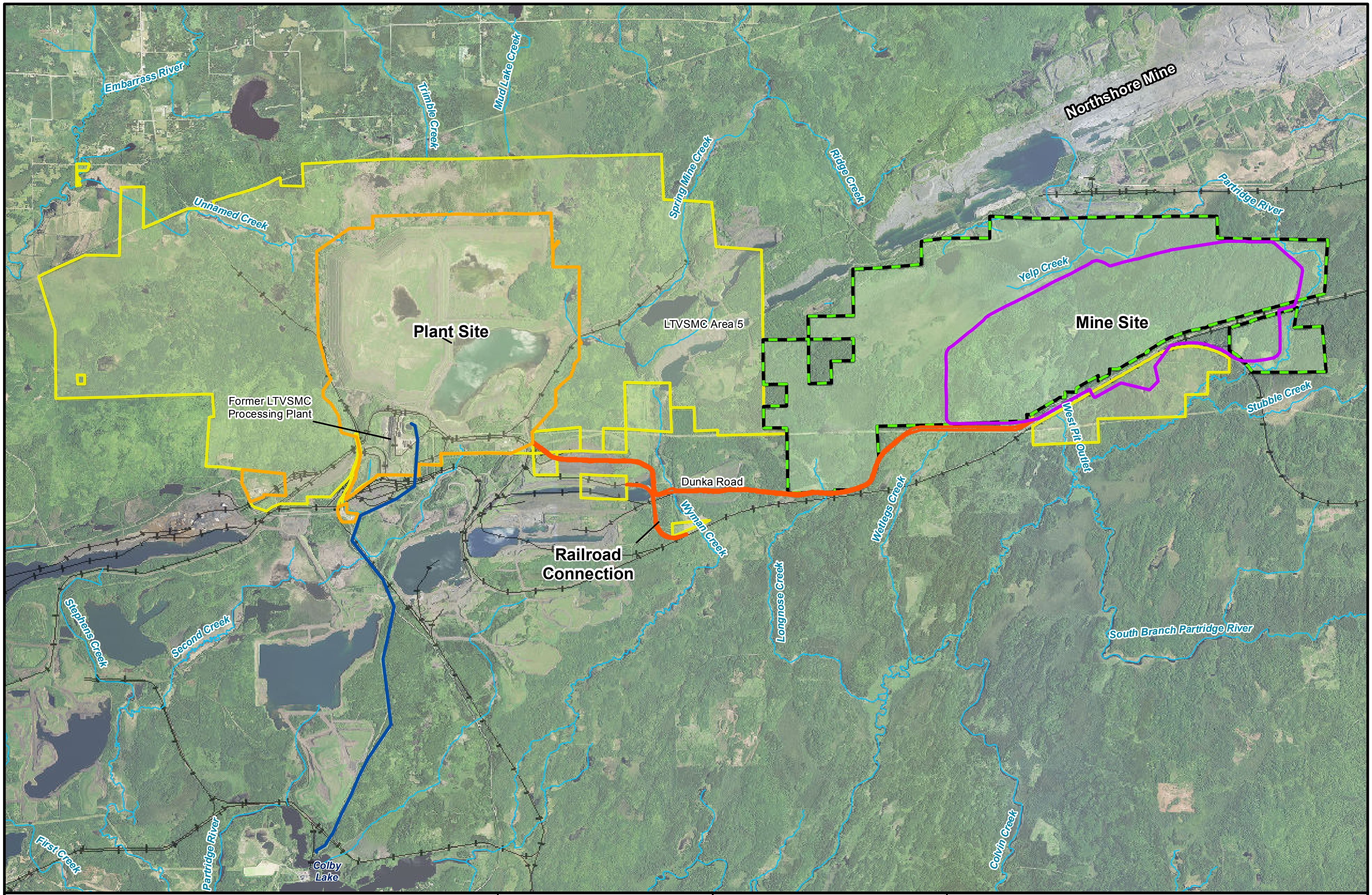
   - Leachate collection system under the Hydrometallurgical Residue Facility;
   - Mine Site WWTF and Plant Site WWTP to treat contaminated waters;
   - An updated sewage treatment system; and
   - Covers on the permanent stockpile and Tailings Basin applied at closure that could be adapted to alter water infiltration as needed.
- Long-term, post-closure monitoring and adaptive management involving mechanical treatment for as long as required until if and when non-mechanical treatment is proven at the site, for affected water from the pits, permanent stockpile, Hydrometallurgical Residue Facility, and Tailings Basin.

A number of alternatives have been evaluated and either incorporated into the NorthMet Project Proposed Action by the applicant, or eliminated in accordance with NEPA and MEPA on the basis of not being reasonable or not having the potential to offer substantial environmental benefit. These alternatives are discussed in Section 3.2.3.

Ultimately, the NorthMet Project No Action Alternative was the only alternative evaluated in detail in this FEIS for reasons detailed in Section 3.2.3. Under the NorthMet Project No Action Alternative:

- NorthMet Project Proposed Action activities would not occur;
- Public land would continue to be managed by the USFS, and private land would continue to be managed under private ownership; and
- The former LTVSMC processing plant and the existing LTVSMC Tailings Basin would be managed and closed as required under the state permits and plans, and Consent Decree (State of Minnesota v. Cliffs Erie, LLC 2010).

A summary of the NorthMet Project Proposed Action and the NorthMet Project No Action Alternative is provided in Table 3.2-1. See Section 3.2.3 for a discussion of alternatives development and alternatives considered for the NorthMet Project but eliminated from detailed analysis. Alternatives for the Land Exchange are discussed in Section 3.3.3.



Federal Lands
PolyMet Owned/Leased Area
Mine Site
Plant Site
Colby Lake Water Pipeline Corridor
Transportation and Utility Corridor
Stream/River

US Army Corps of Engineers
St. Paul District

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N E S W

0 0.5 1 2 Miles

Figure 3.2-1
NorthMet Project Area Surface Rights
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

302

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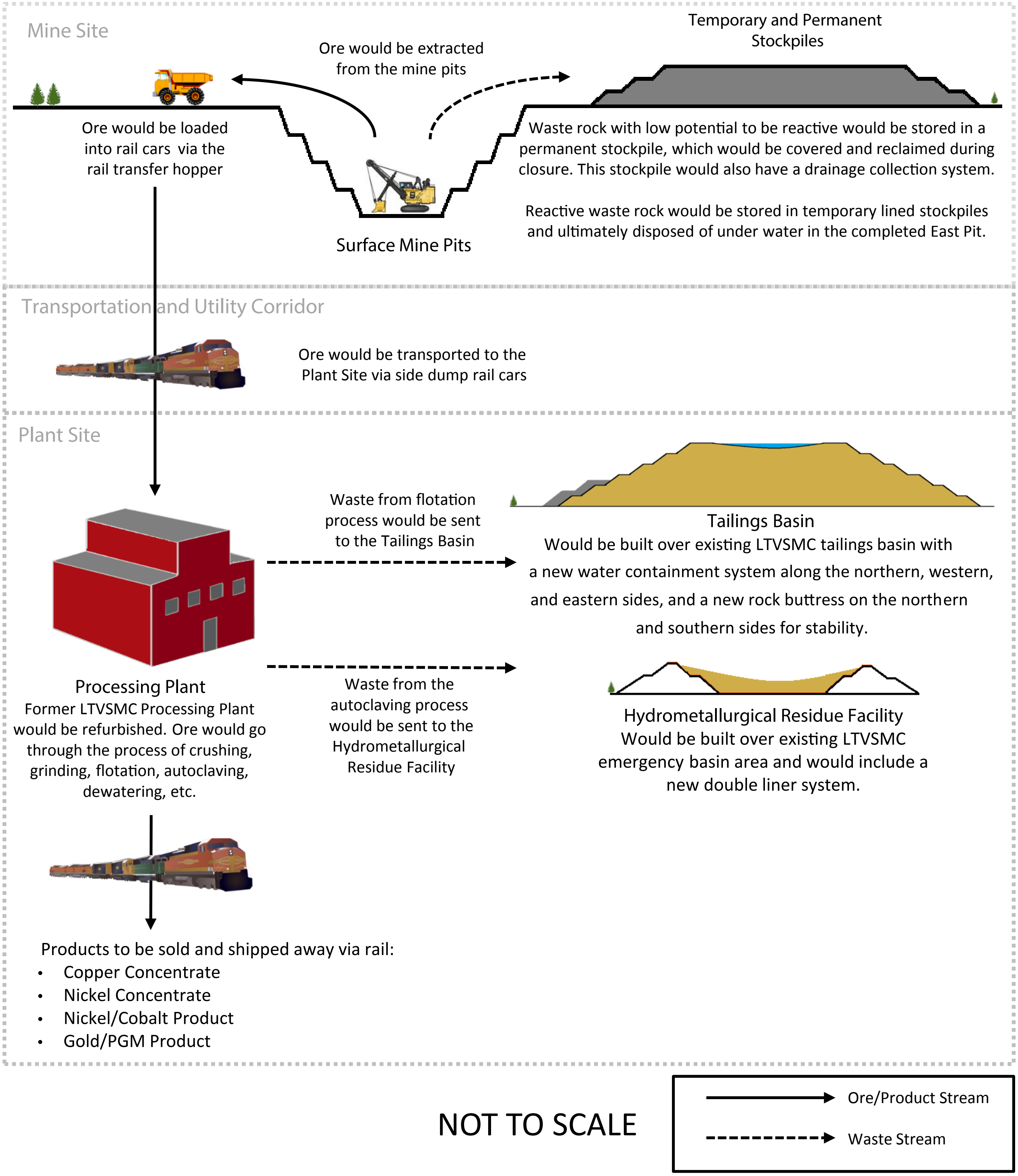

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Figure 3.2-2
NorthMet Project Material Flow
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

304 -Page Intentionally Left Blank-

Table 3.2-1 Summary of the NorthMet Project Proposed Action and the NorthMet Project No Action Alternative

Project Component	Location and Existing Land Use	NorthMet Project Proposed Action	NorthMet Project No Action Alternative
Mine Site	• Undeveloped federal land located 0.5 mile south of the Northshore Mine and 7 miles east of the former LTVSMC processing plant • Surface lands are publicly owned by the USFS • Mineral rights are privately held	• Development of three open pits that, upon closure, would include one backfilled pit wetland and one flooded pit void • Construction of one permanent and two temporary waste rock stockpiles, overburden stockpile, and a temporary Ore Surge Pile • Construction and operation of a WWTF, a Rail Transfer Hopper, and other Mine Site support infrastructure • Treatment of water prior to discharge for as long as required in accordance with permit conditions (mechanical treatment until if and when non-mechanical treatment is proven)	• No mining • Continued management of public land by USFS or private ownership (see Table 3.3-1)
Transportation and Utility Corridor	• Privately owned rail and road (Dunka Road) infrastructure • Generally runs east-west from the southern edge of the Mine Site to Plant Site	• Refurbishment and additions to an existing Transportation and Utility Corridor including: • refurbished railway, • refurbished Dunka Road, • new rail spur, • new rail connection track, and • new water pipeline • To be used to transport materials and ore between the Mine Site and the Plant Site	• Continued private ownership and use
Plant Site	• Privately owned, inactive plant infrastructure (formerly the LTVSMC processing plant site) and Tailings Basin •	• Refurbishment and additions to existing mineral processing facilities at the former LTVSMC processing plant • Tailings disposal on existing Tailings Basin Cells 1E and 2E • Construction of additional dams with LTVSMC tailings on top of the existing Tailings Basin Cells 1E and 2E with bentonite on the outer slopes and CDSM and Rock Buttress for added stability • Construction of Tailings Basin containment system around the base of the Tailings Basin • During closure, addition of a bentonite layer on top of the Tailings Basin to restrict oxygen and water infiltration from the pond • Hydrometallurgical residue disposed of at a new Hydrometallurgical Residue Facility constructed over the existing LTVSMC Emergency Basin • During closure, Hydrometallurgical Residue Facility to be drained, covered, and reclaimed/revegetated	• Brownfield site managed and closed as required under state permits and plans and Cliffs Erie Consent Decree

Project Component	Location and Existing Land Use	NorthMet Project Proposed Action	NorthMet Project No Action Alternative
		• Construction of a WWTP that would discharge water to Plant Site tributaries. • Treatment of water captured from the Tailings Basin and the Hydrometallurgical Residue Facility to continue as long as required in accordance with permit conditions (mechanical treatment until if, and when non-mechanical, passive treatment is proven)	

3.2.2 *NorthMet Project Proposed Action*

The description of the NorthMet Project Proposed Action in the following sections is broken down into the main project components: the Mine Site (see Section 3.2.2.1), Transportation and Utility Corridor (see Section 3.2.2.2), and Plant Site (see Section 3.2.2.3). Financial assurance also forms part of the NorthMet Project Proposed Action and is discussed in Section 3.2.2.4.

The NorthMet Project Proposed Action has been defined by PolyMet Project Description Version 9 (PolyMet 2015a) and includes design elements and mitigation measures identified in the management plans described below. These management plans are preliminary in nature and would be adjusted as appropriate during final design and permitting. The mitigation measures contained within these plans are treated as part of the NorthMet Project Proposed Action.

- Mine Plan (PolyMet 2014q): Describes the site development (infrastructure and facilities), pit development, and mine operations including mining rates and locations to supply ore from the Mine Site to the Plant Site, as well as overburden and waste rock management plans.
- Wetland Management Plan (PolyMet 2015c): Describes the on- and off-site wetland mitigation design, wetland mitigation outcomes, and monitoring and reporting procedures.
- Air Quality Management Plan – Mine (PolyMet 2014m): Describes the emission control systems for point and fugitive sources, air quality modeling outcomes, operating plans for emission controls and fugitive dust control, and air quality monitoring/reporting and adaptive management plans at the Mine Site.
- Air Quality Management Plan – Plant (PolyMet 2014n): Describes the emission control systems for point and fugitive sources, air quality modeling outcomes, operating plans for emission controls and fugitive dust control, and air quality monitoring/reporting and adaptive management plans at the Plant Site.
- Rock and Overburden Management Plan (PolyMet 2015h): Describes baseline data, the design of systems to manage overburden and waste rock (waste characterization, waste classification, and construction uses), outcomes of the design, rock and overburden management operational plans, Category 1 Stockpile groundwater containment system extension design and circumstances that would trigger a design change, water quantity and quality monitoring systems, amount of material in the stockpiles, footprint of the stockpiles, annual reporting requirements, and reclamation plans for next-year closure and forecast of annual estimates for years remaining to end of mining.
- Water Management Plan – Mine (PolyMet 2015r): Describes process water management systems (such as the Mine Site WWTF and stormwater management infrastructure), key water quality outcomes, operational water management plans, monitoring and reporting requirements (including comparison to modeled outcomes and compliance), and adaptive management action plans.
- Water Management Plan – Plant (PolyMet 2015i): Describes, process water management systems (such as the Plant Site WWTP and stormwater management infrastructure), key water quality outcomes, operational water management plans, monitoring and reporting requirements (including comparison to modeled outcomes and compliance), adaptive management action plans, Tailings Basin containment system design and surface seepage management system design, and Plant Site reclamation plans.

- Adaptive Water Management Plan (AWMP) (PolyMet 2015d): Describes Mine Site and Plant Site water management, Category 1 Stockpile geomembrane cover system design and circumstances that would trigger a design change, Category 1 Stockpile water containment conceptual non-mechanical treatment system design, West Pit overflow conceptual non-mechanical treatment system design, Tailings Basin pond cover system design and circumstances that would trigger a design change, WWTF and WWTP mechanical treatment system design, and Tailings Basin conceptual non-mechanical treatment system design.
- Flotation Tailings Management Plan (PolyMet 2015n): Describes existing conditions at the existing LTVSMC Tailings Basin, NorthMet Project Tailings Basin design (including tailings geochemical characterization; engineering design of the dams including cement deep soil mixing (CDSM) and rock buttressing, flotation tailings transport system, and return water system; and seepage and stormwater management), outcomes of modeling, operational plans, monitoring and reporting requirements, and the reclamation plan for the Tailings Basin for next-year closure and forecast of annual estimates for years remaining to end of mining.
- Residue Management Plan (PolyMet 2014r): Describes Hydrometallurgical Residue Facility design, summary of Hydrometallurgical Residue Facility geotechnical analysis outcomes, operational plans (including residue transport and deposition system, return water system, leachate collection system, and general maintenance), monitoring and reporting requirements, and the reclamation plan for the Hydrometallurgical Residue Facility for next-year closure and forecast of annual estimates for years remaining to end of operations.
- Reclamation Plan (PolyMet 2015g): Describes activities associated with demolition of structures and waste disposal, reclamation of the Mine Site (mine pit; stockpile; water management systems, building areas, roads, and parking lots; and removal of railroad tracks and culverts), reclamation of the Plant Site (Tailings Basin; Hydrometallurgical Residue Facility; water management systems, building areas, roads, and parking lots; and removal of railroad tracks and culverts), remediation of legacy Areas of Concern (AOCs) and ongoing mitigation of water quality at the Mining Area 5N and the Tailings Basin, ongoing monitoring and maintenance for the existing solid waste disposal facilities, the methodology for making reclamation estimates and the contingency reclamation estimate, and potential mechanisms for financial assurance.

3.2.2.1 *Mine Site*

This section describes the proposed Mine Site with specific reference to key phases as summarized in Table 3.2-2.

Table 3.2-2 Key Phases and Activities (Mine Site)

Mine Year/Phase	Figure	Key Activities at the Mine Site
Construction		
Prior to mining	Figure 3.2-4 (existing conditions)	• Constructing Mine Site infrastructure • Preparing ground for mine pits and stockpiles
• Operations		
Years 1-11	Figure 3.2-5 (year 1) Figure 3.2-6 (year 2)	• Removal and stockpiling of overburden • Mining in East Pit and West Pit • Stockpiling non-acid-generating waste rock (Category 1) into a permanent stockpile (Category 1 Stockpile) • Stockpiling rock with the potential to generate acid (Category 2, 3, and 4) into temporary stockpiles (Category 2/3 Stockpile, Category 4 Stockpile)
Years 11-16	Figure 3.2-7 (year 11)	• Mining in the West Pit and Central Pit (the Central Pit would eventually expand to the completed East Pit) • Backfilling the East pit with all of the Category 4 Stockpile • Backfilling the East Pit with rock from the temporary Category 2/3 Stockpile, and waste rock from ongoing mining in the West Pit and Central Pit • Reclaiming the Category 1 Stockpile (starting in year 14)
Years 16-20	Figure 3.2-8 (year 20)	• Mining in the West Pit only • Backfilling the combined East Central Pit with waste rock from the temporary Category 2/3 Stockpile, and all waste rock from ongoing mining in the West Pit • Reclaiming the Category 1 Stockpile
• Reclamation, Closure, and Post-closure Maintenance		
Reclamation (after year 20)	Figure 3.2-8 (year 20)	• Flooding of the West Pit • Reclaiming remaining disturbed areas
Long-term management	Figure 3.2-9 (long-term closure management)	• Monitoring and maintenance • Water treatment using reverse osmosis as long as required in accordance with permits until if, and when non-mechanical treatment is proven

3.2.2.1.1 Location and Ownership

As shown in Figure 1.1-1, the NorthMet Deposit is located approximately 6 miles south of the City of Babbitt in St. Louis County, Minnesota. The Mine Site, shown on Figure 3.2-4, comprises 3,014.5 acres. This area represents the boundary within which the proposed mining activity and infrastructure (i.e., surface disturbance) would occur. The Mine Site would include:

- mine pits;
- overburden and waste rock stockpiles; and
- mining infrastructure, haul roads, a rail-loading facility, and a WWTF.

Layout maps of the Mine Site—which include outlines of the mine pit(s) and waste rock stockpile(s), and mining infrastructure for years 1 (the first year that ore would be delivered to the processing plant), 2, 11, and 20—are shown on Figure 3.2-5 through Figure 3.2-8. Mine Site layout for long-term closure management is shown on Figure 3.2-9.

PolyMet leases the mineral rights required for proposed mining at the NorthMet Deposit from mineral rights holders RGGS Inc. (RGGS) and Longyear Mesaba Company (see Figure 3.2-3).

The majority of the surface land at the proposed Mine Site is part of a single contiguous area of publicly owned land managed by the USFS. Smaller portions of the Mine Site are owned by PolyMet or leased by PolyMet from Cliffs Erie. Lands owned or leased by PolyMet are shown on Figure 3.2-1. Ownership of federal land at the proposed Mine Site is subject to the Land Exchange Proposed Action (see Section 3.3).

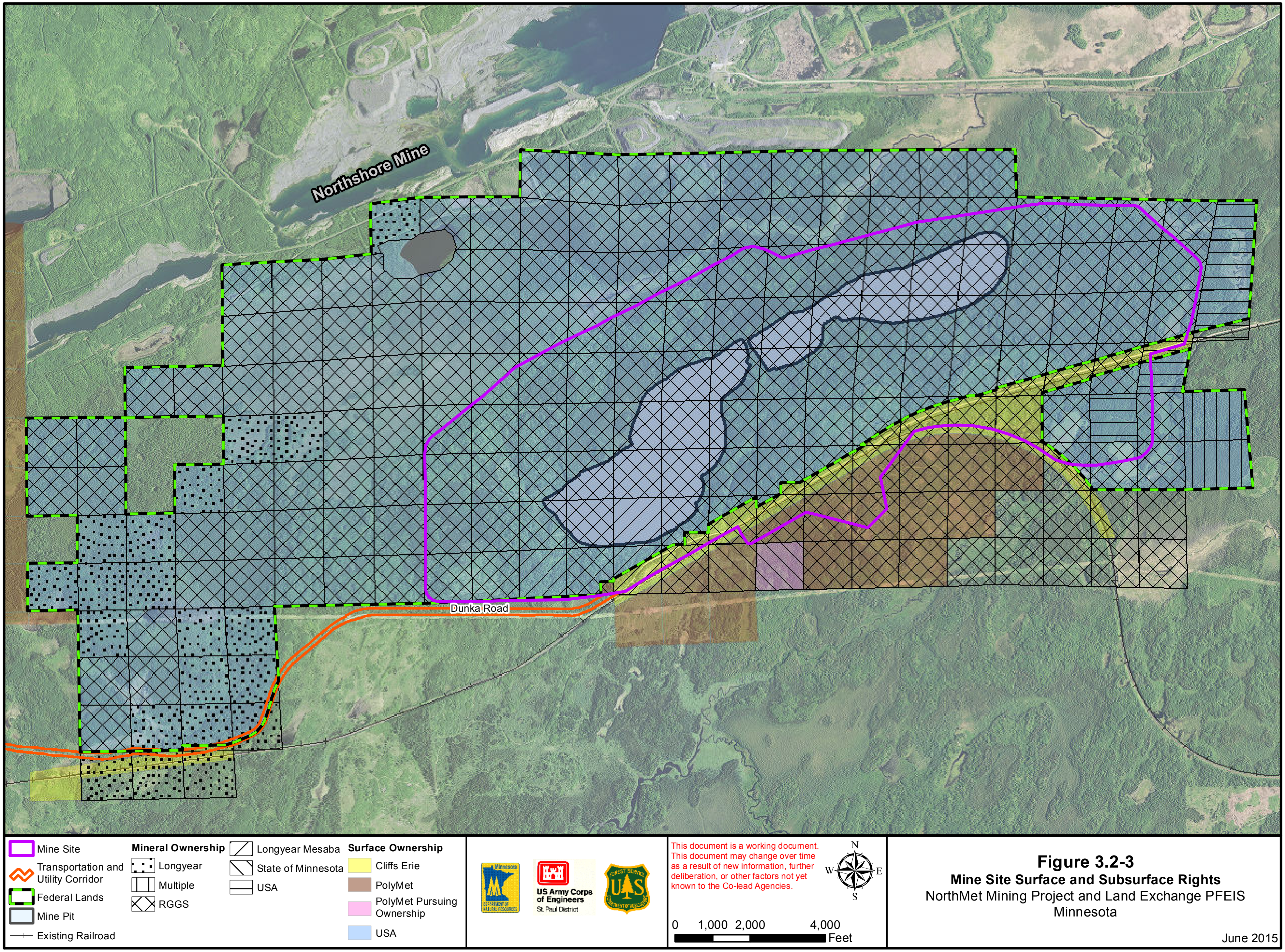

Figure 3.2-3

Mine Site Surface and Subsurface Rights

NorthMet Mining Project and Land Exchange PFEIS

Minnesota

June 2015

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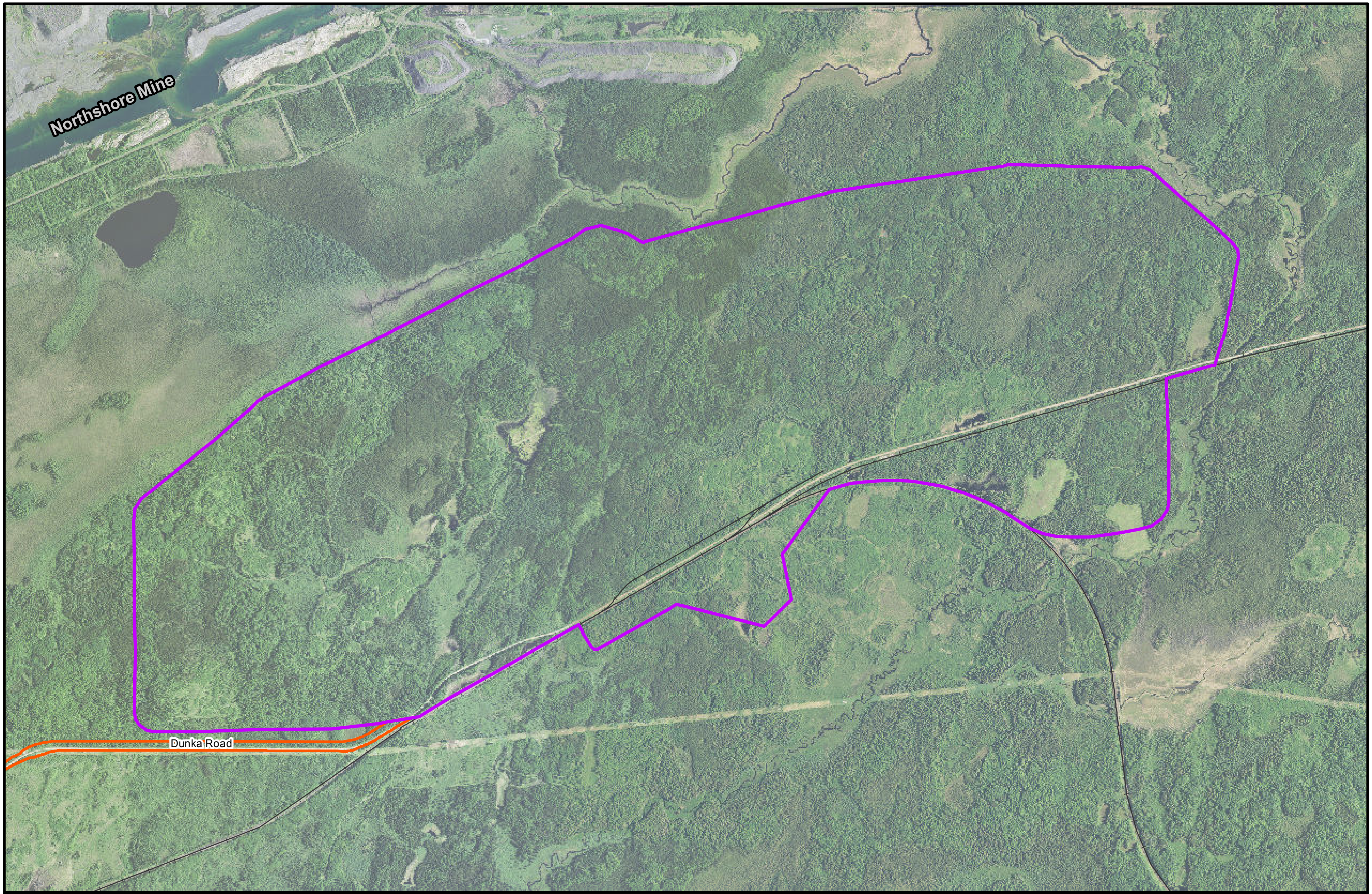

Mine Site

Transportation and Utility Corridor

Existing Railroad

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N
W E
S

0 750 1,500 3,000 Feet

Figure 3.2-4

Existing Conditions at the Mine Site

NorthMet Mining Project and Land Exchange PFEIS

Minnesota

June 2015

404

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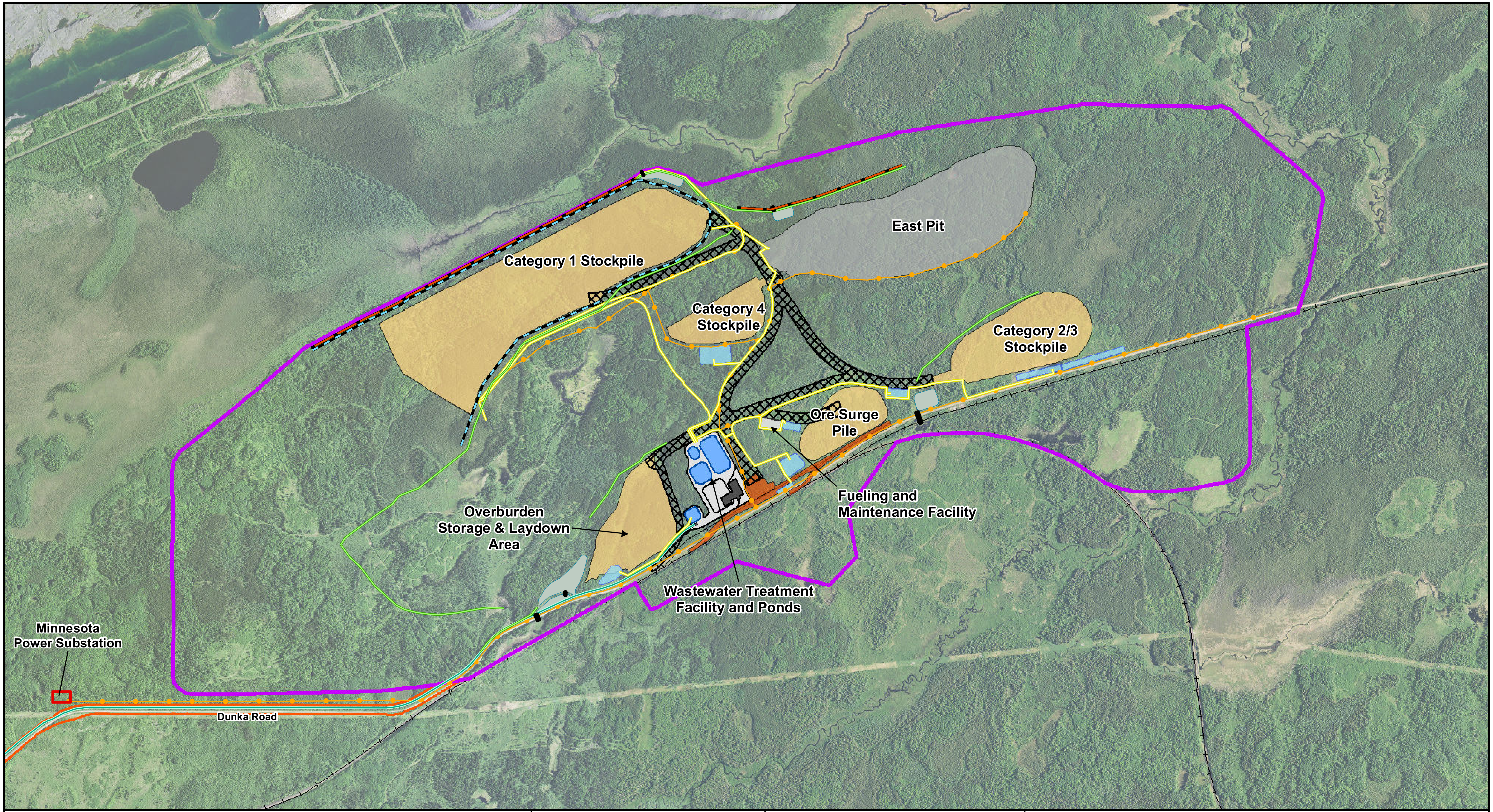

Mine Site
Mine Pit
Active Stockpile
Rail Transfer Hopper and New Railroad Spur
Transportation and Utility Corridor
Groundwater Containment System
Perimeter Dike
Treated Water Pipeline
Stormwater Collection Ditch
Transmission Line
Process Water Pipes
Culvert
Ponds and Sumps
Stormwater Pond
Haul Road

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N W E S

0 750 1,500 3,000 Feet

Figure 3.2-5
Mine Site Plan - Year 1
NorthMet Mining Project and Land Exchange PFEIS
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June 2015

406

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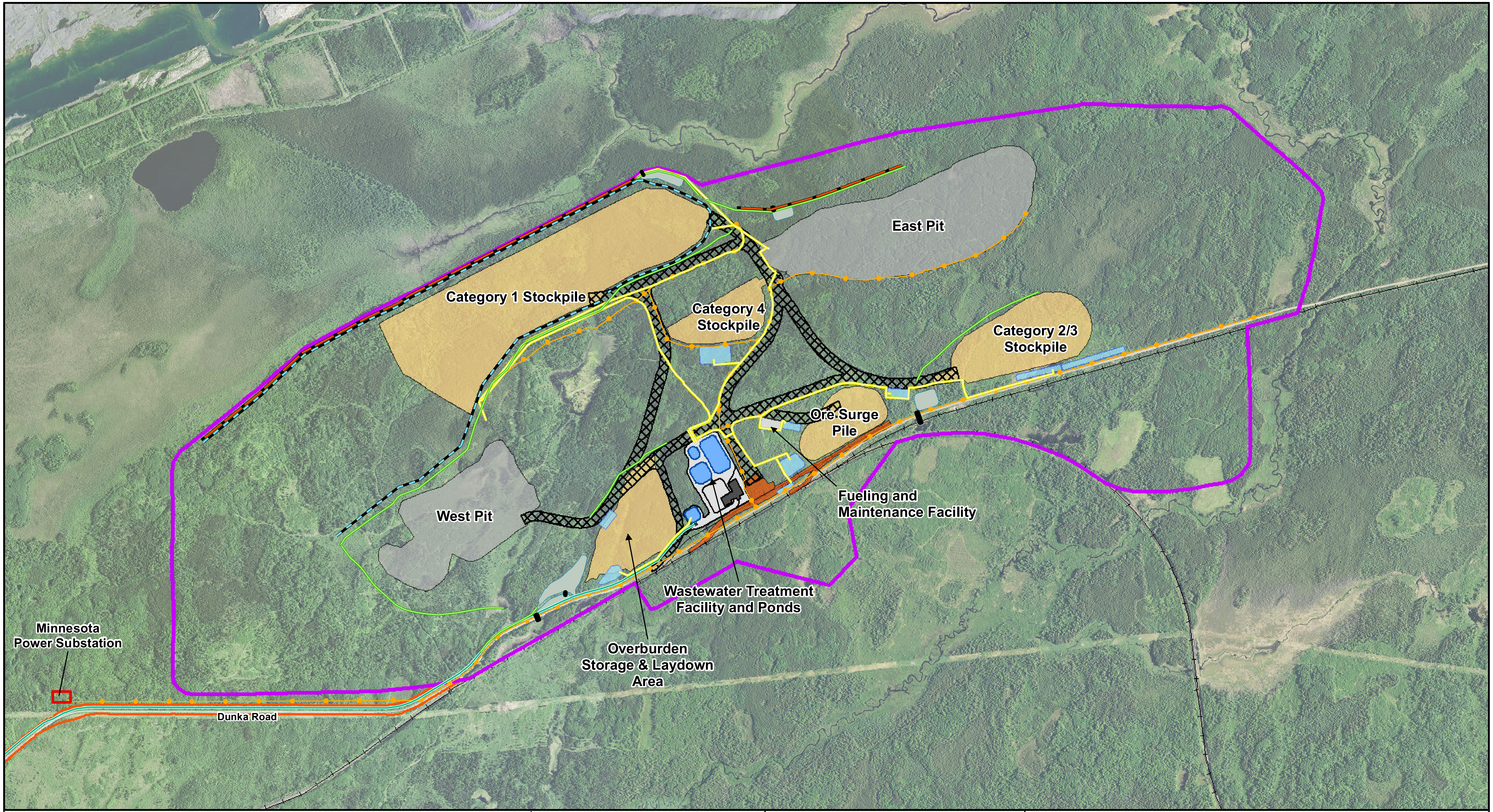

Mine Site
Mine Pit
Active Stockpile
Rail Transfer Hopper and New Railroad Spur
Transportation and Utility Corridor
Groundwater Containment System
Perimeter Dike
Treated Water Pipeline
Stormwater Collection Ditch
Transmission Line
Process Water Pipes
Culvert
Ponds and Sumps
Stormwater Pond
Haul Road

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N W E S

0 750 1,500 3,000 Feet

Figure 3.2-6
Mine Site Plan - Year 2
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

408

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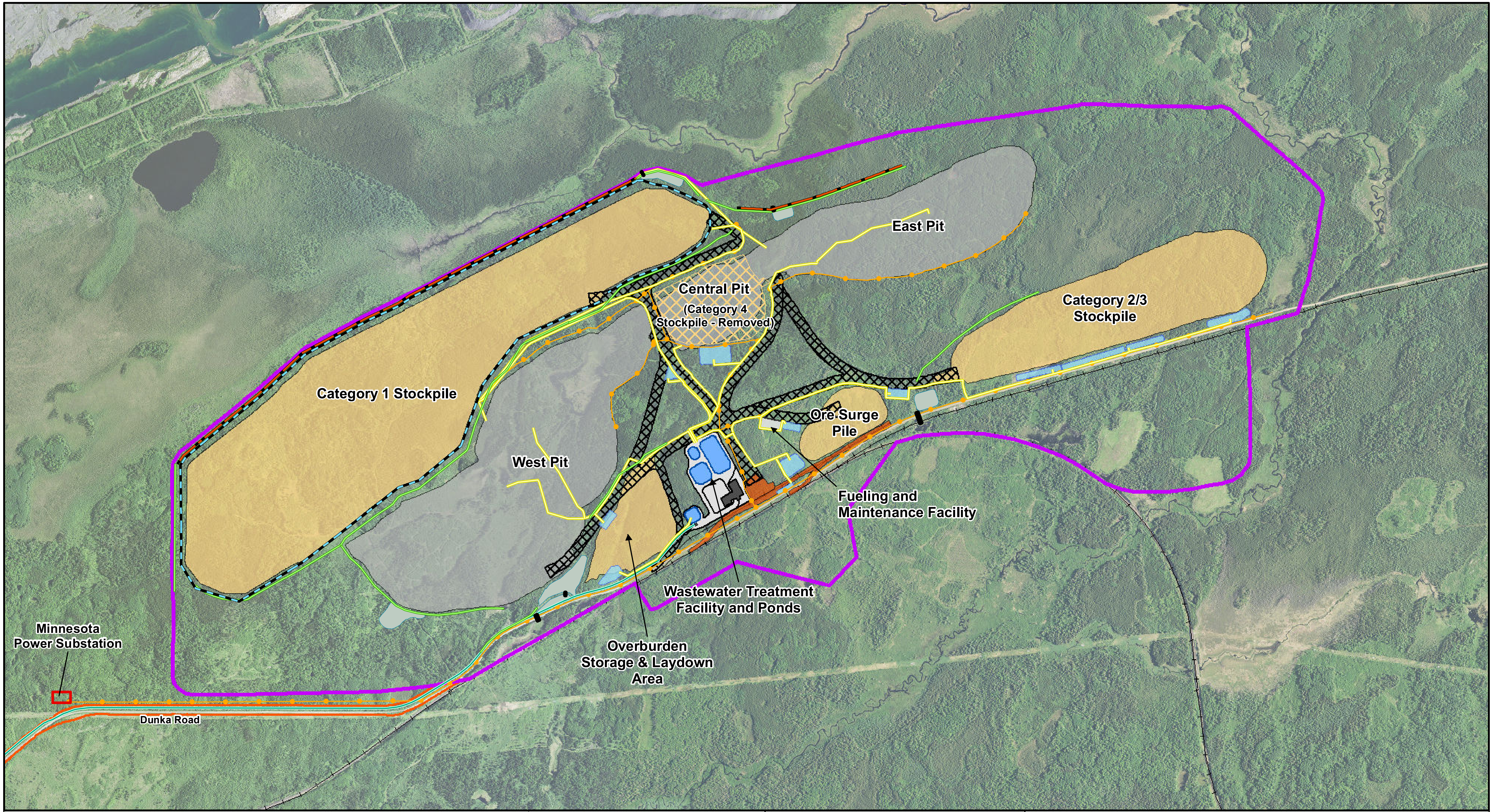

Mine Site
Active Stockpile
Category 4 Stockpile Removed
Mine Pit
Haul Road
Transportation and Utility Corridor
Rail Transfer Hopper and New Railroad Spur
Groundwater Containment System
Perimeter Dike
Transmission Line
Culvert
Stormwater Collection Ditch
Process Water Pipes
Treated Water Pipeline
Ponds and Sumps
Stormwater Pond

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Forest Service U.S. Department of Agriculture

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N W E S

0 750 1,500 3,000 Feet

Figure 3.2-7
Mine Site Plan - Year 11
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Minnesota

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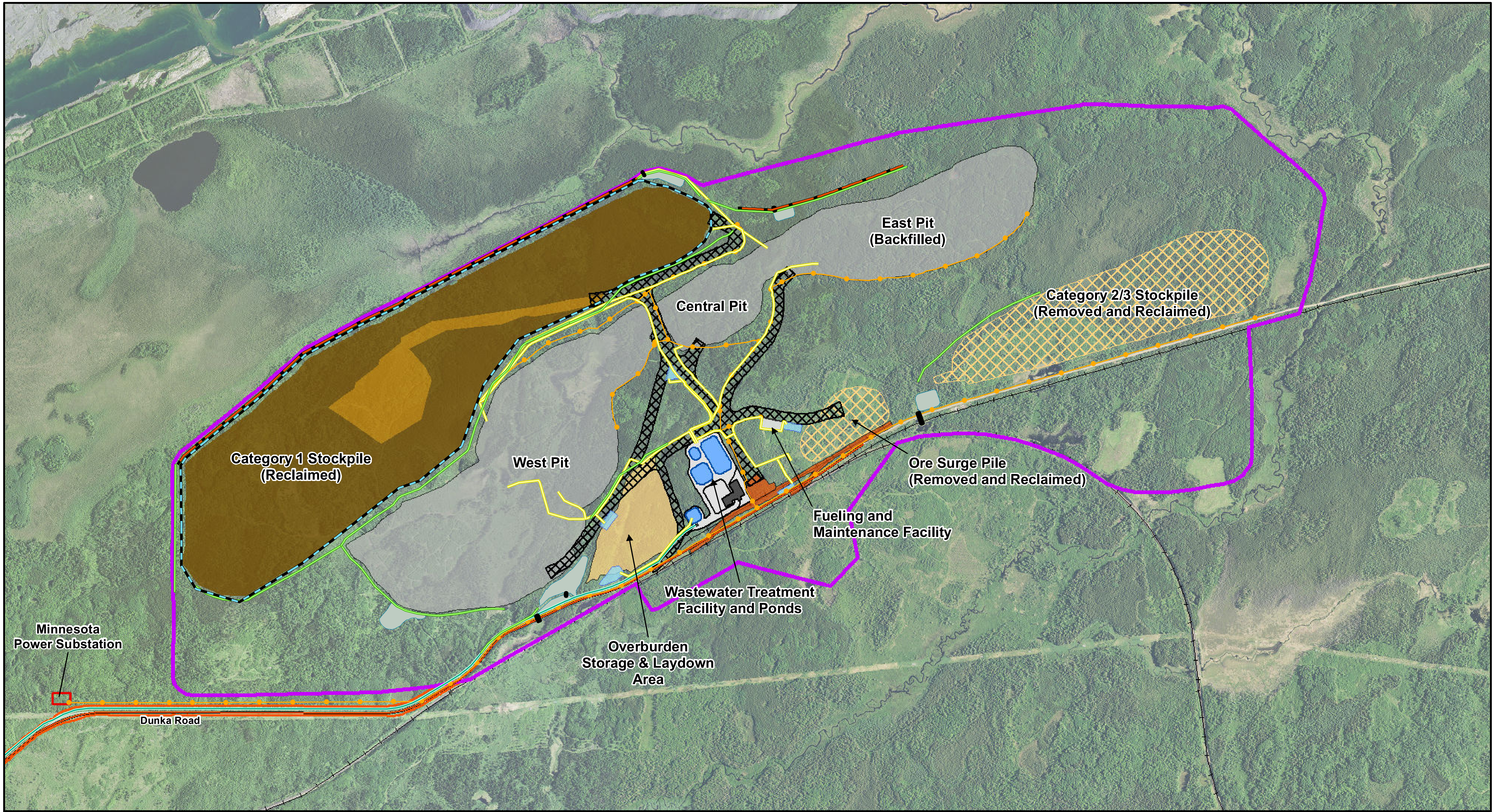
411 -Page Intentionally Left Blank-



Mine Site
Mine Pit
Covered in Previous Years
Covered Upon Mine Closure
Active Stockpile
Removed and Reclaimed Stockpile
Haul Road
Transportation and Utility Corridor
Rail Transfer Hopper and New Railroad Spur
Groundwater Containment System
Perimeter Dike
Transmission Line
Culvert
Stormwater Collection Ditch
Process Water Pipes
Treated Water Pipeline
Ponds and Sumps
Stormwater Pond

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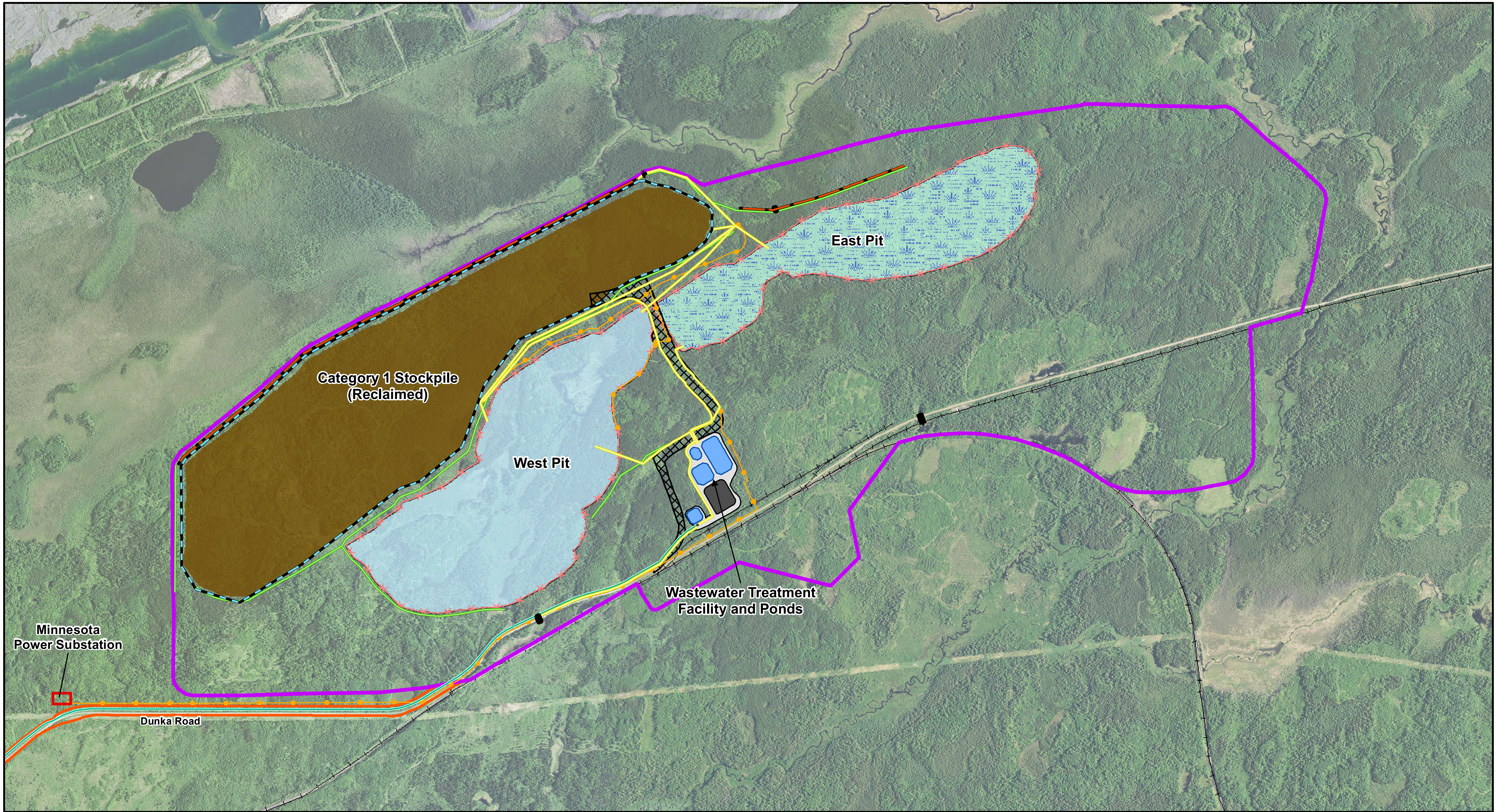
N W E S

0 750 1,500 3,000 Feet

Figure 3.2-8
Mine Site Plan - Year 20
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

413 -Page Intentionally Left Blank-



Mine Site
Pit with Backfill and Surface Wetland
Pit Lake
Covered in Previous Years
Haul Road
Transportation and Utility Corridor
Groundwater Containment System
Transmission Line
Stormwater Collection Ditch
Perimeter Dike
Process Water Pipes
Treated Water Pipeline
Fence
Culvert

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N W E S

0 750 1,500 3,000 Feet

Figure 3.2-9

Mine Site Plan - Long-term Closure

NorthMet Mining Project and Land Exchange PFEIS

Minnesota

June 2015

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3.2.2.1.2 Existing Conditions

The Mine Site is mostly located on undeveloped federal land within the western/central part of the Superior National Forest (see Figure 1.1-1). The area is composed of primarily small-diameter trees, with the most recent harvest having occurred in 2008. As shown on Figure 3.2-4, existing disturbance includes some minor access tracks used for mineral exploration, as well as the existing railway line and Dunka Road that run east-west in the southern part of the Mine Site. Both the rail line and road would be refurbished as part of the NorthMet Project Proposed Action and would be used to transport ore and other material, as required, between the Mine Site and the Plant Site (see Section 3.2.2.2).

Section 4.2 provides additional information on the affected environment at the Mine Site.

NorthMet Deposit Geology

The NorthMet Deposit is one of 10 known significant mineral deposits that have been identified within the 30-mile length of the Duluth Complex and just south of the eastern end of the Mesabi Iron Range. The complex is a well-known geological formation containing large quantities of copper, nickel, cobalt, platinum, palladium, and gold. The MDNR has estimated that the entire complex contains as many as 4.4 billion tons of mineral resources grading at 0.66 percent copper and 0.20 percent nickel. The NorthMet Deposit is believed to be the second largest deposit within the Duluth Complex and represents nearly 25 percent of the known mineral resources in the area.

All of the mineral deposits share a broadly similar geologic setting to the NorthMet Deposit. They are disseminated sulfides with minor, local, massive sulfides hosted in grossly layered heterogeneous troctolitic rocks forming the basal unit of the Duluth Complex. The majority of the metals are concentrated in, or associated with, four sulfide minerals: chalcopyrite, cubanite, pentlandite, and pyrrhotite, with platinum, palladium, and gold also found as elements and in bismuthides, tellurides, and alloys.

There have been many major drilling programs at the NorthMet Deposit since its discovery in 1969, and numerous bulk metallurgical samples have been collected. The general structure of the NorthMet Deposit, as well as individual beds within the Biwabik Iron Formation and Virginia Formation, is dominated by an overall dip ranging from 15 to 25 degrees to the southeast, and striking about N56 degrees east. The mineralized zone dips to a maximum of 60 degrees in the area of the proposed East Pit, where the Duluth Complex steeply cross cuts the Virginia Formation footwall rocks. There is a smaller zone of economic mineralization at the western end of the property in the upper units, known as the “Magenta Zone.” The NorthMet Deposit is a low- to medium-quality copper-nickel-PGE deposit with a low sulfide content.

The lithology of the NorthMet Deposit consists of seven units, as shown on Figure 3.2-10. Further information on the geology and hydrogeology of the Mine Site and Plant Site is provided in Section 4.2.3.

Regionally, the bedrock is variably fractured in the upper sections due to glacial compression. Structural faults may exist in the area; however, because the landscape is covered with surficial deposits and there are few bedrock outcrops, the existence of faults can only be inferred. Additional geological information is provided in PolyMet 2015a.

458

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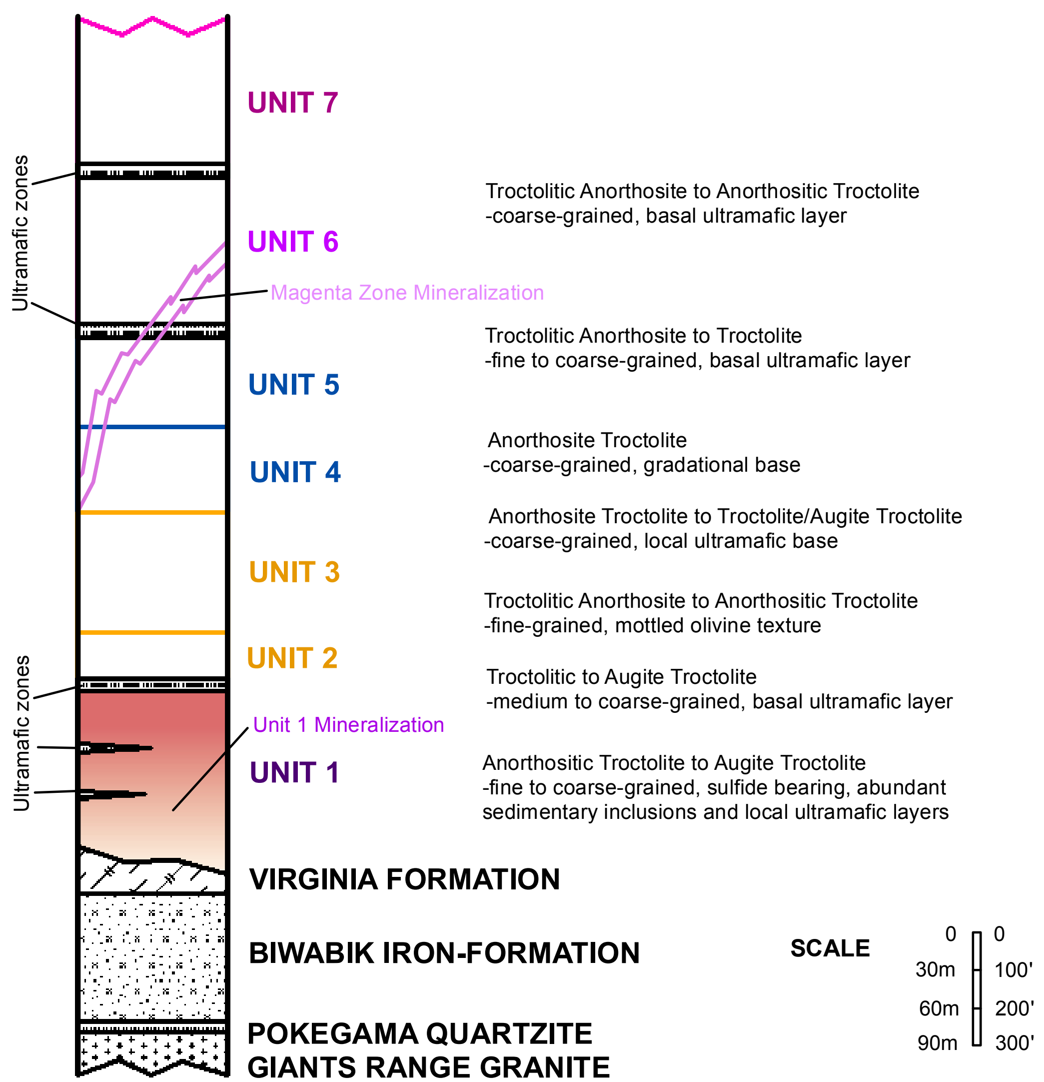
NORTHMET GENERALIZED STRATIGRAPHIC COLUMN



NORTHMET TYPICAL CROSS SECTION FACING EAST

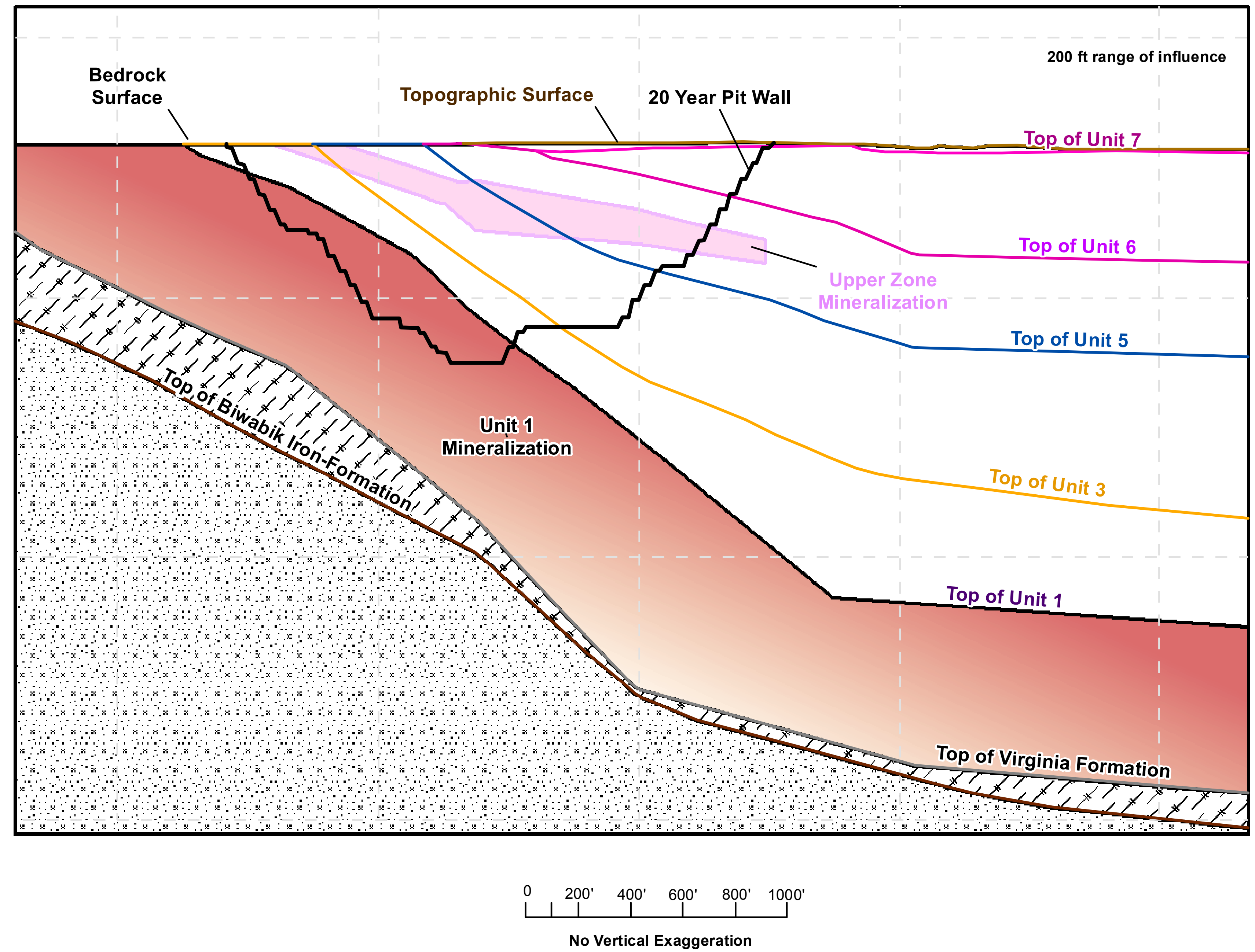


Figure 3.2-10
Schematic Geologic Cross Section and Stratigraphic Column at Mine Site
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

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3.2.2.1.3 New Construction and Pre-production Development

Several construction activities would be completed during the estimated 12 to 18 months of pre-production mine development. These activities would include the following:

- Clearing timber and biomass from surface footprint areas by contracted logging and biomass services, which would remove forest products from the NorthMet Project area;
- Constructing site access and haul roads, upgrading the existing Dunka Road, installing rail connections and spur, and constructing the Mine Site Fueling and Maintenance Facility from existing facilities using standard industrial construction practices and off-site materials;
- Removing overburden from the pit areas and other areas on site, as necessary, using excavation equipment such as backhoes, bulldozers, and standard (non-mining) dump trucks (see Section 3.2.2.1.7);
- Constructing the Overburden Storage and Laydown Area by compaction to provide space to sort and temporarily store overburden;
- Constructing the Rail Transfer Hopper;
- Constructing the liners and containment systems for the Ore Surge Pile and waste rock stockpiles (see Section 3.2.2.1.8);
- Constructing water management features—including dikes, ditches, and ponds—to manage surface water, the Mine Site WWTF, the Central Pumping Station, and the Treated Water Pipeline (see Section 3.2.2.1.8); and
- Constructing a substation drop from the 138 kilovolt (kV) transmission line (by Minnesota Power, which would retain ownership of the line) and installation of power poles and lines that would be owned by PolyMet and would serve as a 13.8 kV Mine Site power distribution system.

The MDNR would need to approve the use of waste rock, overburden, and peat during construction. This material would be supplemented with rock from a state-owned taconite stockpile located approximately 5 miles west of the Mine Site, adjacent to Dunka Road (refer to Section 3.2.2.1.7 for more information on waste rock management).

3.2.2.1.4 Equipment and Services

Equipment

A variety of equipment, mostly diesel-powered unless otherwise noted, would be used at the Mine Site. The anticipated fleet of Mine Site equipment is shown in Table 3.2-3.

Table 3.2-3 Mine Site Equipment Fleet

Typical Machine Type	Power	Number	Duties
Tracked dozer (Cat D10R or equivalent)	582 hp[1]	2	Stockpile maintenance, construction, stockpile reclamation
Wheel dozer (Cat 834G or equivalent)	450 hp	1	Clean-up at the pit loading faces and the Rail Transfer Hopper
Grader (Cat 16H or equivalent)	275 hp	2	Haul road maintenance
Water truck (Cat 777D or equivalent)	937 hp	2	Haul road maintenance, dust suppression, auxiliary firefighting duties
Wheel loader (Cat 992G or equivalent)	800 hp	1	Construction, general purpose loading, reclamation
Backhoe with hammer (Cat 446D or equivalent)	110 hp	1	Secondary breakage
Integrated tool carrier (Cat IT62H or equivalent)	230 hp	1	Miscellaneous tasks (i.e., snow plowing, fork lift, sweeper, etc.)
Field service trucks	114 hp	6	Field maintenance flatbed trucks fitted with hydraulic arm lift
Fuel truck	150 hp	2	Field fueling of mobile equipment and drills
Line truck	100 hp	1	Power line maintenance, excavator, and Rail Transfer Hopper service
Off-road lowboy trailer and tractor	200 hp	1	Transporting tracked equipment around mine and to service areas and workshops
Drills	Electric and/or 1,600 hp	2	Blast hole drilling for waste rock and ore
Excavators	Electric	2	Excavation of ore and waste materials (waste rock and overburden)
Haul trucks	2,500 hp	Up to 9	Haulage of ore and waste materials (waste rock and overburden)
Haul truck retriever	1,120 hp	1	Retrieving and transporting haul trucks unable to move under their own power
Light vehicles (pickups and SUVs)	150-250 hp	Up to 20	Supervisor transport, general duties

[1] hp = horsepower

Fuel and Maintenance Facilities

Equipment fueling and minor service and repair work would be conducted at the Mine Site Fueling and Maintenance Facility located near the Rail Transfer Hopper. This facility would consist of two buildings, one for fueling mobile equipment (fueling station) and the second for mobile equipment maintenance (maintenance building). The fueling station and the maintenance building would be roofed structures with enclosed sides, but open at each end to allow equipment to drive through. The structures would have reinforced concrete floors sloped to drain to a sump to collect any fuel, hydraulic oil, engine oil, and coolant/antifreeze spillage. A licensed disposal contractor would periodically pump out the sumps.

The fueling station would house a fuel-dispensing system, as well as dispensing equipment for lubricating and hydraulic oils, antifreeze/coolant, windshield washer fluid, and compressed air for tires. The building would house storage tanks containing lubricating and hydraulic oils and antifreeze. Two to three 12,000-gallon bulk diesel storage tanks, enclosed within a spill containment system, would be provided. Interior and area lighting would be available to enable safe operation at night. A metering system would record the amount of fuel dispensed to each vehicle. There would be emergency shut-off valves at all necessary locations.

Stationary or slow-moving equipment such as excavators, dozers, drill rigs, and portable light generators would be fueled in the field from mobile fuel tankers specially equipped with pumping and metering devices. The fueling tankers would arrive at the Mine Site with fuel or be replenished at the fueling station.

Minor mobile equipment maintenance—such as oil, filter, tire, and lamp changes; maintenance of fluid levels; haul truck box welding; and other short duration maintenance—would be done at the maintenance building.

Major scheduled maintenance and repair work on mobile equipment—such as haul trucks, front-end loaders, dozers, and graders—that would last several days would be done in the refurbished and reactivated former LTVSMC Area 1 Shop located about 1 mile west of the former LTVSMC processing plant (see Section 3.2.2.3.8). Examples of these types of repairs include engine changes and final drive repairs. Because of the size and weight of the primary excavators and blast hole drill rigs, as well as the distance to the Area 1 Shop, most of their maintenance and repair work would be done at the Mine Site.

3.2.2.1.5 Mining

The key characteristics of proposed mining are summarized in Table 3.2-4 and are discussed further below.

Table 3.2-4 Key Characteristics of Proposed Mining

Aspect/ Feature	Characteristic	Proposed Description
Mining	Life of Mine (duration of metal extraction)	20 years
	Method	Surface blast (Ammonium Nitrate Fuel Oil [ANFO]) and haul from three open pits (West Pit, East Pit, and Central Pit)
	Total material removed	533 million tons of waste rock and ore
	Average ore rate	Up to 32,000 tpd
	Total ore (Life of Mine)	225 million tons
	Total waste rock (Life of Mine)	308 million tons
West Pit	Phases of development	Years 1-20: Mining Year 20+ : Flooding (pit full, and overflow)
	Waste rock management	Years 1-11: Stockpiled in respective stockpiles Years 11-13: Some stockpiled, some disposed of in the East Pit Years 14-16: Disposed of in the East Pit Years 16-20: Disposed of in the combined East Central Pit
	Maximum depth	630 ft below original surface (year 20)
	Maximum surface footprint	321 acres

Aspect/ Feature	Characteristic	Proposed Description
East Pit	Phases of development	Years 1-11: Mining Years 11-16: Backfilled with waste rock and saturated overburden Years 16+: Refer to combined East Central Pit below
	Waste rock management	Years 1-11: Stockpiled in respective stockpiles
	Maximum depth	696 ft below original surface (year 11)
	Maximum surface footprint	155 acres
Central Pit	Phases of development	Years 11-16: Mining Years 16+: Refer to combined East Central Pit below
	Waste rock management	Years 11-16: Disposed of in the East Pit
	Maximum depth	356 ft below original surface (year 16)
	Maximum surface footprint	52 acres (year 16)
Combined East Central Pit	Phases of development	Year 16 (end of mining at the Central Pit): The Central Pit would have been expanded into the East Pit, forming a combined pit Years 16-20: Backfilled with waste rock and saturated overburden Years 20+: Reclamation (constructed wetlands) and maintenance

The pre-production mine development would be followed by a gradual ramp-up of mining and ore output over 6 to 12 months to reach the planned rate of mining, which would be an annual average of 32,000 standard tpd. Because the processing plant feed rate would progressively increase as plant operations ramped up, mining would be scheduled so that the excavated area in the mine pits would also increase to provide an adequate supply of ore and ensure continuity of plant feed.

The NorthMet Project Proposed Action has been designed based on a 20-year mine plan. While mineralization is known to extend beyond the proposed pit outline, the economic feasibility for mining this material has not been assessed. There is no mine plan for any material that lies outside of the proposed open pit; as such, mining this material is not part of the NorthMet Project Proposed Action. Mining of material located beyond the proposed pit outline would be evaluated as appropriate if proposed in the future.

The NorthMet Project Proposed Action would use open-pit mining methods, similar to those currently in use at nearby ferrous metallic (iron) mining operations on the Mesabi Iron Range. The mine would consist of three open pits (East Pit, Central Pit, and West Pit). The development and configuration of these pits are summarized and shown in Tables 3.2-2 and 3.2-4 and on Figures 3.2-5 through 3.2-6. Ore would be hauled to a Rail Transfer Hopper for transportation to the Plant Site (see Sections 3.2.2.1.6 and 3.2.2.2, respectively) and waste rock and overburden would be categorized and disposed of as discussed in Section 3.2.2.1.7.

The northwest edge of the mine pits would be constrained by the northward extent of the Duluth Complex, which hosts the mineral deposit. The pits follow the mineralization, which dips southeast at about 25 percent and roughly parallels the top of the Virginia Formation (see Figure 3.2-10). The mine pits would be developed in a series of benches that would be approximately 40 ft high. These benches would be accessed by ramps with a driving surface approximately 85 ft wide to accommodate mine traffic, with additional width for safety berms and ditches, power lines and cables, and pipes on an as-required basis. The pit slope design has an overall pit slope angle of approximately 51 degrees. This would be continuously monitored and refined throughout the life of the mine.

It would be necessary to dewater the pits during mining to remove groundwater and precipitation runoff. These waters would be directed to low areas in the pits, collected in sumps, and pumped to the WWTF. The mine pit sump areas and pump capacities would be designed to minimize delay to mining operations during the typical spring snowmelt or major precipitation events. Water management at the Mine Site is addressed in Sections 3.2.2.1.8 and 3.2.2.1.9.

Drilling and Blasting

The drilling and blasting plan has been prepared based on standard design, with consideration of specific aspects of the NorthMet Deposit. The general parameters are presented in Table 3.2-5. PolyMet would conduct blasting in accordance with *Minnesota Rules*, part 6132.2900, Air Overpressure and Ground Vibrations from Blasting. PolyMet has committed to developing an ore and rock blasting program with industry standard methods and experiences from other area mines, including blast vibration damage prevention and monitoring.

Table 3.2-5 Blasting Parameters

Blasting Parameter	Specifications
Blast hole diameter (range)	10-16 inches
Explosive type/blasting agent	ANFO, emulsion and emulsion blends (ANFO and emulsions)
Burden (distance from free face) and spacing (distance between holes)	Approximately 25 ft x 28 ft with 5 ft of subdrilling for ore and 29 ft x 33 ft with 6 ft of subdrilling for waste rock, based on a 12¼-inch diameter blasthole.
Powder factor	Approximately 0.69 pound per ton for ore and 0.45 pound per ton for waste rock, based on a 12¼-inch diameter blasthole.
Drilling rate – approximate (Assumed drilling time/rig 24 hours/day)	50 to 70 ft per hour based on a 12¼-inch diameter drill bit.
Average ft drilled per month	34,425

Drilling and blasting would share a common drilling fleet and have similar blast design specifications for the ore and waste rock. Based on a planned annual rock movement rate of 26.7 million tons and a blast design as shown in Table 3.2-5, it is estimated that the total annual amount of blasting agent used for breaking ore would be 15.3 million pounds, not including initiators and blasting accessories. Secondary breaking of oversize pieces would be done using a wheel loader or excavator-mounted, drop-weight hammer. Blasting of ore and waste rock is anticipated to take place approximately every 2 to 3 days. This would typically include separate blasts of ore and waste rock benches totaling about 200,000 to 300,000 tons of broken rock per blast.

Excavation

After being drilled and blasted, the ore would be loaded by excavators into haul trucks that would transport the rock to the Rail Transfer Hopper or Ore Surge Pile. Electric-hydraulic excavators with an approximate capacity of 31 cubic yards would be the primary rock-loading tools in the mining fleet, with a large, diesel front-end loader (approximately 21.5-cubic-yard capacity) available to provide operational flexibility and additional loading capacity.

3.2.2.1.6 Haulage, Storage, and Transport of Ore

Haulage

Haul trucks would transport the ore to the Rail Transfer Hopper for transportation to the processing plant (see Section 3.2.2.2). Should a delay or shutdown of any part of the rail haulage system occur, the ore would be temporarily stored on the lined Ore Surge Pile. A list of the equipment, including trucks, to be used at the Mine Site is provided in Table 3.2-3.

The haul truck fleet would initially consist of five conventional 240-ton diesel-powered rear dump trucks and increase to a maximum of nine trucks as hauls became longer and temporary stockpiles are relocated to the East Pit and, ultimately, the combined East Central Pit. Haul trucks could be reassigned between excavators loading ore, waste rock, and overburden. PolyMet intends to use only private roads that they manage and would not use or intersect any public roads.

Ore Surge Pile

An Ore Surge Pile would be constructed near the Rail Transfer Hopper to allow for temporary storage of ore until it could be processed, or as required by rail haulage delays. Use of the Ore Surge Pile would allow for a steady annual flow of rock and would assist in providing a uniform grade of ore to the processing plant. Ore would flow into and out of this pile as needed to meet mine and plant operating conditions. The footprint would have a capacity of 2.5 million tons in one 40-ft lift, with side slopes at the angle of repose; additional lifts could be added to increase storage capacity. A summary of the key characteristics of the Ore Surge Pile is provided in Table 3.2-6.

A lined foundation would be constructed (see Section 3.2.2.1.8) and drainage from the Ore Surge Pile would be collected on the liner and routed to a sump for pumping to the Mine Site WWTF (see Section 3.2.2.1.8.). The Ore Surge Pile would be removed at the completion of mining activities.

Table 3.2-6 Key Characteristics of the Ore Surge Pile

Characteristic	Proposed Description
Purpose	To temporarily store and mix ore to allow for a steady annual flow of uniform grade ore to the processing plant
Phases of Development	Pre-mining: Ground preparation (including lining) Years 1-20: Temporary storage of ore until it could fit into the rail haul and/or plant processing schedule Year 20+: Reclaimed
Capacity	2.5 million tons in one 40-ft lift. Additional lifts could be added to increase storage capacity.
Maximum surface footprint	31 acres
Maximum height	120 ft

Rail Transfer Hopper

The Rail Transfer Hopper would consist of a raised platform from which haul trucks would dump into a hopper over a pan feeder. The pan feeder would pass through an opening in a retaining wall and discharge into a rail car positioned under the feeder outlet. The pan feeder and the control gate would be hydraulically powered and could be controlled by the locomotive operator using controls in the operator's cab of the Rail Transfer Hopper. Loading time would be approximately 1 minute per 100-ton rail car, or about 20 to 30 minutes to load a 16-car train, allowing for car-spotting and the operator to move between the locomotive and the Rail Transfer Hopper operator's cab.

The Rail Transfer Hopper would be located to the south of the mine pits and would be connected to the existing Cliffs Erie main line track by a new spur line. The rail track in the area of the Rail Transfer Hopper would be designed to allow rail cars to be loaded directly by front-end loader at the Ore Surge Pile should the Rail Transfer Hopper break down or be unavailable due to maintenance.

3.2.2.1.7 Overburden and Waste Rock Management

Overburden, the surficial material that lies on top of the mineral resource and infrastructure footprints, would be stripped prior to mining and as required prior to construction of facilities and infrastructure at the Mine Site. All overburden would be removed from footprints and for stockpile construction by the end of year 11. Waste rock would be generated throughout mining. A summary of the key waste rock management features is provided in Table 3.2-7 and discussed further below.

Table 3.2-7 Key Characteristics of Waste Rock Management

Aspect/ Feature	Characteristic	Proposed Description[1]
Category 1 Stockpile	Phases of development	Pre-mining: Ground preparation and construction of water engineering controls and collection system Years 1-13: Stockpiling Years 14-21: Capping and reclamation Years 21+: Maintenance
	Maximum surface footprint	526 acres (reached at year 21; maximum footprint during operations is 508 acres, reached in year 6)
	Waste rock volume	167,922,000 tons (reached at year 13) Maximum capacity based on current design: 177,988,000 tons waste rock
	Waste rock height	240 ft above ground level; 1,840 ft above sea level Maximum height based on current design: 280 ft above ground level
Category 2/3 Stockpile	Phases of development	Pre-mining: Ground preparation (including lining) and construction of collection system Years 1-11: Stockpiling Years 11-20: Transferring waste from stockpile to the East Pit Years 20+: Reclamation
	Maximum surface footprint	180 acres (reached at year 6)
	Waste rock volume	44,021,200 tons waste rock (reached at year 11 and subsequently removed) Maximum capacity based on current design: 60,602,000 tons waste rock
	Waste rock height	Maximum height based on current design: 200 ft above ground level; 1,770 ft above sea level Planned height based on current design: 160 ft above ground level
Category 4 Stockpile	Phases of development	Pre-mining: Ground preparation (including lining) and construction of collection system Years 1-11: Stockpiling Year 11: Transferring waste from stockpile to the East Pit (to allow mining in the Central Pit) Years 20+: Reclamation outside Central Pit footprint

Aspect/ Feature	Characteristic	Proposed Description[1]
	Maximum surface footprint	57 acres (reached at year 3)
	Waste rock volume	6,206,700 tons waste rock (reached at year 11 and subsequently removed) Maximum capacity based on current design: 14,975,100 tons waste rock
	Waste rock height	Maximum height based on current design: 180 ft above ground level; 1,790 ft above sea level Planned height based on current design: 80 ft above ground level

[1]Stockpile volumes and heights provided are based on the current design within the proposed footprints. Maximum capacities of the temporary stockpiles and planned capacity of the permanent stockpile were used for impact evaluations.

Overburden

Three types of overburden are present at the site: unsaturated overburden, saturated overburden, and peat. Each type of overburden would be managed according to its potential to be reactive (i.e., acid-producing through oxidization of iron sulfides).

Unsaturated overburden is the material that has been above the natural water table and exposed to air long enough for chemical reactions to have taken place. This material would be used for on-site construction purposes. Peat (organic soils) and unsaturated overburden that exceed immediate construction and reclamation needs would be stored in unlined overburden stockpiles at the Overburden Storage and Laydown Area.

Saturated overburden is material that has been below the natural water table. Because it has not been exposed to air, this material has the potential to be reactive. Saturated overburden would be used only for specific on-site construction applications, as approved by the MDNR. Applications for saturated overburden would include those where water contacting the construction material would be collected or drained to the mine pits, where it would be placed back below the water table or above a membrane liner system. Other applications where site-specific modeling has demonstrated that applicable surface and groundwater standards would be met would also be options. Saturated overburden not used for construction would be commingled in the temporary Category 2/3 Stockpile or Category 4 Stockpile, which have membrane liners, until final backfilling into the East Pit.

Waste Rock Categorization and Management

Geochemical characterization has identified four types of waste rock that would be managed, based on their potential to oxidize and their geochemistry and metal leaching potential. PolyMet has developed a Rock and Overburden Management Plan for monitoring and testing of waste rock during mine operations. Classification of the waste rock during operations would be based on blast hole sampling and frequent updates to a mine block model. The four categories of waste rock and the proposed management of each are summarized in Table 3.2-8. The geochemistry of the material is discussed further in Section 5.2.2.

Waste rock would be disposed of in a combination of permanent and temporary stockpiles, with material in the temporary stockpiles ultimately moved into the East Pit and Central Pit after completion of mining in those areas. Before construction of the stockpiles, overburden would be removed, if necessary, and foundations would be built with suitable overburden material or waste rock from the state taconite mining waste rock stockpile located approximately 5 miles west of the Mine Site, or with Category 1 waste rock, upon approval by MDNR. Proposed engineered water management controls such as liners, covers, and containment systems are described in Section 3.2.2.1.8.

Table 3.2-8 Waste Rock Categorization Properties

Categorization	Sulfur Content (%S)[1]	% of Total Waste Rock Mass	Management
Category 1	%S ≤ 0.12 Low potential to generate acid, but may leach heavy metals	70%	Used for construction material at the Mine Site (subject to approval by MDNR during permitting). The Category 1 waste rock not used as construction material would be placed on the permanent Category 1 Stockpile during years 1-13 and in the East Pit following year 13.
Category 2	0.12 < %S ≤ 0.31 Low to medium potential to generate acid and would leach heavy metals	24%	Temporarily stored in the lined Category 2/3 Stockpile (years 1-11). New and stockpiled material would be moved to the East Pit (years 11-16) and the combined East Central Pit (years 16-20).
Category 3	0.31 < %S ≤ 0.6 Medium potential to generate acid and would leach heavy metals	3%	Temporarily stored in the lined Category 2/3 Stockpile (years 1-11). New and stockpiled material would be moved to the East Pit (years 11-16) and the combined East Central Pit (years 16-20).
Category 4[(2)]	> 0.6 %S Duluth Complex 0.4 ≤ %S ≤ 5.0 Virginia Formation High potential to generate acid and would leach heavy metals	3%	Temporarily stored in the lined Category 4 Stockpile (years 1-11). Stockpiled material would be moved to the East Pit (year 11). New material would be disposed of in the East Pit (years 11-16) and the combined East Central Pit (years 16-20).

1 In general, the higher the rock's sulfur content, the higher its potential for generating acid rock drainage or leaching heavy metals.
2 Includes all Virginia Formation rock.

During years 1 through 11, all waste rock would be placed in stockpiles segregated by categorized sulfur content (see Table 3.2-8). Category 1 waste rock would be placed on the permanent Category 1 Stockpile located north of the West Pit. Category 2 and 3 waste rock would be placed on the lined, temporary Category 2/3 Stockpile located to the southeast of the mine pits. Category 4 waste rock would be placed on the lined, temporary Category 4 Stockpile located over the top of the future Central Pit, which is proposed to be mined starting in year 11 (see Figures 3.2-5 through 3.2-9). Separation of the waste rock would be based on the material characteristics identified in the Mine Plan and during operations by blast hole sampling and frequent updates to a mine block model. Each stockpile would have engineering controls to capture and treat contact water from stockpiles (containment system around Category 1 Stockpile and liners for Category 2/3 and 4 Stockpiles).

The East Pit is anticipated to be exhausted in year 11 of mining. During this year, all of the Category 4 waste rock, stored in a lined stockpile over the future Central Pit until this time, would be backfilled into the East Pit. All new Category 2, 3, and 4 waste rock would be disposed of in the East Pit between years 11 and 16, and the Category 2/3 Stockpile would begin to be moved into the East Pit. New Category 1 waste rock would continue to be placed on the Category 1 Stockpile until year 13, when it would be placed in the East Pit until year 16.

It is anticipated that mining in the Central Pit would cease at year 16. At this time, the Central Pit would have been excavated into the East Pit, forming a combined pit. From year 16 to 20, all waste rock generated from ongoing mining at the West Pit, as well as the remaining material in the Category 2/3 Stockpile, would be placed into the combined East Central Pit. The combined East Central Pit would be flooded (using groundwater, in-pit runoff, direct precipitation, and treated process water from the WWTF) at approximately the same rate of backfilling to ensure that backfilled material would remain saturated (see Section 3.2.2.1.10).

The Category 1 Stockpile that was created in years 1 to 13 would be covered and would remain in perpetuity. Reclamation of the Category 1 Stockpile would start in year 14 and would continue until year 21, one year after the completion of mining (see Section 3.2.2.1.10).

The geotechnical stability section in Chapter 5 presents more detail on the proposed construction of the stockpiles.

3.2.2.1.8 Engineered Water Controls

The Mine Site would include water management features designed to control water potentially affected by sulfides and metal leachates from oxidized rock exposed through mining. This process water would be directed to the Mine Site WWTF. Non-contact stormwater that hadn't been affected by sulfides and metal leachates from oxidized rock exposed through mining would be directed off-site.

The following section describes the engineered controls that would be used for water management. The flow and management of water is discussed in Section 3.2.2.1.9. Figures 3.2-5 through 3.2-8 show the water management features and infrastructure.

Category 1 Stockpile Water Containment System and Cover

The permanent Category 1 Stockpile, which has a low reactivity potential, would be constructed with a water containment system to collect drainage from the stockpile.

Figure 3.2-11 shows the containment system that would consist of a cutoff wall (a low-permeability hydraulic barrier extending down to bedrock) combined with a drainage collection system surrounding the perimeter of the stockpile near its toe.

The cutoff wall would have a hydraulic conductivity specification of no more than $1x10^{-5}$ centimeters per second (cm/sec). The drainage collection system would collect stockpile drainage and draw down the water table on the stockpile side of the cutoff wall, thereby maintaining an inward gradient along the cutoff wall and minimizing the potential for drainage passing through the cutoff wall. The geologic conditions are favorable for a cutoff wall due to the presence of low permeability bedrock. Performance modeling of the containment systems performed by PolyMet and reviewed by the Co-leads provides strong evidence that the capture efficiency would be greater than 90 percent.

The drainage collection component of the containment system would consist of a slotted or perforated horizontal drain pipe surrounded by aggregate (coarse rock) within the trench, excavated to bedrock and backfilled with granular, free-draining material. The horizontal pipe would have vertical risers extending upward into a process water ditch to collect surficial seeps and surface runoff. The trench would intercept stockpile drainage, collect it in the drain pipe, and convey it by gravity flow to two sumps that have emergency gravity overflows to the East Pit or West Pit. From the sumps, it would be pumped to the WWTF described in Section 3.2.2.1.10.

Reclamation of the Category 1 Stockpile would begin in mine year 14, with progressive installation of an engineered geomembrane cover system to limit water percolation into the stockpile. The cover would be completed by year 21. The design of this cover system is discussed in Section 3.2.2.1.10.

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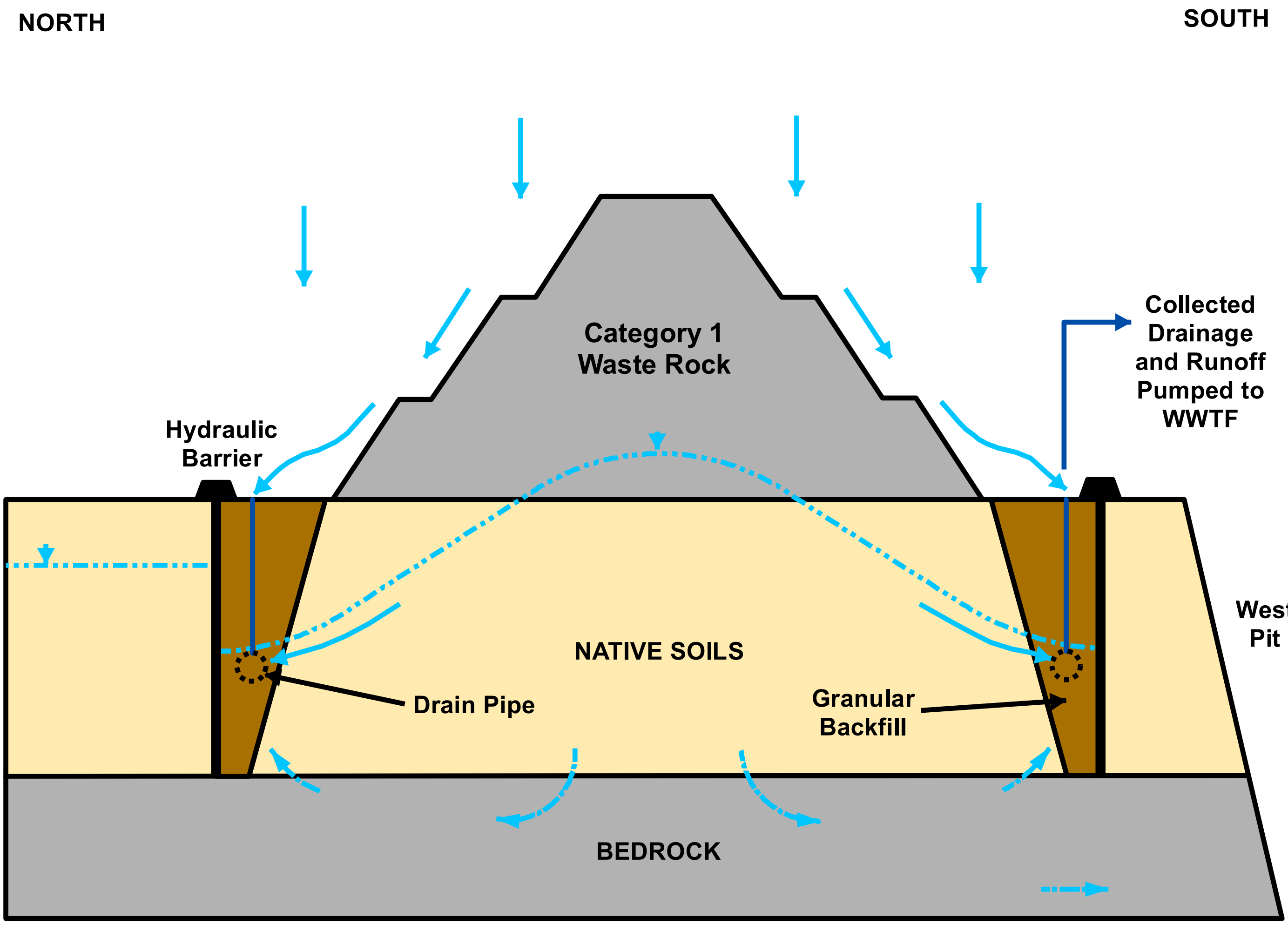

Water Flow

Not To Scale

Figure 3.2-11
Conceptual Representation of the Category 1 Stockpile Containment System - Years 1-13
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

738 -Page Intentionally Left Blank-

Category 2/3 and 4 Stockpiles and Ore Surge Pile Liners

The temporary Category 2/3 Stockpile and Category 4 Stockpile, which have the potential to generate acid and metal leachate, would have liner systems to capture water penetrating through the stockpiles (see Table 3.2-9).

The liner systems would consist of an impermeable barrier layer (to limit the downward infiltration of water through the liner system) and an overlying drainage layer (to promote the conveyance, via gravity, of water that may reach the barrier layer to a collection removal point along the barrier layer). Foundation underdrains would be used, if necessary, to provide gravity drainage should elevated groundwater be encountered, to prevent or minimize the potential for excess pore pressures as the stockpile is loaded. These three design details (impermeable barrier, overliner drainage layer, and underdrains) would enhance liner effectiveness and integrity. Additional detail on the foundation materials and design would be required for permitting. The proposed Category 4 Stockpile liner has a lower permeability design criteria than the Category 2/3 Stockpile liner because the Category 4 waste rock would be more reactive. These stockpiles would be removed and reclaimed prior to the end of mining (i.e., prior to year 20). The liners for these stockpiles would be expected to perform to specification.

Table 3.2-9 Summary of the Stockpile Liners and Covers

Stockpiles	Stockpile Duration	Liner and Cover System	Long-term Management
Category 1	Permanent (constructed in years 1-13)	No liner system; a containment system would collect seeped groundwater for pumping to the WWTF; 3-ft engineered cover with a 40-mil geomembrane barrier (applied progressively during years 14-21)	Containment system and cover maintained and replaced as necessary
Category 2/3	Temporary (constructed in years 1-11 and removed in years 11-20)	12-inch compacted ($1x10^{-5}$ cm/s) subgrade overlaid by 80-mil LLDPE[1] geomembrane, covered by a 24-inch overliner drainage layer	Stockpile and liner to be completely removed and reclaimed (years 11-20)
Category 4	Temporary (constructed in years 1-11 and removed in year 11)	12-inch compacted ($1x10^{-6}$ cm/s) subgrade overlaid by 80-mil LLDPE geomembrane, covered by a 24-inch overliner drainage layer	Stockpile and liner to be completely removed (year 11) to allow mining in the Central Pit
Ore Surge Pile	Temporary (used as required in years 1-20)	12-inch compacted ($1x10^{-6}$ cm/s) subgrade overlaid by 80-mil LLDPE geomembrane, covered by a 24-inch overliner drainage layer	Stockpile and liner to be completely removed and reclaimed (closure)

[1] LLDPE = Linear low-density polyethylene

Mine Site Perimeter and Pit Rim Dike and Ditch Systems

Stormwater would be managed with a system of dikes and ditches constructed at the Mine Site perimeter. The layout of drainage ditches is illustrated on Figures 3.2-5, 3.2-7, and 3.2-8 for mine years 1, 11, and 20, respectively. The dikes and ditches would minimize the amount of surface water flowing onto the site, minimize the amount of surface runoff flowing into the mine pits, manage the amount of process water collected, and control stormwater flowing off the site.

Dikes would be constructed of silty sands or glacial till material that would be excavated during construction of ditches and removal of overburden. Side slopes would be vegetated to control erosion. Small dikes would be constructed at the rims of the mine pits in all areas where the existing ground surface does not naturally drain surface runoff away from the pit, and would be rebuilt as the pit perimeter expands. Small dikes would also be constructed, as needed, along interior stormwater ditches and around stockpile construction areas to separate stormwater and process water. In some areas along the site perimeter, the existing ground is already relatively high so that a ditch would be able to capture the site surface runoff without a dike.

Ditches would be constructed along the interior of most of the perimeter dike system and throughout the interior of the Mine Site in order to:

- Convey stormwater adjacent to the dikes,
- Prevent surface runoff from entering the mine pits,
- Intercept stormwater prior to reaching process water areas, and
- Prevent water from pooling in areas where the dikes cut across low areas.

Dike design could be modified for shallow groundwater control if needed, such as along the perimeter dike north of the Central Pit and East Pit. Where peat or high-permeability glacial till is present in the dike foundation zone below the water table, seepage control measures would be installed to restrict groundwater movement. Seepage control measure design would depend on soil type and depth to bedrock. In areas where peat is present, seepage would be prevented by compressing the peat with earthen dike materials to create a low-permeability layer. If a sand seam or other high-permeability material were found in the dike foundation zone below the peat deposit, a soil cutoff trench, slurry wall, or sheetpile wall would be installed (depending on depth to bedrock) to cut off seepage. In areas where glacial till is present, seepage control measures would include soil cut-off trenches constructed of compacted silty sand or compacted glacial till or would include slurry trenches. Seepage cut-offs are generally not planned to be used in areas of silty sand soils, as geotechnical testing of these soils at the Mine Site indicates these are materials with relatively low permeability in their natural state.

Wastewater Treatment Facility

A WWTF would be constructed to treat affected water at the Mine Site and also treat the reject concentrate from the Plant Site WWTP (see Section 3.2.2.3.10). The WWTF would be constructed on approximately 40 acres and would include equalization and treatment basins and a building that would house the treatment equipment. Water treatment would include chemical precipitation and membrane filtration treatment methodologies. The design of the WWTF is based on the predicted water loads and constituents modeling (see Section 5.2.2). However, should water monitoring undertaken during or following operations indicate a need to do so, the WWTF could be expanded or treatment capabilities modified to meet water quality standards. A reverse osmosis (RO) unit or equivalently performing technology would be added to the WWTF at closure (see Section 3.2.2.1.10).

A Central Pumping Station would be constructed to pump water to the respective management areas as needed.

3.2.2.1.9 Water Management

During mining operations, stormwater captured by the ditches would be directed to sedimentation ponds and then routed into a natural drainage system off-site. Process water collected from the Overburden Storage and Laydown Area would be treated for sedimentation and would be routed to the East Pit or directly to the Tailings Basin for use at the Plant Site or, if monitoring indicates a need, to the Mine Site WWTF.

The water from Mine Site project features (waste rock stockpiles, Ore Surge Pile, ancillary mine features, and mine pits) would be collected and treated at the WWTF. Treated water would be pumped to the Tailings Basin at the Plant Site. The sludge waste would be disposed of off-site in a solid waste landfill until the Hydrometallurgical Plant became operational (see Section 3.2.2.3). When available, sludge waste would be filtered and moved by truck along the Transportation and Utility Corridor and introduced to the autoclave in the Hydrometallurgical Plant to recover metals or placed directly into the Hydrometallurgical Residue Facility (see Section 3.2.2.3.7).

Starting in year 11, some water from the WWTF would be sent to the East Pit to help manage the water level in the pit as it is being backfilled. Covering of the Category 1 Stockpile would begin in year 14 and would be completed in year 21. Once covered, stormwater from the Category 1 Stockpile would be considered non-contact water and would not require treatment. A flow diagram of the proposed water management at the Mine Site for the initial and later years of mining is shown on Figures 3.2-12 and 3.2-13, respectively.

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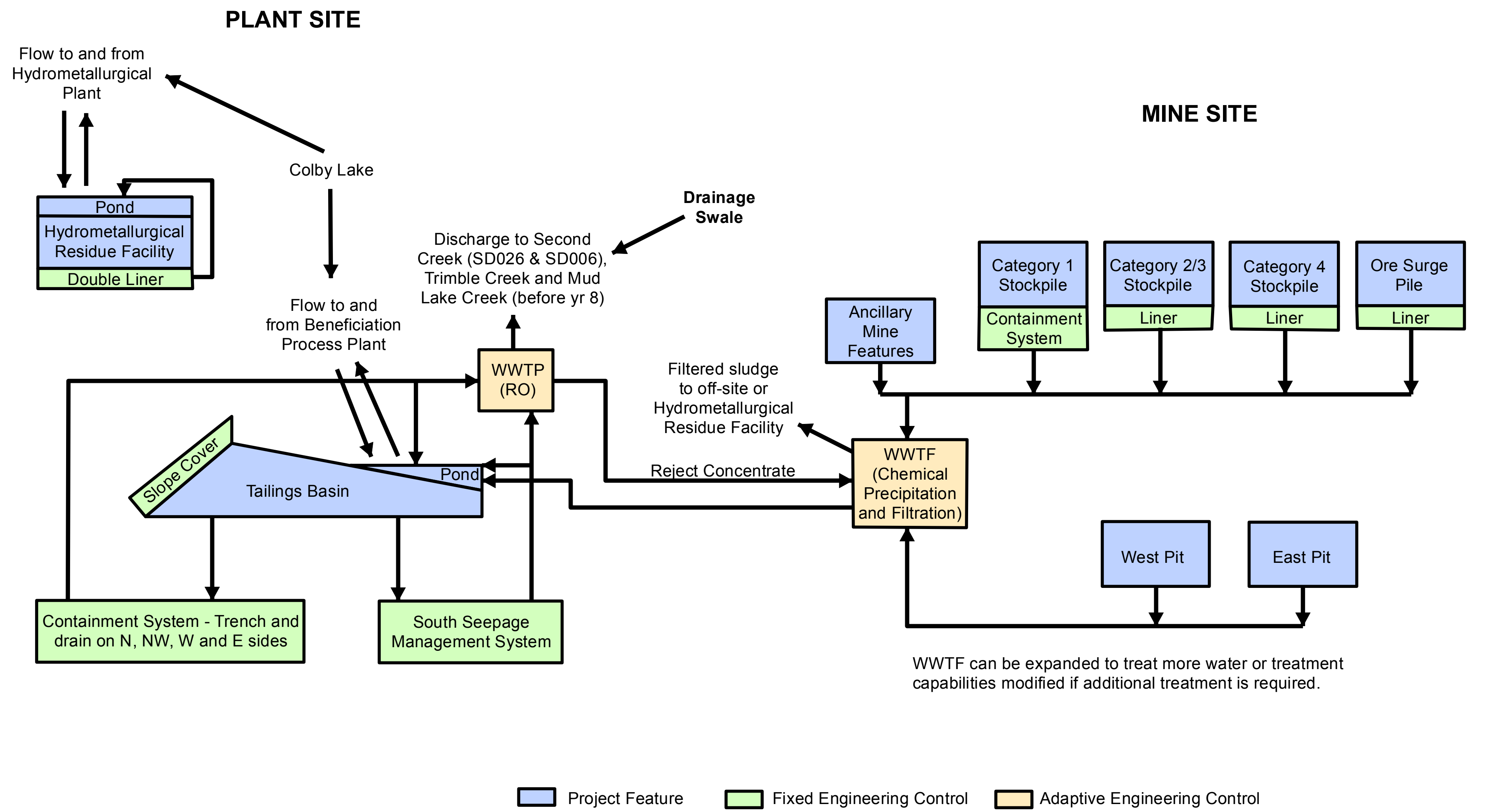

Figure 3.2-12
Water Management Schematic - Initial Years of Operations - Approximately Years 1-11
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Minnesota

June 2015

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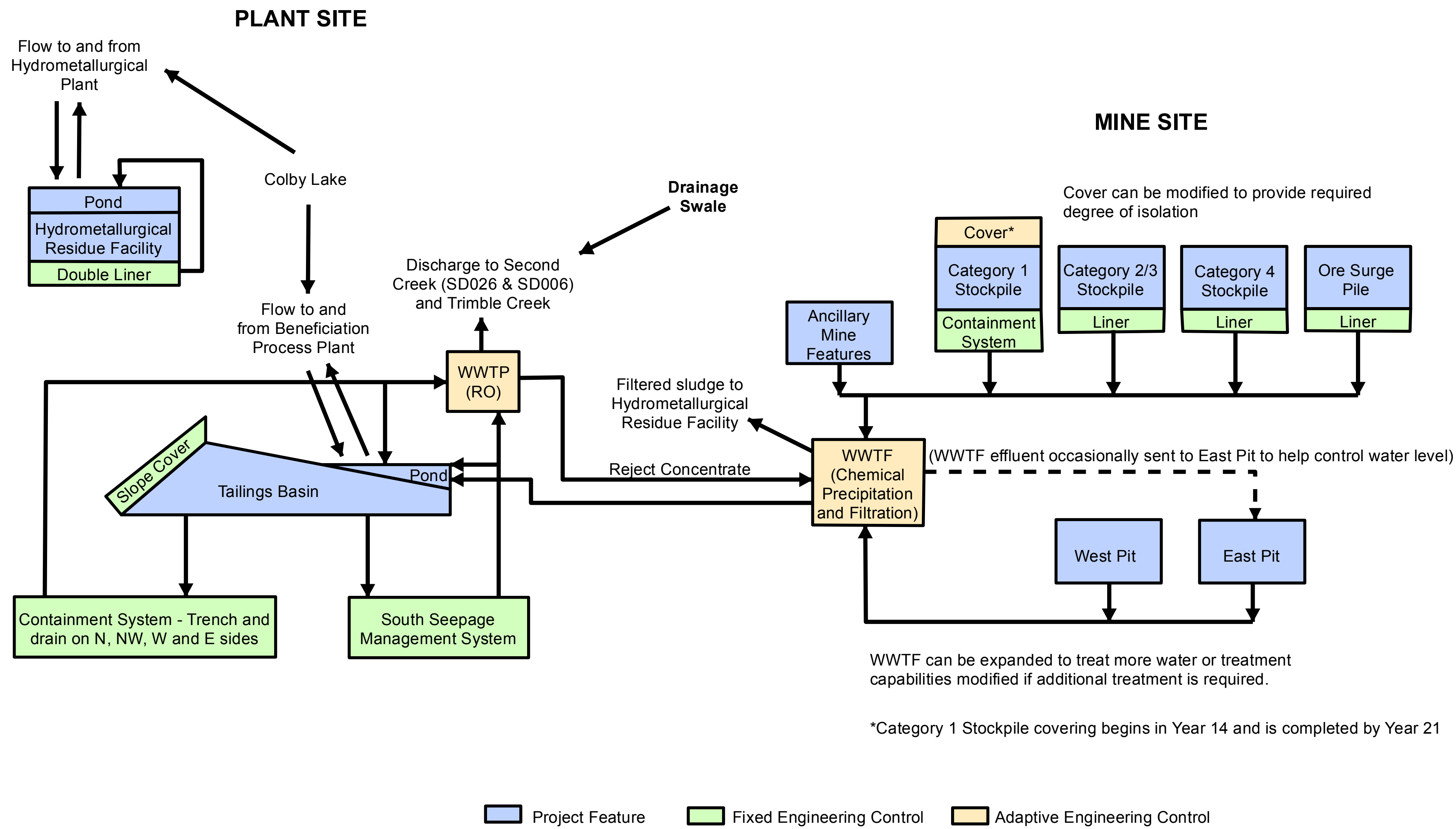

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Figure 3.2-13
Water Management Schematic - Later Years of Operations - Approximately Years 11-20
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

827 -Page Intentionally Left Blank-

3.2.2.1.10 Reclamation and Long-term Closure Management

In general, NorthMet Project area facilities have been designed and would be operated to allow for progressive reclamation, or "mining in a manner that creates areas that can be reclaimed as soon after initiation of the operation as practical and as continuously as practical throughout the life of operation" (*Minnesota Rules*, part 6132.0100). This would leave a smaller portion of the NorthMet Project area needing to be reclaimed at the end of mining. Under the NorthMet Project Proposed Action, progressive reclamation at the Mine Site would include backfilling the East Pit once its ore was exhausted (from year 11 of mining) using waste rock generated through mining following this time and relocating waste rock from the temporary Category 2/3 Stockpile and Category 4 Stockpile. Therefore, at the end of mining, all of the temporary Category 2/3 Stockpile and Category 4 Stockpile would have been removed, and the combined East Central Pit would be mostly backfilled.

At the end of mining, PolyMet would remove all infrastructure and facilities not approved for potential future use, and continue reclamation of disturbed lands. Reclamation objectives would include rapidly establishing a self-sustaining plant community, controlling dust, controlling soil erosion, providing wildlife habitat, and minimizing the need for maintenance. Post-reclamation activities would include monitoring and maintenance of reclamation and water quality until the various facility features were deemed environmentally acceptable, in a self-sustaining and stable condition.

The water quality objective of closure would be to provide mechanical or non-mechanical treatment for as long as necessary to meet regulatory standards at applicable groundwater and surface water compliance points. Water quality modeling performed in support of this FEIS indicates that water treatment systems would be needed indefinitely at the Mine Site and Plant Site. The water models constructed to assess the potential effects from the NorthMet Project Proposed Action were not designed to predict the duration of treatment nor do they capture all the factors that influence the duration of treatment (e.g., potential future regulatory and technological changes). Therefore, the models cannot be used to predict when treatment would end. Actual treatment requirements would be assessed on a recurring basis throughout operations, reclamation, and closure considering influent and effluent water quality and monitoring results. Those periodic assessments would be carried out to ensure continuous protection of groundwater and surface water quality and compliance with water quality-based effluent limits. The periodic assessment process would rely on monitoring results coupled with predictive modeling rather than the results of the predictive modeling alone. Regardless of the precise duration of effects or water treatment at either the Mine Site or Plant Site, there are measures available to address impacts to natural resources, such as those identified in the Adaptive Water Management Plan (PolyMet 2015d) and permit conditions. PolyMet would be held accountable for maintenance and monitoring required under the permit and would not be released from financial assurance until all permit conditions have been met.

The reclamation and long-term closure activities are discussed below, along with the transition to non-mechanical treatment.

A schematic cross section showing the evolution of the pit and stockpile features at the Mine Site from year 11 to post-closure is provided on Figure 3.2-14.

870 -Page Intentionally Left Blank-

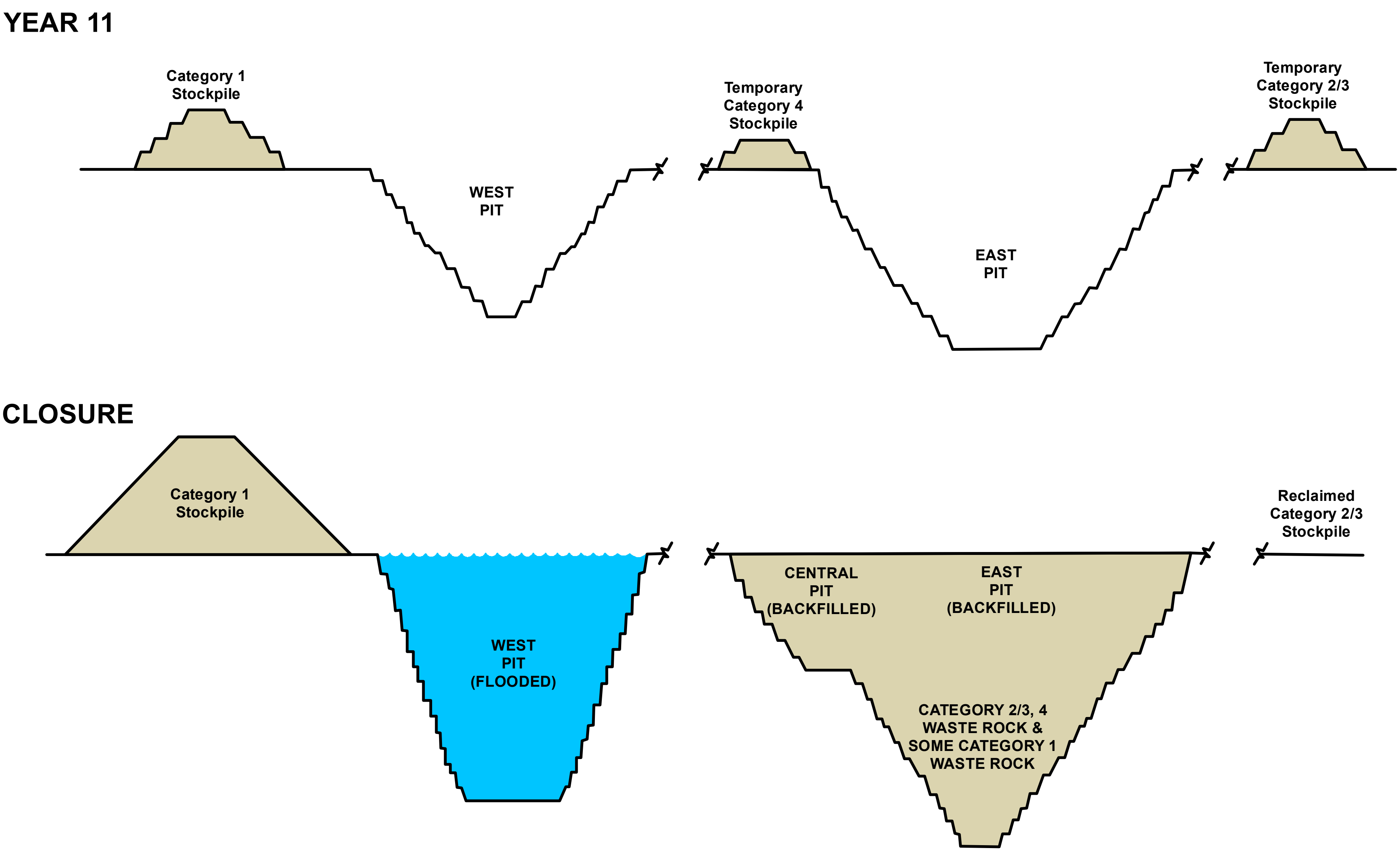

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Figure 3.2-14
Schematic Cross Sections of the Geotechnical Features at the Mine Site (Year 11 and Closure)
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

873

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Reclamation Planning

Mining is expected to be completed approximately 20 years after operations begin. PolyMet has committed to develop a Reclamation Plan as part of its application for the Permit to Mine. The Reclamation Plan would be finalized to provide details and schedule for the final reclamation of the actual as-built facilities. In addition, PolyMet would submit an annual Contingency Reclamation Plan, per *Minnesota Rules*, part 6132.1300, subpart 4, to identify activities that would be implemented if operations were to cease in that upcoming year and the financial assurance necessary to implement that plan.

Building and Structure Demolition and Equipment Removal

All buildings and structures would be removed and foundations razed and covered with a minimum of 2 ft of soil and vegetated according to *Minnesota Rules*, parts 6132.2700 and 6132.3200. Demolition waste from structure removal would be disposed in the existing on-site demolition landfill (SW-619) located northwest of the Area 1 Shops at the Plant Site. Concrete from demolition would be placed in the basements of the coarse-crusher, fine-crusher and concentrator, and the plant reservoir, or placed in landfills as required.

Most roads, parking areas, or storage pads built to access these facilities would be demolished according to the planned schedule or as approved by the MDNR. Utility tunnels would be sealed and closed in place. Asphalt from paved surfaces would be removed and recycled and the disturbed areas reclaimed and vegetated according to *Minnesota Rules*, part 6132.2700. Railroad track and ties that were not used by common carriers would be removed and recycled. Any roads, including mine pit access roads (*Minnesota Rules*, part 6132.3200), that may develop into unofficial off-road vehicle trails would require a variance from MDNR reclamation rules to allow a 15-ft-wide unpaved, unvegetated track down the centerline of the road. Such approvals would also be coordinated with the St. Louis County Mine Inspector's Office.

All mine, railroad, service, and electrical equipment would be moved from the pit to ensure it would be above pit water elevations until it could be scrapped, decommissioned, or sold. Debris and equipment would be removed from the Mine Site.

Any special materials would be disposed of as discussed in Section 3.2.2.3.12.

Rail Transfer Hopper Demolition and Reclamation

During reclamation, aboveground concrete and steel structures would be razed and the area covered with at least 2 ft of soil and vegetated according to *Minnesota Rules*, parts 6132.2700 and 6132.3200. If constructed with Category 1 waste rock, the rock platform from which trucks dump into the hopper would be sloped and covered in the same manner as the Category 1 Stockpile. If constructed of inert material, the platform would be sloped and vegetated according to *Minnesota Rules*, parts 6132.2700 and 6132.3200.

It is possible that the Rail Transfer Hopper could contain ore residuals, which would have the potential to generate acid and metal leachates. Any ore remaining in the Rail Transfer Hopper, Ore Surge Pile, or anywhere else in the vicinity of the Rail Transfer Hopper, as well as sediment removed from ditches and process water ponds, would be placed in the East Pit. Any remaining material located at the top of the rail-loading platform would be tested and placed in an appropriate waste disposal location (i.e., the East Pit or covered with at least 2 ft of soil and vegetated according to *Minnesota Rules*, parts 6132.2700 and 6132.3200).

Mine Pit Reclamation

Mining is anticipated to be completed in the East Pit, Central Pit, and West Pit in mine years 11, 16, and 20, respectively. Ultimately, the combined East Central Pit (after year 16 of mining) would be backfilled with waste rock and flooded to form wetlands. The West Pit would be flooded to form a pit lake.

At the end of mining in each respective pit, the walls would be sloped and graded in accordance with *Minnesota Rules*, part 6132.2300. The toe of the overburden portion of all pit walls would be set back at least 20 ft from the crest of the rock portion of the pit wall. Lift heights would be no higher than 60 ft and would be selected based on the need to protect public safety, the location of the pit wall in relation to the surrounding land uses, the soil types and their erosion characteristics, the variability of overburden thickness, and the potential uses of the pit following mining. The overburden portions of the pit walls would be sloped and graded at no steeper than a horizontal-to-vertical ratio of 2.5:1 and would be vegetated to conform to *Minnesota Rules,* part 6132.2700. Safe access would be provided to the bottom of each mine pit (*Minnesota Rules*, part 6132.3200) via selected original haul roads built during pit development. The access road would be selected such that, as the pits flood, there would always be a clear path to the water surface.

The dewatering systems—including power lines, substations, pumps, hoses, pipes, and appurtenances—would be removed. All areas disturbed during pipe removal would be graded and revegetated. Some piping and temporary pumps may remain in the pits for selected dewatering that would be performed during reclamation.

Pit perimeter fencing systems would be installed and consist of fences, rock barricades, ditches, stockpiles, and berms. A gated entrance would be placed at each pit access location. The fencing system plan would be submitted to the St. Louis County mine inspector for review and approval before installation. As required by the St. Louis County mine inspector and in accordance with *Minnesota Statutes*, chapter 180.03, fencing would consist of five strands of barbed wire in most locations and 5-ft, non-climbable mesh fencing with two strands of barbed wire at the top in areas where roads would remain adjacent to the fences unless other means were agreed to with the mine inspector.

East Pit and Central Pit

Waste rock would be placed into the East Pit at the completion of mining at year 11 and then in the combined East Central Pit beginning in year 16. It is anticipated that the combined East Central Pit would be completely backfilled with waste rock shortly after year 20.

While being backfilled with waste rock, the pits would be flooded with water to minimize the amount of pit wall and backfilled waste rock exposed to the atmosphere, thus limiting the oxidation of the sulfide minerals and reducing the amount of metals leaching to the pit water. Water used to flood the pits would come from groundwater, in-pit runoff, direct precipitation, and treated process water from the WWTF. During backfilling, the water elevation would be maintained below the surface of the waste rock to safely avoid equipment working in the water and to maximize the amount of material used to fill the pit. During periods of high precipitation or during spring snowmelt, dewatering (to the WWTF and ultimately to the Tailings Basin) may be required to allow placement of the waste rock. Lime could be added to the East Pit during East Pit backfilling, as needed, in order to maintain circumneutral pH in the pit pore water. The volume of lime required would be determined through monitoring (see section 5.2.2 for more information).

Once backfilling of the East Pit is complete, a wetland would be constructed over the backfilled material (see Figures 3.2-9 and 3.2-14). The water depth in the backfilled, combined East Central Pit would be maintained within the wetland by a gravity overflow structure to the West Pit. The East Pit overflow structure would be formed out of bedrock or a cast-in-place, reinforced concrete weir.

West Pit

West Pit reclamation would commence when mining activity ceases, expected in year 20. Primary dewatering systems would no longer be operated, and the West Pit would begin to flood naturally with groundwater, precipitation, and surface runoff from the tributary watershed. Flooding would also be accelerated with water from the Plant Site. With the addition of water pumped from the Plant Site to the West Pit, flooding of the West Pit is projected to be completed by the end of year 52. When the West Pit is full, the discharge would be controlled via a lift station and pumped to the WWTF for treatment. The WWTF would be upgraded to include RO or equivalently performing technology; this effluent would be discharged into an existing wetland then into the West Pit Overflow creek, which flows toward Dunka Road south of the West Pit and eventually into the Partridge River. The reject concentrate from the WWTF RO or equivalent technology that would meet water quality targets would be evaporated and the residual solids disposed of off-site (see Section 3.2.2.1.8).

Stockpile Reclamation

As described above, material in the temporary Category 2/3 Stockpile and Category 4 Stockpile would be moved to the East Pit from year 11, and the combined East Central Pit from year 16. The Category 4 Stockpile would be completely removed in year 11 to allow mining to begin in the Central Pit.

Category 2/3 and 4 Stockpiles and the Ore Surge Pile

At year 20, any material remaining in the Category 2/3 Stockpile would be moved to the combined East Central Pit. The disturbed areas would be reclaimed.

The ore in the Ore Surge Pile would be processed as operations wind down, and any remaining material would be sent to the processing plant for processing or relocated to the East Pit after operations cease. Material may still remain in the Overburden Storage and Laydown Area, but the area would be graded to stable conditions and reclaimed.

Infrastructure (pipes, pumps, liners, etc.) associated with the temporary Category 2/3 Stockpile and Category 4 Stockpile and the Ore Surge Pile would be removed and the footprint of each area would be reclaimed to wetlands where practical.

Category 1 Stockpile

Following completion of its construction in year 13, a cover would be installed incrementally over the permanent Category 1 Stockpile. This cover would include an engineered geomembrane system that would be vegetated to meet the requirements of *Minnesota Rules*, part 6132.2200, subpart 2, item B. A subgrade layer would be placed over the Category 1 Stockpile to provide a uniform layer to construct the cover system. As shown in Figure 3.2-15, this cover system would consist of, from top to bottom: 18 inches of rooting zone soil consisting of on-site unsaturated overburden mixed with peat as needed to provide organic matter, 12 inches of granular drainage material with drain pipes to facilitate lateral drainage of infiltrating precipitation and snowmelt off the stockpile cover, the 40-mil geomembrane barrier layer, and a 6-inch soil bedding layer below the geomembrane. The design of the Category 1 Stockpile cover system was derived from landfill requirements, *Minnesota Rules*, part 7035.2815, subpart 6, item D.

The soils at the Mine Site are anticipated to be used for cover material. The cover would be designed to promote runoff with minimal erosion. To provide an adequate base for sloping of cover materials, Category 1 Stockpile side slopes would be re-shaped to no steeper than a horizontal-to-vertical ratio of 3.75H:1V, with the cover system placed on top of the re-shaped waste rock. The outermost layer would consist of local till soils (also known as “overburden” per *Minnesota Rules*, part 6132.0100, subpart 32) adequate for vegetation growth. To provide further erosion control, catch benches at least 30 ft in width would remain on the stockpile.

Stockpile tops and benches would be seeded with a certain selection of grasses/forbs and a potentially different group of species for the slopes. The three groups of species designated for the top and benches would include a native, slow growth mix; a non-native, rapid growth mix; and a mix of both native and non-native species. Non-native species would be used to ensure dust control on areas that have a higher potential to erode. The species mix for the stockpile slopes would contain the same native species as the stockpile bench and flats as well as a slightly modified group of non-native species. Preference would be given to the establishment of native plant communities. The final seed mix would be determined in permitting.

Upon reclamation of a portion of the Category 1 Stockpile, runoff from the top and sides of that portion of the stockpile would be classified as non-contact stormwater and would be routed through a system of ditches prior to being discharged into the natural drainage system. Ditches on the reclaimed stockpile surface would direct stormwater flows into channels that would route flows down the sides of the stockpile. The Category 1 Stockpile water containment system would continue to collect drainage from the stockpile during reclamation, with drainage treated at the WWTF. The general flow of water on the reclaimed stockpile is shown in Figure 3.2-16.

Long-term maintenance of the Category 1 Stockpile would include repairing erosion and removal of woody species and trees from the stockpile cover system.

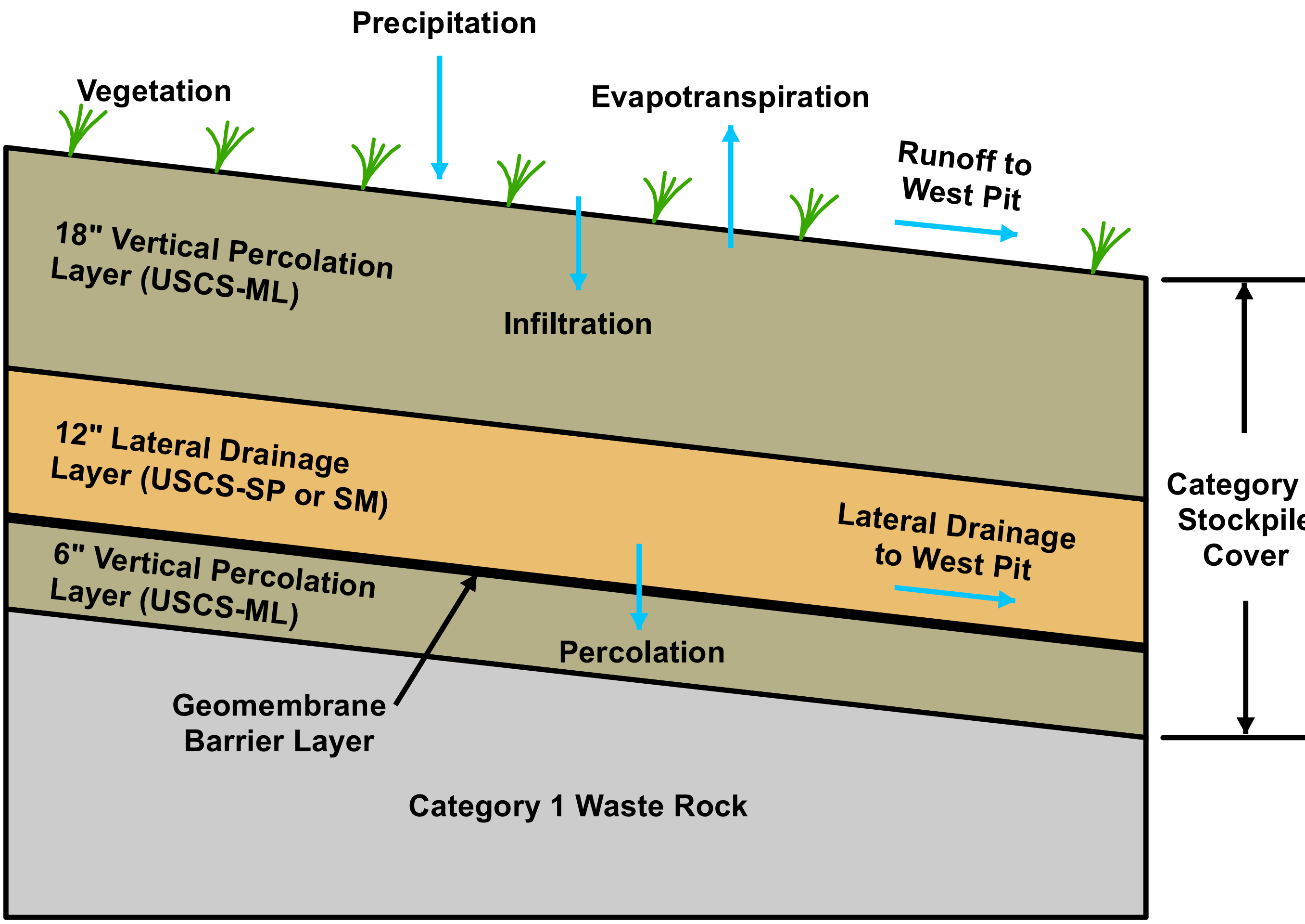

Figure 3.2-15
Conceptual Cross Section - Category 1 Stockpile Cover System
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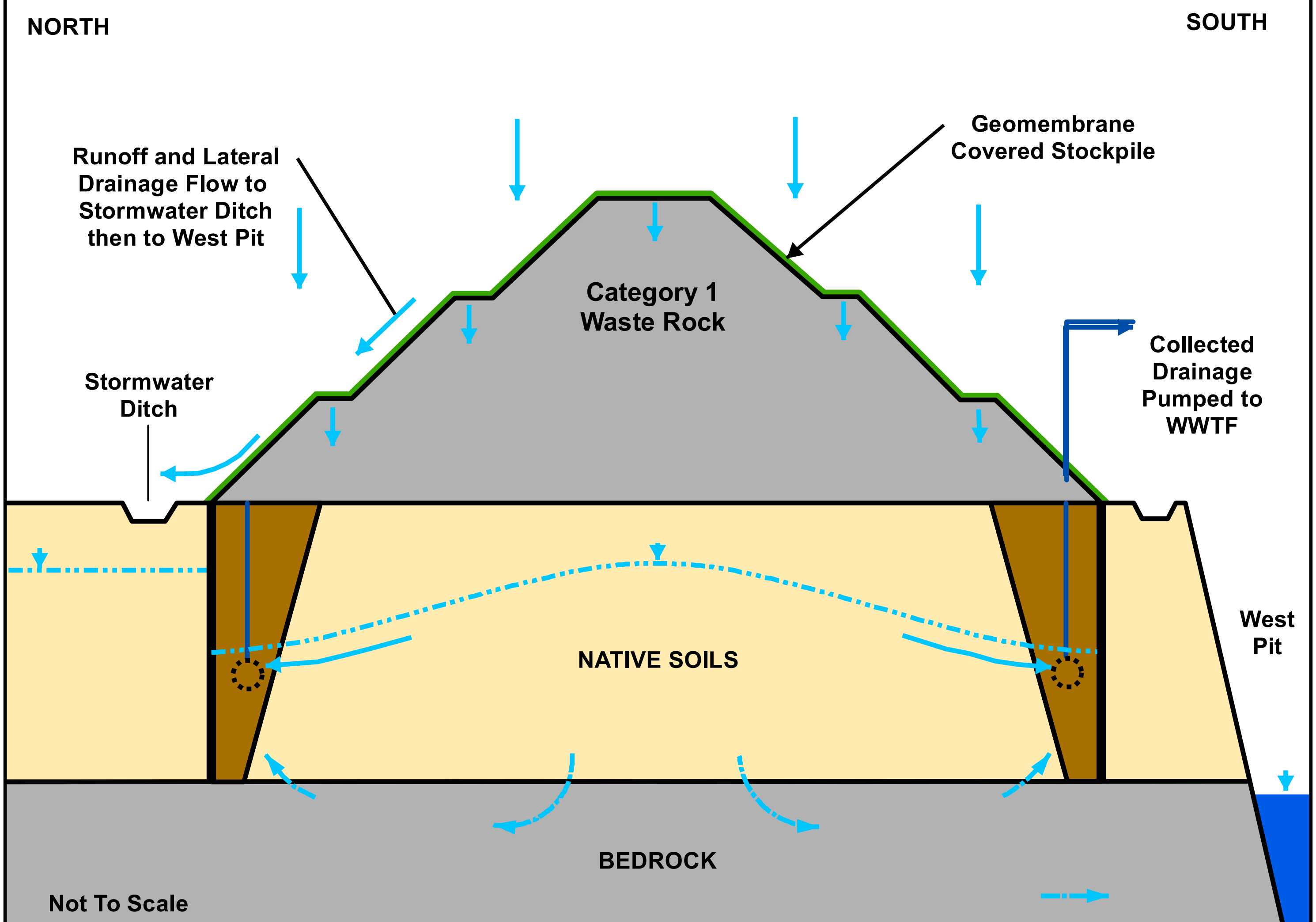
Minnesota

June 2015

1032 -Page Intentionally Left Blank-



Water Flow

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St. Paul District

Figure 3.2-16
Conceptual Cross Section - Category 1 Stockpile Containment System - Long Term Closure Conditions
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Minnesota

June 2015

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Watershed Restoration

During mining operations, stormwater runoff from reclaimed stockpile areas and natural (undisturbed) areas would be routed via dikes and ditches to stormwater sedimentation ponds. Upon completion of stockpile reclamation, these water management systems would be modified. Perimeter dikes that would no longer be needed to provide access or separation from the areas outside the Mine Site would be removed. The dike located north of the East Pit would remain in place to minimize mixing of the Partridge River flows with the East Pit water and prevent gully development on the northern side of the pit in the segments not protected by ditches. In addition, the dike located north of the Category 1 Stockpile would remain in place to allow access to groundwater monitoring locations.

Surface runoff would be routed to the mine pits using a combination of existing and new ditches. Some portions of the pit rim dikes may be left in place, if needed, to prevent an uncontrolled flow to or from the pits and potential erosion (head cutting) of the pit walls.

In all cases of dike removal, material from the main body of the dikes would be removed and used at the site for restoration of disturbed surfaces. To minimize disturbance of subsurface soils, any subsurface seepage control components of the dikes would remain in place. As part of the dike removal work, typical construction erosion-control measures would be used. These could include installing silt fencing on the down-slope side of disturbed areas and controlling surface water runoff. The reclaimed surface would then be scarified, topsoil would be placed, and the area would be revegetated with native species.

Ditches would be filled or rerouted during reclamation to direct stormwater into the West Pit for flooding. Use of existing ditches would be maximized, but some new ditches may need to be constructed to direct stormwater runoff from the Mine Site into the East Pit or West Pit.

All ponds—including the stormwater ponds, the Overburden Storage and Laydown Area process water pond, the Rail Transfer Hopper process water pond, the haul road process water ponds, and all stockpile sumps and overflow ponds—would either be filled or converted into wetlands. Once filled, the ponds would be covered with topsoil and revegetated to restore these areas. If the process water ponds were converted into wetlands, any sedimentation that occurred within the pond would be evaluated to determine if removal or covering would be necessary to prevent adverse effects to wetlands during restoration.

Stormwater pond outlet control structures would remain in place as necessary to manage water resource effects. The outlet control structure on the stormwater pond located immediately north of the East Pit and the Category 1 Stockpile (and associated dike) would remain in place to minimize the mixing of the Partridge River flows with the East Pit water and prevent gully development on the northern side of the pit. The outlet control structures on the two stormwater ponds next to Dunka Road would remain in place to direct water under the road and the railroad to a tributary to the Partridge River along natural drainage paths. As a requirement of the NPDES stormwater permit and/or reclamation plan for the facility, discharges from these outlet control structures would be monitored as necessary to ensure that runoff to the Partridge River meets water quality discharge limits.

Water Management

During the reclamation phase (while the West Pit is flooding), the water from the Category 1 Stockpile groundwater containment system would be pumped to the WWTF and treated. Water from the combined East Central Pit would also be pumped to the WWTF and treated. The effluent from the WWTF would be sent to the combined East Central Pit and West Pit. Treatment of the combined East Central Pit water would include removing the flushing load of constituents added as waste rock is backfilled to the combined East Central Pit, and the pit walls would be inundated. In addition, water from the Plant Site would be pumped to the West Pit to flood the pit faster. In the final years of the reclamation phase, water from the West Pit would be pumped to the WWTF, treated, and returned to the West Pit. The objective of treating the West Pit water would be to manage water quality within the pit prior to groundwater outflow from the pit lake via the surficial aquifer. The WWTF could be expanded or treatment capabilities modified if required to meet water resource objectives during this time.

Once the West Pit is full (by the end of year 52), discharge of treated water from the WWTF to the West Pit would be terminated. The WWTF would be upgraded to RO or equivalent technology that would meet water quality targets and include evaporator/crystalizers to convert the RO reject concentrate to residual solids, which would be disposed of at appropriate off-site facilities. The WWTF would continue to treat water collected by the Category 1 Stockpile groundwater containment system, as well as water from the West Pit, to ensure that the discharge met applicable water quality based effluent limits. Treated water would be discharged into an existing wetland on the other side of Dunka Road then into the West Pit Overflow Creek and eventually into the Partridge Inspection, maintenance, and reporting activities would continue while the mechanical treatment systems operate during long-term closure. Surface water and groundwater would be monitored as required by relevant permits.

These long-term closure activities would be ongoing until the various facility features were deemed environmentally acceptable, in a self-sustaining and stable condition, and until it were shown that water quality standards were being met. The objective of closure would be to provide mechanical or non-mechanical treatment for as long as necessary to meet regulatory standards at applicable groundwater and surface water compliance points. Water quality modeling performed in support of this FEIS indicates that water treatment systems would be needed indefinitely at the Mine Site and Plant Site. The water models constructed to assess the potential effects from the NorthMet Project Proposed Action were not designed to predict the duration of treatment nor do they capture all the factors that influence the duration of treatment (e.g., potential future regulatory and technological changes). Therefore, the models cannot be used to predict when treatment would end. Actual treatment requirements would be assessed on a recurring basis throughout operations, reclamation, and closure considering influent and effluent water quality and monitoring results. Those periodic assessments would be carried out to ensure continuous protection of groundwater and surface water quality and compliance with water quality-based effluent limits. The periodic assessment process would rely on monitoring results coupled with predictive modeling rather than the results of the predictive modeling alone. Regardless of the precise duration of effects or water treatment at either the Mine Site or Plant Site, there are measures available to address impacts to natural resources. PolyMet would be held accountable for maintenance and monitoring required under the permit and would not be released from financial assurance until all permit conditions have been met.

When all reclamation activities required by the Permit to Mine are completed, a Request for Release per *Minnesota Rules*, part 6132.1400, would be submitted. This request would provide the Commissioner of the MDNR with detailed information on the final reclamation status of the NorthMet Project area.

A summary of the water management during reclamation and long-term management is provided on Figures 3.2-17, 3.2-18, and 3.2-19.

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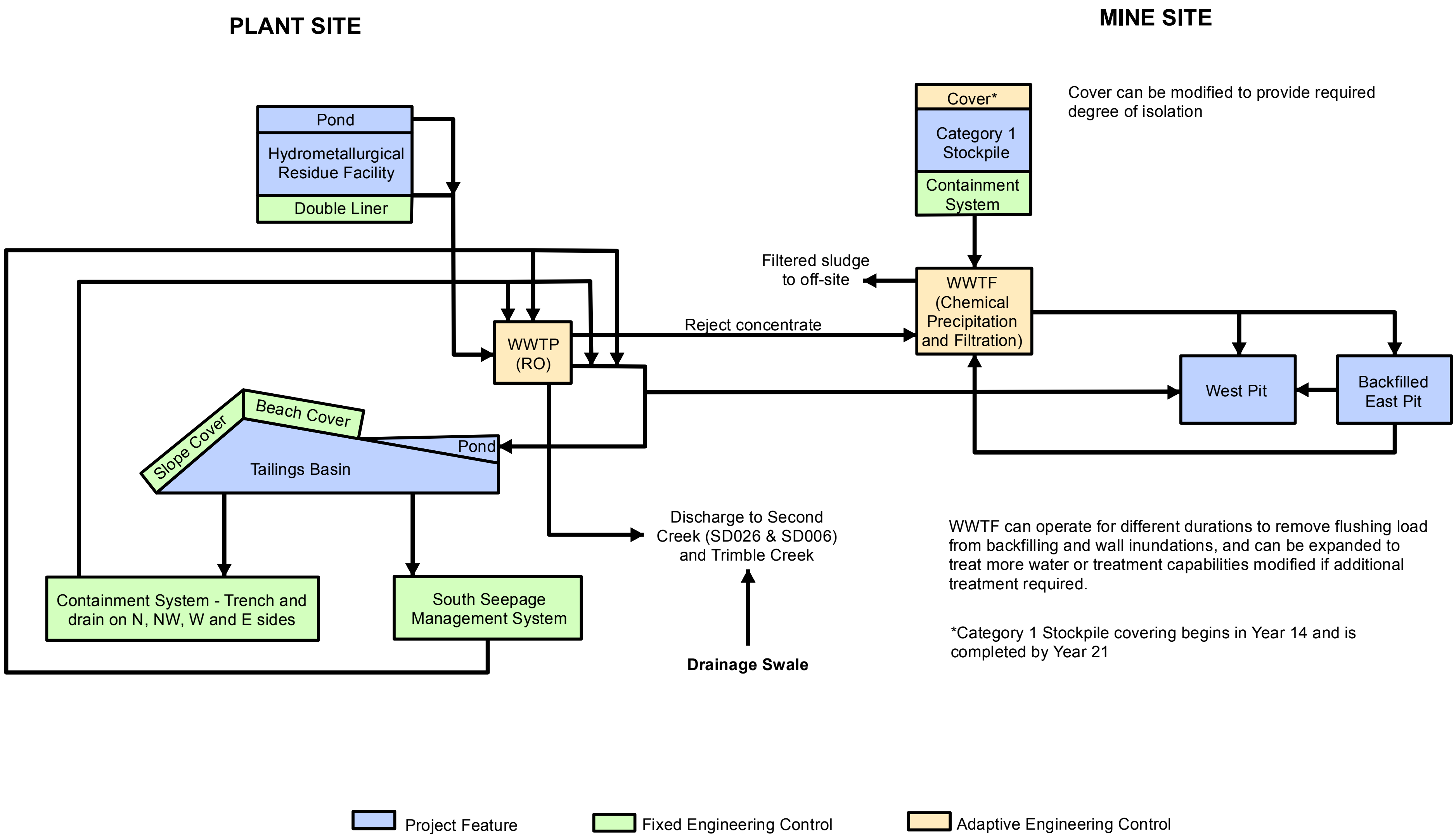

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St. Paul District

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Figure 3.2-17
Water Management Schematic - Reclamation - Approximate Years 21-30
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Minnesota

June 2015

1128

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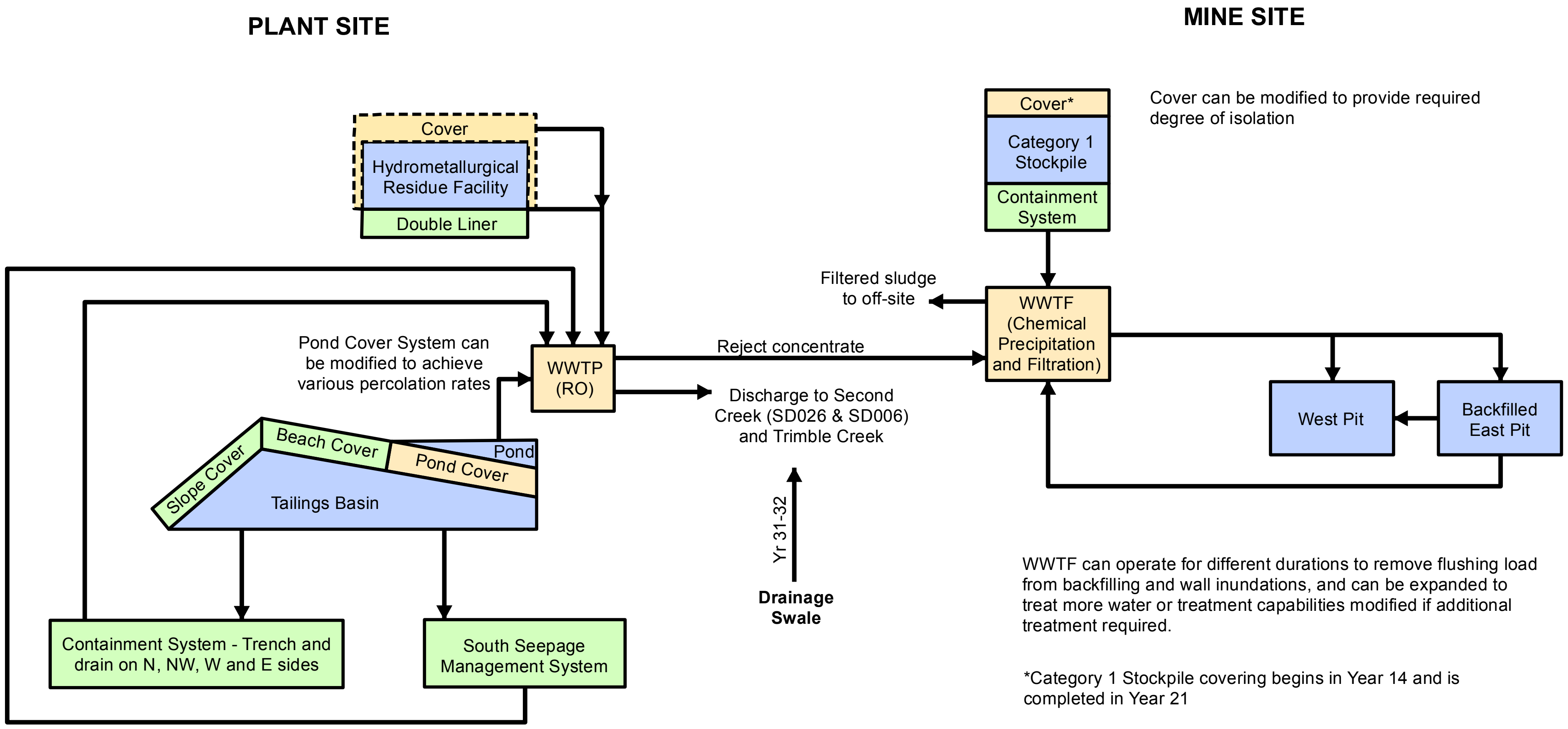

Project Feature | Fixed Engineering Control | Adaptive Engineering Control | Adaptive Engineering Control (unknown timeframe)

Figure 3.2-18
Water Management Schematic - Reclamation - Approximate Years 31-52
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June 2015

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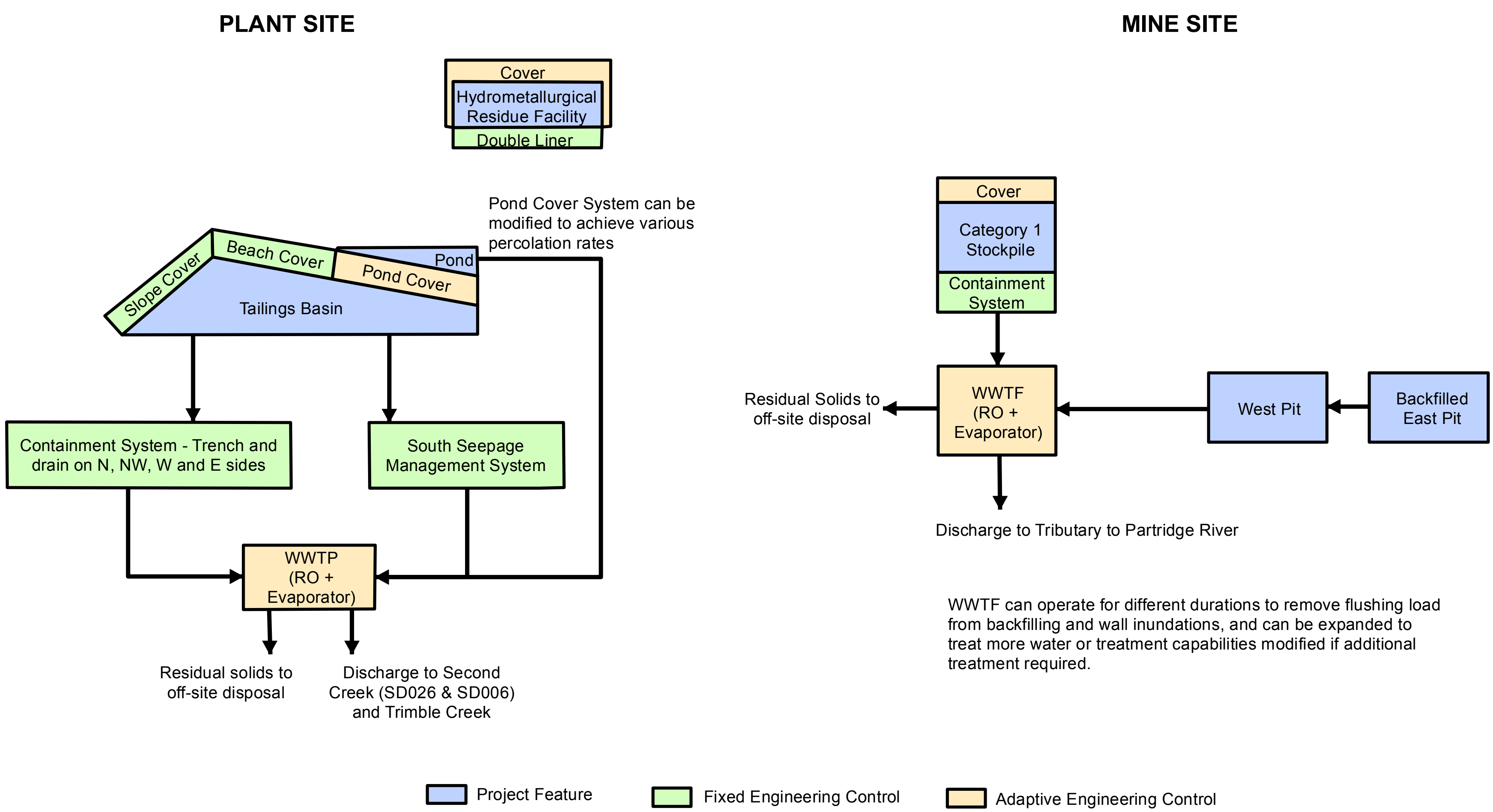

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Figure 3.2-19
Water Management Schematic - Long-term Mechanical Treatment
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Minnesota

June 2015

1132 -Page Intentionally Left Blank-

Transition from Mechanical to Non-Mechanical Treatment

The information in this section does not reflect the NorthMet Project Proposed Action as modeled for predicted impacts in this FEIS, but provides an overview of the transitional approach from mechanical water treatment to the use of non-mechanical treatment technologies that PolyMet would evaluate during operations. PolyMet would include funds in its contingency reclamation estimate and financial assurance package to operate mechanical water treatment for as long as necessary as a part of its Permit to Mine. However, the Permit to Mine would also require PolyMet to present a plan for eventual transition from mechanical water treatment to non-mechanical water treatment.

PolyMet would transition from mechanical to non-mechanical water treatment as soon as the company demonstrates that non-mechanical water treatment technologies would effectively treat water to meet water quality based effluent limits and as soon as formal approval is received from the agencies.

Non-mechanical water treatment technologies need to be designed for site-specific conditions and actual site water quality. PolyMet accordingly would test non-mechanical water treatment technologies for several years during mine operations and reclamation, until an acceptable treatment performance could be achieved.

Non-mechanical water treatment technologies can be evaluated in four steps: 1) collecting additional local site information (i.e., hydrology and influent water quality), 2) laboratory testing, 3) pilot-scale testing, and 4) designing a system for full-scale implementation. At the Tailings Basin, this additional site-specific hydrologic information could be collected when the containment system is being constructed and throughout operations. Also, the quality of the water expected at the Tailings Basin in the long term due to PolyMet's operation would start to appear at the toe of the Tailings Basin during operations. Thus, the four steps for evaluating non-mechanical water treatment at the Tailings Basin are planned to be accomplished during operations, allowing the non-mechanical water treatment system at the Tailings Basin to be in place shortly after operations are complete and the Tailings Basin pond cover is in place.

At the Mine Site, the four steps for evaluating non-mechanical treatment technologies could be completed in less than the time estimated for the West Pit to flood (e.g., before the end of year 52 or 32 years after the mine stops operating). However, additional time is included in the plan because the water quality in the pit could take a few years to reach equilibrium after the West Pit is flooded. Therefore, the four steps would be undertaken during reclamation. As a result, non-mechanical water treatment technology could be implemented at the Mine Site a few years after the West Pit is flooded.

The conceptual design for a non-mechanical treatment system is to treat each flow expected in the long term. The Adaptive Water Management Plan (PolyMet 2015d) outlines the purpose, design, degree of industry use, up-front preparation, timing, and duration of implementation and potential indirect impacts of these systems.

PolyMet has initiated testing of non-mechanical water treatment technologies on site (in collaboration with Cliffs Erie) and will continue testing these systems and evaluating other non-mechanical water treatment technologies until they could be demonstrated to the satisfaction of the MDNR and MPCA to provide the required water treatment. Provisions would be included in the NorthMet Project financial assurance package to ensure this test work and implementation of the non-mechanical water treatment technologies could be completed, in order to achieve the long-term closure goals and eventual release from the Permit to Mine.

Post-Closure Activities

Maintenance activities that would continue throughout reclamation and post-reclamation include erosion repair, woody species and tree removal on the Category 1 Stockpile cover system, and ongoing operation and maintenance of the Category 1 Stockpile groundwater containment system and WWTF. PolyMet has committed to conduct demonstration projects during the Life of Mine and reclamation phases to establish non-mechanical water treatment systems to be used at the Mine Site. The WWTF would remain operational until water quality monitoring results demonstrate that a non-mechanical system could produce an effluent water quality, which is shown by pilot-testing and modeling, to achieve future water quality criteria at evaluation locations without the need for mechanical treatment.

PolyMet would be held accountable to maintenance and monitoring required under permit and would not be released until all conditions have been met.

3.2.2.2 *Transportation and Utility Corridor*

The Mine Site and Plant Site would be connected by a Transportation and Utility Corridor that would contain refurbished and new infrastructure proposed to transport goods, including ore, between the Mine Site and Plant Site.

3.2.2.2.1 Location and Ownership

The Transportation and Utility Corridor would be approximately 7 to 8 miles in length, generally consisting of two alignments (railroad and Dunka Road) that deviate from one another at various points along the corridor (see Figure 3.2-20).

PolyMet has acquired ownership of, or the rights to use, the land and existing infrastructure required within the Transportation and Utility Corridor. Surface owners of land intersected by the existing Dunka Road and existing and new sections of railway are listed in Table 3.2-10.

Table 3.2-10 Surface Owners along the Transportation and Utility Corridor

Alignments	Land Surface Owner	Township and Section
Dunka Road and/or Treated Water Pipeline	State of Minnesota	Township 59 N, Range 13 W, Section 16
		Township 59N, Range 14W, Sections 13, 14, 15
	Cliffs Mining Services	Township 59N, Range 13W, Sections 1, 10, 11, 15, 18
		Township 59N, Range 14W, Section 13
	United States of America	Township 59N, Range 13W, Sections 12, 17, 18
	Allete, Inc.	Township 59N, Range 13W, Section 17
Railroad	State of Minnesota	Township 59N, Range 13W, Section 16
		Township 59N, Range 14W, Sections 14, 23
	Cliffs Mining Services	Township 59N, Range 13W, Sections 1, 10, 11, 12, 15, 17, 18
		Township 59N, Range 14W, Sections 13, 24

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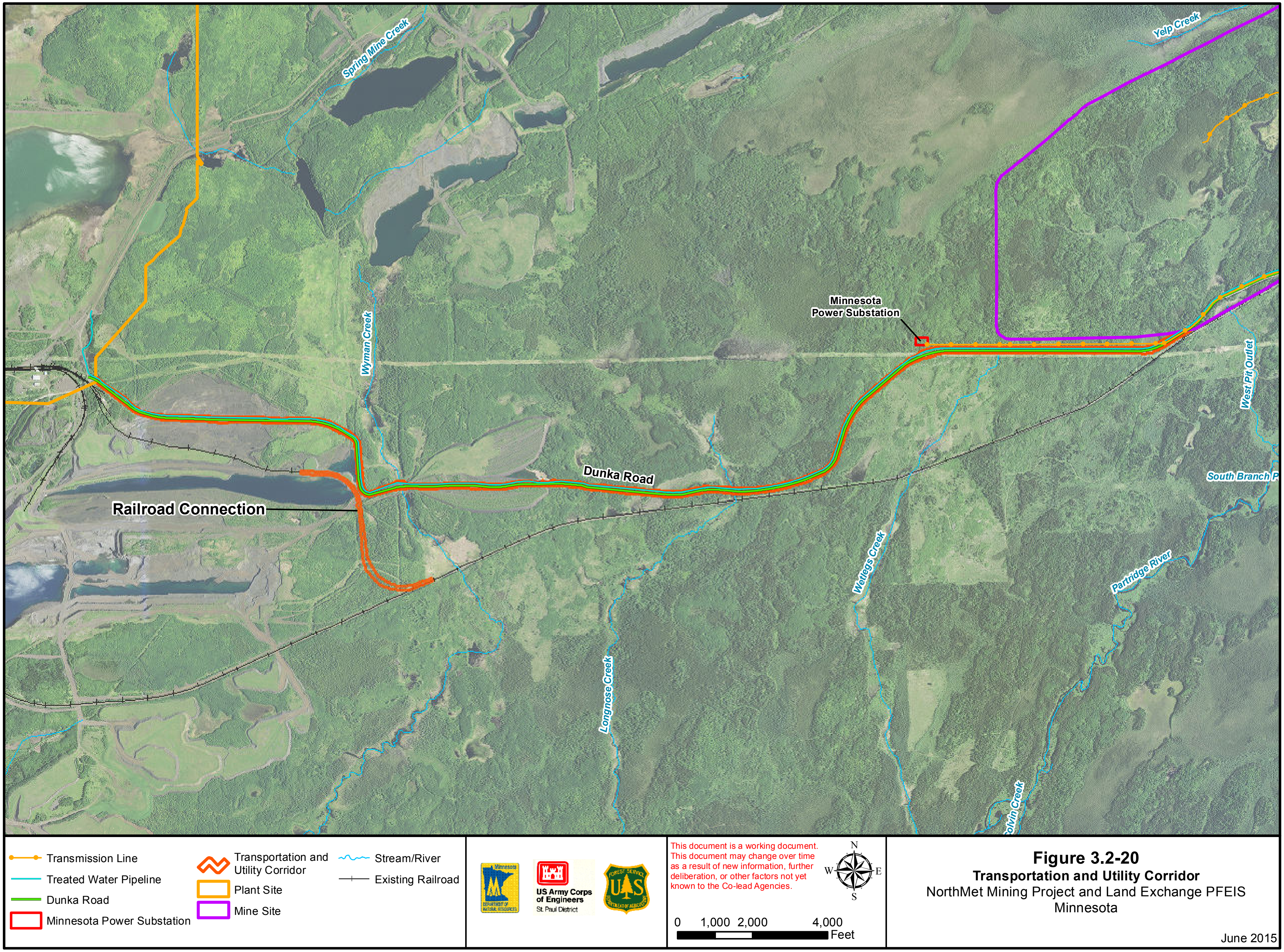

Figure 3.2-20
Transportation and Utility Corridor
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June 2015

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3.2.2.2.2 Existing Conditions

The existing Cliffs Erie private railroad and Dunka Road are located within the Transportation and Utility Corridor (see Figure 3.2-20), and both would be refurbished for use as part of the NorthMet Project Proposed Action.

3.2.2.2.3 New Construction and Pre-production Development

Pre-production development along the Transportation and Utility Corridor would include the following:

- Refurbishing the existing 8-mile portion of the Cliffs Erie private railroad located between the Mine Site and Plant Site;
- Constructing a new rail spur (less than 1 mile in length) to connect the existing Cliffs Erie private railroad to the Rail Transfer Hopper at the Mine Site;
- Constructing a new rail connection track (just over 1 mile in length) connecting the existing Cliffs Erie private railroad to existing railroad infrastructure at the Plant Site;
- Upgrading an existing 7-mile segment of the private Dunka Road located between the Mine Site and Plant Site;
- Constructing a new water pipeline approximately 7.5 miles in length along Dunka Road, to connect the Mine Site with the Plant Site; and
- Constructing a new 2.5-mile 13.8 kV transmission line along a portion of Dunka Road to connect the Mine Site to a new Minnesota Power electrical substation.

3.2.2.2.4 Use During Operations

The primary portion of the Transportation and Utility Corridor consists of Dunka Road and the Treated Water Pipeline. Dunka Road would be used to transport various materials and personnel between the Mine Site and Plant Site. The Treated Water Pipeline would be used to transport treated water from the Mine Site to the Tailings Basin at the Plant Site.

The secondary portion of the Transportation and Utility Corridor is the railroad, which would generally be used to transport ore from the Mine Site to the Plant Site using three to four trains, each consisting of sixteen to twenty 100-ton, side-dumping ore cars and one 2,100-hp (approximate), six-axle diesel-electric “Gen-Set” or “Multi-Engine” locomotive.

The side-dump cars have two hinged doors that act as the sides of the car and drop down when the cars are tipped at the coarse-crusher for unloading. PolyMet plans to use an existing but currently decommissioned fleet of LTVSMC side-dump ore cars. This ore car fleet currently shows wear at the hinges and joint areas, which have resulted in gaps in these areas where couplings and linkages have loosened over time. Prior to the start of operations, PolyMet would refurbish these ore cars, which would include tightening or replacement of the couplings and linkages to minimize gaps along the hinges and joint areas. Figure 3.2-21 shows the configuration of the ore cars. These side-dump ore cars are different from the bottom-dump pellet rail cars that LTVSMC used to haul taconite pellets, which were spilled along the railroad. Since these side-dump cars proposed to be used for the NorthMet Project Proposed Action would be refurbished and only used to haul ore, they would result in less spillage than from the bottom-dump cars that were used for the LTVSMC operations (PolyMet 2014a).

1246 -Page Intentionally Left Blank-

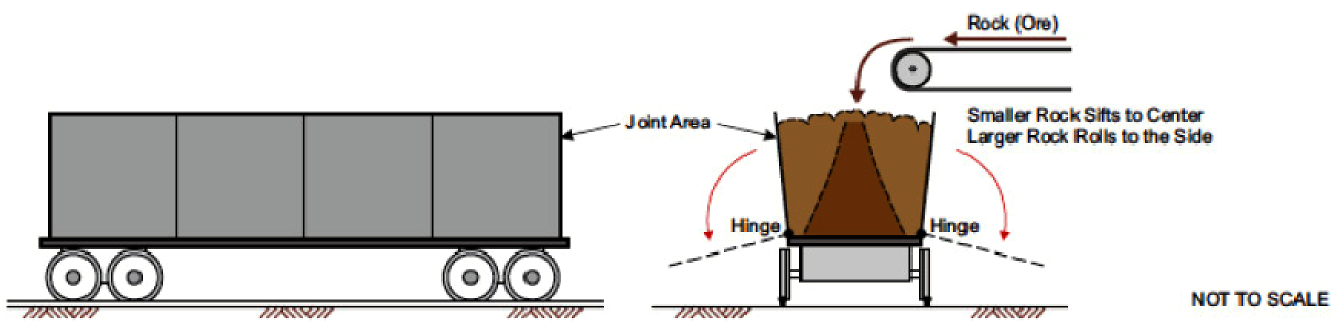

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Figure 3.2-21

Side Dump Railroad Cars

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1249 -Page Intentionally Left Blank-

3.2.2.2.5 Reclamation and Long-term Closure

At closure, infrastructure along the Transportation and Utility Corridor would be managed in accordance with the respective usage agreements.

3.2.2.3 *Plant Site*

The NorthMet Project Proposed Action would include the development and operation of a Plant Site, an area located at the former LTVSMC processing plant. The Plant Site would include infrastructure required to process ore received from the Mine Site in order to recover base metals and Au/PGE, and to manage associated wastes.

Operating at the average mining rate (see Section 3.2.2.1), annual production would yield about 113,000 short tons of copper concentrate, 18,000 short tons of mixed nickel/cobalt hydroxide, and 500 short tons of gold and PGE precipitate. Tailings and hydrometallurgical residue would be stored in expanded existing facilities that would be progressively constructed throughout operations.

The required infrastructure and the steps undertaken during processing, including the inputs and outputs, are discussed below.

3.2.2.3.1 Location and Ownership

The Plant Site is located at the site of the former LTVSMC processing plant, approximately 6 miles north of the City of Hoyt Lakes (see Figure 1.1-1).

PolyMet has surface ownership of the lands encompassing the Plant Site, including the existing infrastructure and tailings facilities (see Figure 3.2-1).

3.2.2.3.2 Existing Facilities

The Plant Site was previously used for the former LTVSMC taconite processing operations that ended in 2001. As shown in Figure 3.2-22, existing infrastructure at the site includes a Beneficiation Plant, access roads, railway infrastructure, maintenance facilities (shops), and a process waste facility (Tailings Basin), as well as ancillary and support infrastructure and buildings such as administration, warehouse, and storage facilities. A pump station and pipeline also connect the Plant Site to Colby Lake, located to the south.

The existing LTVSMC Tailings Basin is unlined and was constructed in stages beginning in the 1950s. It was configured as a combination of three adjacent cells, identified as Cell 1E, Cell 2E, and Cell 2W, and was developed by first constructing perimeter starter dams and placing tailings from the iron-ore process directly on native material. Perimeter dams were initially constructed from rock and subsequent perimeter dams were constructed of coarse tailings using upstream construction methods. The Tailings Basin operations were shut down in January 2001 and have been inactive since then except for reclamation activities consistent with an MDNR-approved closure plan and Cliffs Erie Consent Decree.

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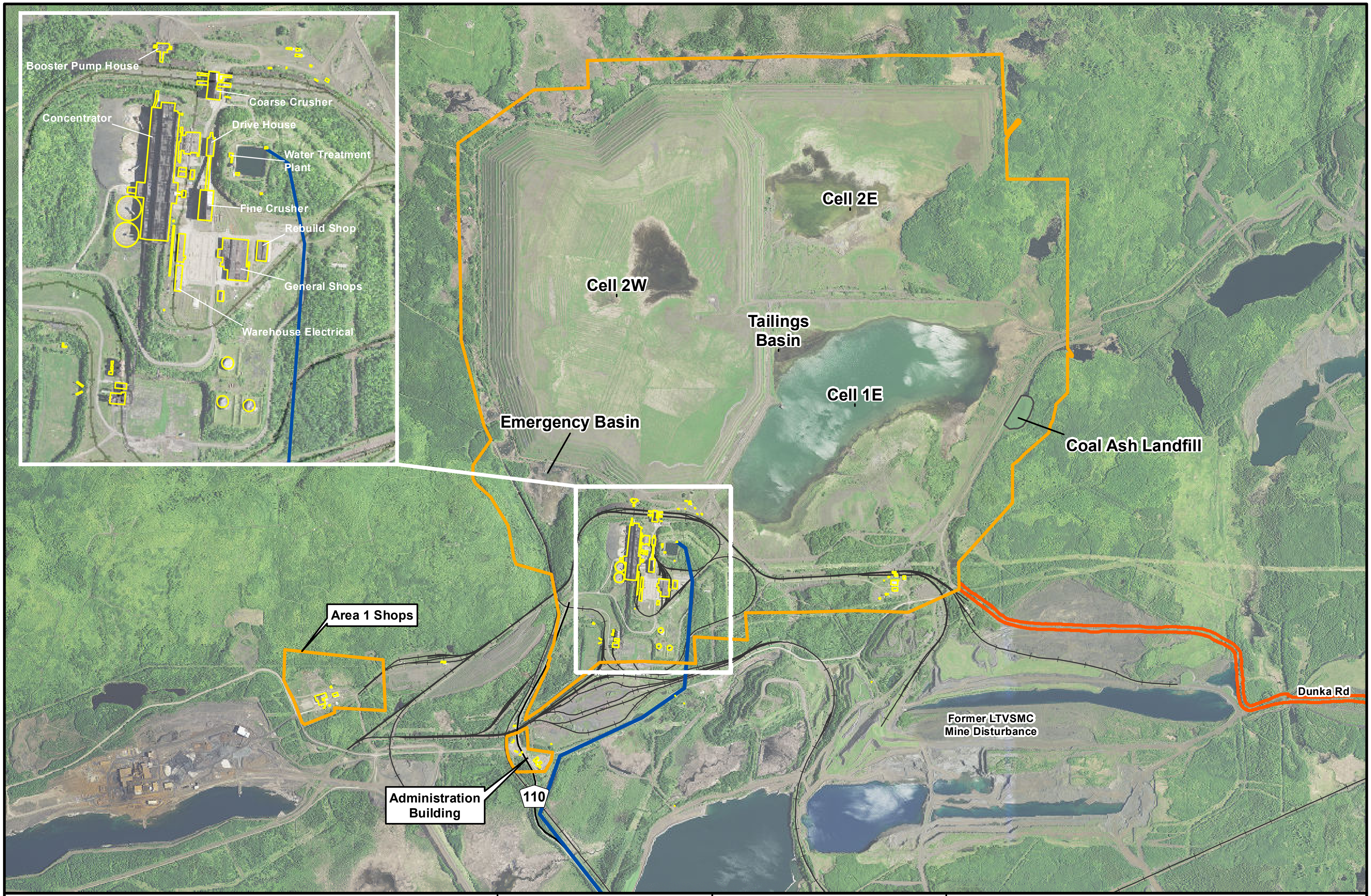

Plant Site
Existing Building
Colby Lake Water Pipeline Corridor
Transportation and Utility Corridor
Existing Railroad

Minnesota Department of Natural Resources
US Army Corps of Engineers St. Paul District
Forest Service Department of Agriculture

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N S W E

0 1,000 2,000 4,000 Feet

Figure 3.2-22
Existing Conditions at the Plant Site
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June 2015

1287 -Page Intentionally Left Blank-

3.2.2.3.3 New Construction and Pre-production Development

PolyMet proposes to use some of the existing infrastructure at the Plant Site. The existing infrastructure would be refurbished and supplemented with new facilities that would be constructed and operated as part of the NorthMet Project Proposed Action.

Key infrastructure at the Plant Site that would be refurbished and used includes:

- Beneficiation Plant facilities such as:
  - Coarse-crusher building,
  - Fine-crusher building, and
  - Concentrator building, which would be refurbished to include construction of the new semi-autogenous grinding (SAG) mill inside;
- Area 1 Shops;
- Area 2 Shops;
- Ancillary buildings (warehouses, general shops, rebuilt shop, booster pump house, potable water plant, administration building, etc.);
- Ancillary infrastructure (roads, railroad tracks, plant reservoir, loadout facilities, storage yards, stormwater infrastructure, sewage treatment collection system, septic systems, etc.); and
- A pump station and pipeline connecting the Plant Site to Colby Lake, located approximately 4 miles to the south of the Plant Site.

Flotation in the beneficiation process would occur in a new flotation building located on disturbed ground immediately to the west of the concentrator building. Dewatering, storage, and shipping would occur in new concentrate dewatering, storage, and loadout buildings located on disturbed ground near an existing heating and additive plant, which would be demolished.

All equipment used in the hydrometallurgical process would be located in a new Hydrometallurgical Plant building.

New tailings would be placed within new dams on top of the existing LTVSMC Tailings Basin. Hydrometallurgical residue would be placed within new dams built on top of the existing LTVSMC Emergency Basin adjacent to the existing tailings facility. Refer to the geotechnical stability section in Chapter 4.0 for more information on the existing geotechnical conditions at the Tailings Basin and Hydrometallurgical Residue Facility.

CDSM is an engineering measure that would be used to stabilize the existing tailings and peat layers in the northern dams of the LTVSMC Tailings Basin prior to the use of that facility for the NorthMet tailings. It would involve mixing cement into multiple three-foot diameter columns by auguring the Tailings Basin to improve the strength of the Tailings Basin, without substantially affecting water flow or quality.

A new WWTP would be built at the Plant Site to treat intercepted seepage from the Tailings Basin and treat water from the Hydrometallurgical Residue Facility, as needed.

The existing LTVSMC sewage treatment system would be upgraded to include a new stabilization pond facility, which would replace the existing LTVSMC mechanical sewage treatment plant. The sewage treatment system pond facility would include a lift station, which would pump the effluent to the Tailings Basin.

The layout of existing and proposed buildings and infrastructure at the Plant Site is shown on Figure 3.2-23.

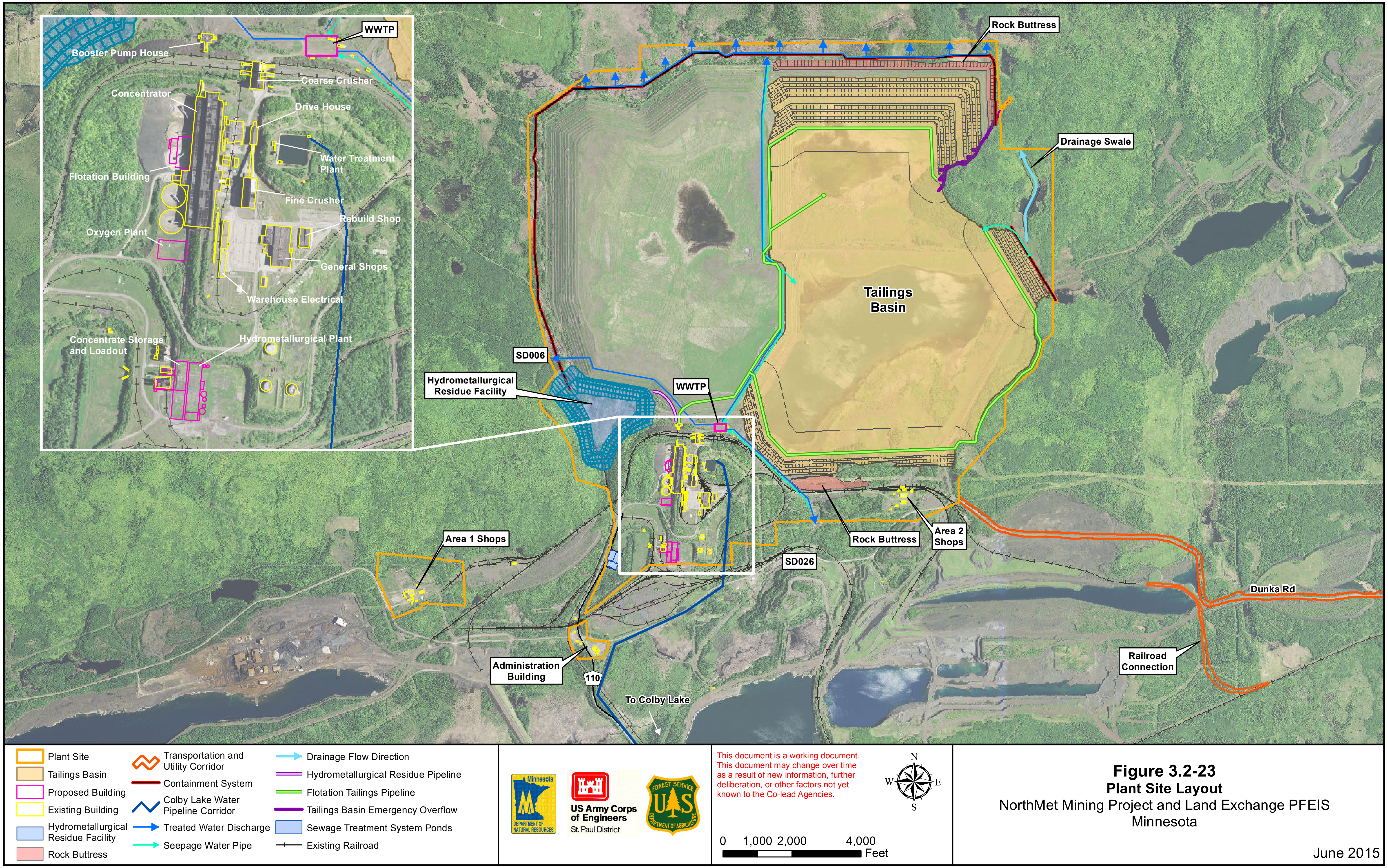

Figure 3.2-23
Plant Site Layout
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June 2015

1333 -Page Intentionally Left Blank-

3.2.2.3.4 Beneficiation Process

Mined ore would be processed using beneficiation and hydrometallurgical technologies. The purpose of the beneficiation process would be to produce final separate concentrates of copper and differing grades of nickel.. Nickel concentrates may be used as a feedstock to the Hydrometallurgical Plant that would then extract and isolate platinum-group elements, precious metals, and base metals. PolyMet expects that the Beneficiation Plant would be operational 2 to 4 years before the Hydrometallurgical Plant. The decision to ship nickel concentrate produced from the beneficiation process or nickel concentrate that is further processed through the Hydrometallurgical Plant would be based on equipment maintenance schedules, customer requirements, and overall project economics.

Processes at the Beneficiation Plant would include ore crushing, grinding, flotation, dewatering, storage, and shipping. Crushing and grinding would occur at the existing coarse-crusher building and concentrator building, both of which remain from operations of the former LTVSMC processing plant. Ore would be fed from the secondary crusher in the coarse-crusher building, into a SAG mill and ball mill in the concentrator building. Flotation would occur at a new flotation building located on disturbed ground immediately to the west of the concentrator building. Dewatering, storage, and shipping would occur at a new concentrate dewatering and storage building located on disturbed ground near the Heating and Additive Plant, which would be demolished. A simplified process flow diagram for the beneficiation process is shown on Figure 3.2-24.

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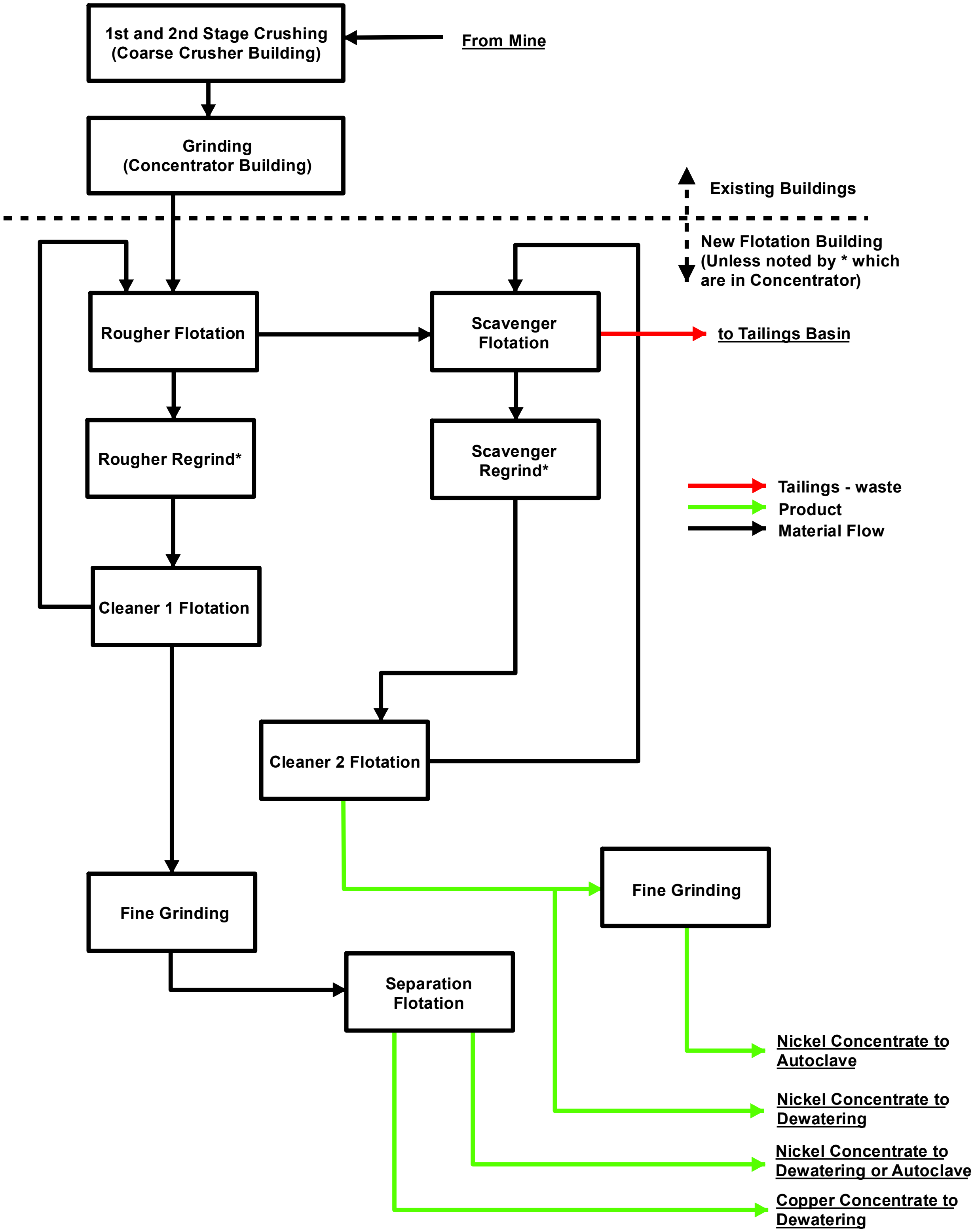

Figure 3.2-24
Beneficiation Plant Process Flow Diagram
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June 2015

1357 -Page Intentionally Left Blank-

Ore Crushing

In ore crushing, ore as large as 48 inches in diameter would be delivered by rail from the mine to the existing coarse-crusher building, where each car would be emptied into a primary crusher at an average (calculated using the hours the primary crusher would be actually running, as it would not run continuously) feed rate of about 1,667 tons per hour. From the primary crusher, ore would move by gravity to four parallel secondary crushers. A conveyor system would move the ore, 80 percent of which would now be smaller than 4.25 inches, to the ore storage bins located in the concentrator building.

The existing coarse--crusher building emission control system would be replaced with components that meet or exceed the particulate emission standard required of new sources at taconite plants. To reduce space-heating requirements, emission control system exhaust would be recycled to the buildings. The material collected would be mixed with water and added to the milling circuit. This means that the solids removed from the air stream would be recycled to the process and no solid waste management would be required and no water would be lost.

Ore Grinding

The coarse, crushed ore would be fed into a SAG mill and ball mill in the existing concentrator building. The SAG mill output would feed ball mills via cyclone feed pumps, also located in the concentrator building. The ground ore would re-circulate through the milling circuit until the particle size is small enough for flotation (80 percent would be less than 120 microns [4.7×10^{-3} inches]).

The existing emission control systems in the concentrator building would be replaced with components that meet or exceeded the particulate emission standard required of new sources at taconite plants. To reduce space-heating requirements, emission control system exhaust would be recycled to the buildings. The material collected would be mixed with water and added to the milling circuit. Solids removed from the air stream would therefore be recycled to the process and no solid waste management would be required and no water would be lost. Because water would be added to the mill lines and the beneficiation process would be wet from that point on, there would be no need for particulate emission control systems downstream of the feed to the SAG mill.

In the event of a power failure, all process fluids would be contained within the concentrator building and recycled to the process when power is restored. This same containment and recycle system would contain and control any minor spills.

Flotation

Once at a size of 120 microns, the ore would be processed in flotation to recover the base and precious metal sulfide minerals. Flotation would consist of rougher and scavenger flotation lines followed by cleaner stages in a new flotation building and would produce separate nickel and copper concentrates.

In flotation, separation of the sulfide minerals would be achieved using a collector and frother combination. Air would be injected into each flotation cell and the cell would be mechanically agitated to create air bubbles that would pass upward through the slurry in the cell. The frother (methyl isobutyl carbinol and polyglycol ether, or MIBC/DF250), would provide strength to the bubbles, and the collector (potassium amyl xanthate [PAX]) would cause the sulfide minerals to attach to the air bubbles. The material attached to the bubbles would be concentrated and the material remaining in the slurry would be tailings.

The rougher tailings would go to scavenger flotation, where collector and frother would be added, along with copper sulfate as a flotation activator. The activator would ensure that the particles that would be difficult to float (i.e., contain minor amounts of sulfide) would be recovered in the concentrate, which would reduce the total sulfur content of the tailings. The concentrate from scavenger flotation would go through scavenger regrind to cleaner 2 flotation. Cleaner 2 tailings would go back to the scavenger flotation feed, while the nickel-rich cleaner 2 flotation concentrate would be sent through fine grinding 2 to the Hydrometallurgical Plant or directly to concentrate dewatering. The tailings from scavenger flotation would be sent to the Tailings Basin. Rougher flotation concentrate would be fed through rougher regrind to cleaner 1 flotation. Cleaner 1 flotation tailings would go back to the rougher flotation feed, while the concentrate would be sent through fine grinding 1 to separation flotation. Separation flotation would produce a copper concentrate and two nickel concentrates. The copper concentrate would go to concentrate dewatering. The nickel concentrates would go to concentrate dewatering or to the Hydrometallurgical Plant.

Lime would be added in separation flotation, which would result in a highly basic process water stream. Because this stream would be combined with other process water streams and makeup water, buildup of basicity is not expected. If there were a buildup of basicity, the basicity could be neutralized before it was combined with other process water streams.

The scavenger tailings would be pumped to the Tailings Basin, where the solids would settle and be stored permanently (refer to the tailings section below). The clear water would be re-circulated to the mill process water system.

In the event of a power failure, all process fluids would be contained within the flotation building and recycled to the process when power is restored. This same containment and recycle system would contain and control any minor spills.

Concentrate Dewatering and Storage – Concentrate Mode

Concentrate dewatering and storage would be used to dewater and store copper and nickel concentrates and to load those concentrates into covered rail cars. Concentrate dewatering and storage would be within the new concentrate dewatering and storage building.

The copper and nickel concentrates would be delivered to separate dewatering lines, each with a filter that would reduce concentrate moisture content to approximately 8 to 10 percent. The water removed by the filter would be returned to the Beneficiation Plant.

Each filtered concentrate would be conveyed to separate stockpiles within an enclosed 10,000-ton storage facility for loading into covered rail cars. The storage facility would contain about 15 days of production capacity. The storage facility would have a concrete floor and provisions to wash wheeled equipment leaving the facility to prevent concentrates from being tracked out of the facility.

In the event of a power failure, all process fluids would be contained within the concentrate dewatering and storage building and recycled to the process when power is restored. This same containment and recycle system would contain and control any minor spills.

Processing Parameters

Table 3.2-11 shows PolyMet's estimates for daily production rates and size reduction through the processing steps in the beneficiation process. The rates and sizes provided are the values PolyMet intends to use to design plant piping and equipment.

Table 3.2-11 Design Processing Parameters

Process	Input			Output		
	Material	Rate (stpd)	Size (inches)	Material	Rate (stpd)	Size (inches)
Ore crushing	Ore	32,000	48	Ore	32,000	4
Ore grinding	Ore	32,000	4	Ore	32,000	4.7 x 10^{-3}
Flotation	Ore	32,000	4.7 x 10^{-3}	Concentrate	374 to Hydrometallurgical Plant and 286 to concentrate dewatering or 660 to concentrate dewatering	Varies depending on concentrate stream and next process step
				Tailings	31,340	4.7 x 10^{-3}
Concentrate dewatering	Concentrate	660	Varies depending on concentrate stream	Dried nickel and copper concentrates	286 copper and 374 nickel	Same as input[1]

[1] Flotation step has two fine grinding stages that produce a defined size. One nickel concentrate stream to concentrate dewatering does not pass through a fine grinding stage, but all concentrates to the Hydrometallurgical Plant pass through a fine grinding stage. Therefore, the average output for flotation does not coincide with the average input for concentrate dewatering.

stpd = short ton(s) per day

Process Consumables

PolyMet anticipates the raw materials shown in Table 3.2-12 would be consumed by the Beneficiation Plant processes.

Table 3.2-12 Materials Consumed by the Beneficiation Plant Process

Consumable	Quantity	Mode of Delivery	Delivery Condition	Storage Location	Containment
Grinding Media (metal alloy balls)	10,000 tpy	Rail (9 rail cars/ mo[1])	Bulk	Concentrator Building	None required
Flotation Collector (PAX)	1,171 tpy	Truck (2-3 trucks/mo)	Bulk bags	Reagents Building	None required
Flotation Frother (MIBC and DF250)	1,007 tpy	Tank truck (2-3 trucks/mo)	Bulk	Reagents Building	Separate 13,200-gallon storage tanks
Flotation Activators (copper sulfate)	592 tpy	Truck (1-2 trucks/mo)	Bulk bags	Reagents Building	9,200-gallon activator storage tank
Flocculant (MagnaFlox 10)	16.5 tpy	Truck (1 truck/2 mo)	1,875-lb[2] bulk bags	Reagents Building	None required
Gangue Depressant (CMC)	1,073 tpy	Truck (2-3 trucks/mo)	Bulk bags	Reagents Building	None required
pH Modifier (hydrated lime)	10,279 tpy	Tank Truck (1-2 trucks/day)	Bulk	Reagents Building	Storage silo

[1] mo = month
[2] lb = pound

Plant Process Water

Water needed for the milling and flotation circuits would primarily be return water from the Tailings Basin, which would include treated Mine Site process water. As a contingency measure, any shortfall in water requirements would be made up by raw water from Colby Lake as necessary using an existing pump station and pipeline. Throughout operations, the average annual makeup water drawn from Colby Lake would vary between 260 and 1,760 gallons per minute (gpm), with an average annual demand of 760 gpm. This would be the total potential raw water demand from both the Beneficiation Plant and the Hydrometallurgical Plant.

Water collection at the Tailings Basin and Plant Site water management are discussed further in Sections 3.2.2.3.10 and 3.2.2.3.11 below.

3.2.2.3.5 Tailings Management

The NorthMet Project Proposed Action would generate approximately 11.27 million short tons of flotation tailings annually (approximately 10,000,000 in-place cubic yards annually). Tailings would be placed on top of part of the unlined existing LTVSMC Tailings Basin. For the first 7 years of operation, tailings would be placed on top of Cell 2E (currently approximately 1,595 ft above mean sea level [amsl]) or until it reached the same height as the existing Cell 1E (approximately 1,660 ft amsl). After that, tailings would go on top of both Cells 1E and 2E (forming a single cell) up to the same height of Cell 2W (approximately 1,735 ft amsl). A schematic cross section of the Tailings Basin at its maximum height is provided on Figure 3.2-25.

The future perimeter dams of the Tailings Basin would be raised in an upstream construction method using compacted LTVSMC bulk tailings that consist primarily of coarse tailings with limited amounts of LTVSMC fines and slimes mixed in. This material would be sourced from the existing LTVSMC Tailings Basin dams to the north and east of Cell 2W, from the southeast dam of Cell 1E, and from the south dam of Cell 2E. Upon exhaustion of LTVSMC tailings available for dam construction, off-site borrow from MDNR-approved sources would be utilized.

To increase geotechnical stability, a rock buttress would be constructed around the northern dam of Cell 2E and southern dam of Cell 1E of the existing LTVSMC Tailings Basin. Rock buttress material would be from MDNR-approved sources. Material from former LTVSMC Area 5 would be a likely source for the rock buttress and fill material, but other sources could also be considered. CDSM would also be used to stabilize the existing tailings and peat layers in the northern dams of the LTVSMC Tailings Basin prior to the use of that facility for the NorthMet tailings. It would involve mixing cement into multiple three-foot diameter columns by auguring the Tailings Basin to improve the strength of the Tailings Basin, without substantially affecting water flow or quality.

During LTVSMC operations, fly ash, dredging spoil, and coal pile cleanup material were placed in a solid waste storage site (Coal Ash Landfill) upgradient and to the east of Cell 1E (see Figure 3.2-22). The location of this landfill would be inundated by tailings in approximately year 7 of Tailings Basin operation. Therefore, the contents would be relocated to the Hydrometallurgical Residue Facility prior to that time.

A bentonite-amended oxygen barrier layer (at a depth of 30 inches from the surface of the dams) on exterior sides of dams would be added as part of construction. The design also includes a mid-slope setback and construction of buttresses along the northern foot of existing LTVSMC Tailings Basin Cell 2E and southern foot of Cell 1E, using material from former LTVSMC Area 5. Refer to Section 5.2.14 for more information on the proposed construction of the Tailings Basin.

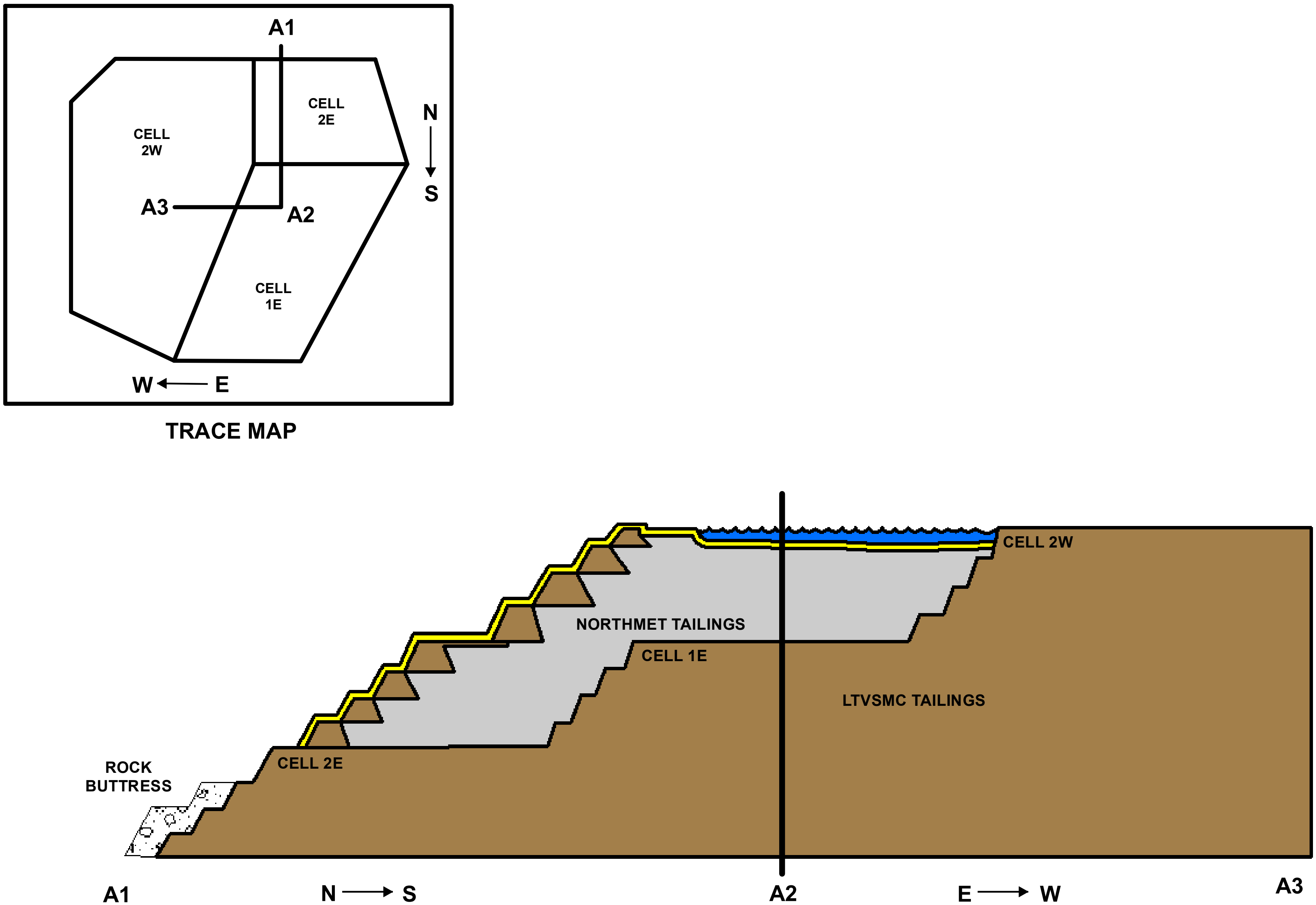
The NorthMet tailings would be deposited in slurry form through a system of pumps and moveable pipelines. Tailings would be deposited over discharge beaches or underwater in the Tailings Basin pond using movable diffusers. The small and fairly uniform grind size of the tailings would allow for a fairly consistent particle-size distribution, minimizing segregation of coarse and fine portions.

Tailings beaches would exist along the northern and northeastern dams of Cell 2E and the southern and eastern dams of Cell 1E, where the natural landscape is higher, thus bounding the material.

The tailings would settle out of the slurry and the decanted water would be allowed to pond and would be collected using a barge pump-back system that would pump the water back for use at the Beneficiation Plant. The barge system would consist of a primary pump barge in Cell 1E, an auxiliary pump barge in Cell 2E, piping from the primary pump barge to the Beneficiation Plant, and piping from the auxiliary pump barge to Cell 1E. The auxiliary pump barge would not be needed once the cells combine to form one cell. The return water pipelines would be moved as dams are raised (up to the maximum of 1,732 ft amsl), to keep the pipeline at or near the top of the dam. The return water pipes would be fitted with a relief drain valve to allow for water to be drained back to ponds in case of shutdown during winter operations to avoid damage to the pipes from freezing or suction. Pumps would also be fitted with deicing mechanisms to avoid freezing.

Plant Site water management, including management at the Tailings Basin, is discussed further in Sections 3.2.2.3.10 and 3.2.2.3.11 below.

Stability modeling and the rationale for the design are discussed in Section 5.2.14. Final design is subject to permitting under the requirements of the MDNR Dam Safety Permit and Permit to Mine.



LTVSMC Tailings
NorthMet Tailings
Bentonite
Rock Buttress

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Figure 3.2-25
Schematic Cross Section of the Tailings Basin - Post Closure
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1527 -Page Intentionally Left Blank-

3.2.2.3.6 Hydrometallurgical Process

Hydrometallurgical processing technology would process nickel concentrates. This process would involve high-pressure and high-temperature autoclave leaching followed by solution purification steps to extract and isolate PGEs, precious metals, and base metals. All equipment used in the hydrometallurgical process would be located in a new Hydrometallurgical Plant. Should spillage of process fluids occur, it would remain within the Hydrometallurgical Plant buildings and be returned to the appropriate process streams.

Once the Hydrometallurgical Plant becomes operational, some of the concentrates produced in the Beneficiation Plant would be feedstock to the hydrometallurgical process. The feedstock would be a combination of the separate nickel concentrates produced by the Beneficiation Plant. The decision to ship nickel concentrations directly from the beneficiation process or further process the concentrates through the autoclave would be based on equipment maintenance schedules, customer requirements, and overall project economics.

PolyMet expects that the autoclave would be operational 2 to 4 years after the Beneficiation Plant becomes operational. A simplified process-flow diagram for the hydrometallurgical process is shown on Figure 3.2-26.

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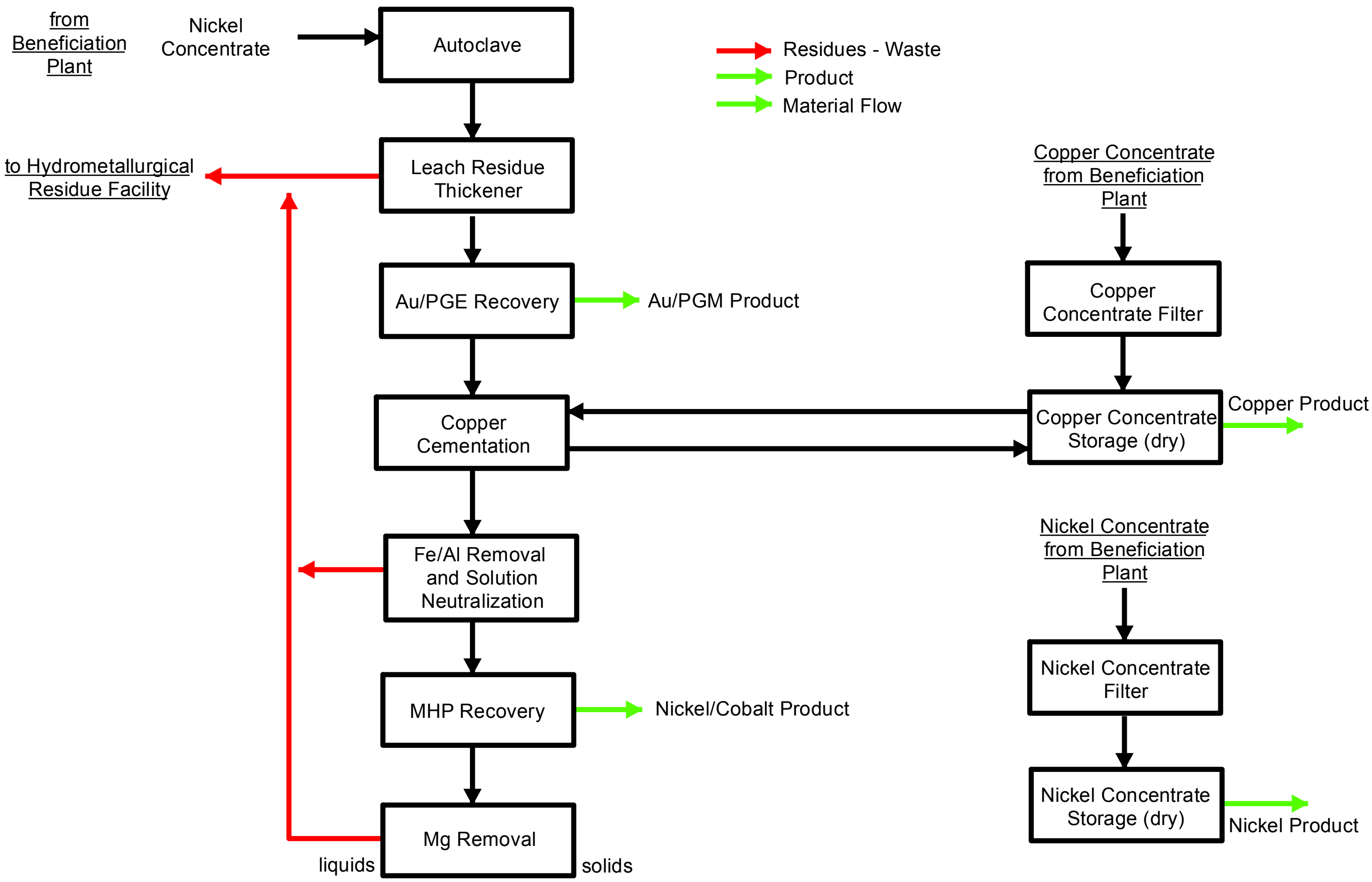

US Army Corps of Engineers
St. Paul District

Figure 3.2-26
Hydrometallurgical Plant Process Flow Diagram
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June 2015

1546 -Page Intentionally Left Blank-

Autoclave

In the autoclave, the sulfide minerals in the concentrate would be oxidized and dissolved in a solution. Gold/PGE would dissolve as soluble chloride salts. The solid residue produced would contain iron oxide, jarosite (potassium-iron sulfate), and any insoluble gangue (non-ore silicate and oxide minerals) from the concentrate. Generation of acid from the oxidation of major sulfide minerals would result in leaching of the silicate, hydroxide, and carbonate minerals present in the concentrate.

Mine Site WWTF sludge (to recover metals and provide disposal of remaining solids) and hydrochloric acid (to maintain the proper chloride concentration in the solution to enable leaching of the Au/PGE) would be added to the concentrate before the autoclave. The autoclave would be injected with oxygen gas supplied by a cryogenic oxygen plant at a rate that would be controlled to ensure complete oxidation of all sulfide sulfur in the concentrate.

Slurry discharging from the autoclave would be sent to the leach residue thickener where solids would be settled with the aid of a flocculant. The leach residue thickener underflow would be filtered to produce a filter cake, which would be washed, re-pulped, combined with other hydrometallurgical residues, and pumped to the Hydrometallurgical Residue Facility. The leach residue thickener overflow would go to the Au/PGE recovery.

Gold and Platinum Group Element Recovery

The product produced by Au/PGE recovery would be a filter cake made up of a mixed Au/PGE sulfide precipitate. The filter cake would be put into either bulk bags or drums for sale to a third-party refinery. The remaining solution would go to copper cementation.

Copper Cementation

Copper concentrate from dry concentrate storage would be re-pulped, and the solution from Au/PGE recovery would be combined with the re-pulped copper concentrate. Copper would precipitate mostly in the form of copper sulfide. The enriched copper concentrate would be filtered and placed back into dry concentrate storage. The remaining solution would then go to solution neutralization.

Solution Neutralization

Solution neutralization would be used to neutralize acids formed as a result of the upstream process. Solution from copper cementation would go to solution neutralization. Calcium, in the form of either limestone or lime, would be added. The result of the calcium addition would be the formation of gypsum that would be filtered to produce a gypsum filter cake. This filter cake would be washed, re-pulped, combined with other hydrometallurgical residues, and pumped to the Hydrometallurgical Residue Facility. The solution remaining after neutralization would go to iron and aluminum removal.

Iron and Aluminum Removal

Solution neutralization would feed iron and aluminum removal. Limestone, steam, and air would be added to cause the aluminum and iron to precipitate. The precipitated metals would be filtered to produce a filter cake, which would be washed, re-pulped, combined with other hydrometallurgical residues, and pumped to the Hydrometallurgical Residue Facility. The remaining solution would be sent to mixed hydroxide product recovery.

Nickel-Cobalt Recovery (Mixed Hydroxide Product)

Copper-free solution from iron and aluminum removal would be reacted with magnesium hydroxide to produce nickel and cobalt precipitate. The precipitated metals would be filtered to produce a filter cake that would have an approximate composition of 97 percent nickel and cobalt hydroxides, with the remainder as magnesium hydroxide. The high-quality mixed hydroxide filter cake would be packaged for shipment to a third-party refiner. The remaining solution would go to magnesium removal.

Magnesium Removal

Lime slurry would be added to the solution from the mixed hydroxide product recovery (above) to facilitate magnesium precipitation. The resulting slurry would be pumped to the Hydrometallurgical Residue Facility along with other residues. The solids would settle in the Hydrometallurgical Residue Facility, to be stored permanently, while the clear water would be reclaimed continuously to the Hydrometallurgical Plant process water system.

Process Consumables

The raw materials described below, and those summarized in Table 3.2-13, would be consumed by the Hydrometallurgical Plant processes.

Table 3.2-13 Materials Consumed by the Hydrometallurgical Plant Process

Consumable	Quantity	Mode of Delivery	Delivery Condition	Storage Location	Containment
Sulfuric acid	1,500 tpy	Tanker truck (2 tank cars/ mo)	Bulk	Adjacent to General Shop Building	31,965-gallon storage tank with secondary containment
Hydrochloric acid	3,590 tpy	Tanker truck (3 tank cars/mo)	Bulk	Adjacent to General Shop Building	36,120-gallon storage tank with secondary containment
Liquid sulfur dioxide	1,433 tpy	Tanker truck (2 tank cars/mo)	Bulk	Adjacent to General Shop Building	30,000-gallon pressurized storage tank with secondary containment
Sodium hydrosulfide	513 tpy	Tanker truck (2-3 tankers/mo)	Bulk as a 45% solution with water	Adjacent to General Shop Building	25,750-gallon storage tank
Limestone	125,000 tpy	Rail (one 100-car train/week from April to October)	Bulk	Stockpiled on site	Berms/ditches around outdoor stockpile with water that has contacted limestone collected and added to the plant process water
Lime	4,344 tpy	Freight truck (75 loads/mo)	Bulk	Adjacent to General Shop Building	Lime silo and 21,000-gallon storage tank

Consumable	Quantity	Mode of Delivery	Delivery Condition	Storage Location	Containment
Magnesium hydroxide	4,866 tpy	Tanker truck (7 tank cars/mo[2])	60% w/w[4] magnesium hydroxide slurry	Adjacent to General Shop Building	Magnesium hydroxide 270,000-gallon storage tank
Caustic (NaOH)	33 tpy	Tanker truck (1 load/mo)	50% w/w solution	General Shop Building	1,300-gallon storage tank
Flocculant (MagnaFloc 342)	14 tpy	Freight truck	1,543 lb bulk bags of powder	Main Warehouse	In bags and batch mixed regularly as 0.3% w/w solution
Flocculant (MagnaFloc 351)	90 tpy	Freight truck	1,543 lb bulk bags of powder	Main Warehouse	In bags and batch mixed regularly as 0.3% w/w solution
Nitrogen (used in Hydrometallurgical Plant)[1]	19,113 tpy	NA[3]	NA	NA	NA

[1] Nitrogen used in the Hydrometallurgical Plant would be produced as a byproduct in the Oxygen Plant and no shipping or storage would be required.
[2] mo = month
[3] NA = not applicable
[4] w/w = weight for weight

<u>Hydrometallurgical Process Water</u>

The Hydrometallurgical Plant would require separate water than the Beneficiation Plant due to the different nature of the solutions involved in the two processes. Hydrometallurgical process water would contain substantial levels of chloride relative to the water in the milling and flotation circuits.

The hydrometallurgical system would receive recycled water collected at the Hydrometallurgical Residue Facility (discharged water used to transport hydrometallurgical residue to the facility) and would distribute it to various water addition points throughout the Hydrometallurgical Plant. Makeup water would come from flotation concentrate water and raw water. Raw water demand for ore processing is described in Table 3.2.14.

Water collection at the Hydrometallurgical Residue Facility and Plant Site water management are discussed further in Sections 3.2.2.3.10 and 3.2.2.3.11 below.

Table 3.2-14 Plant Site Services

Service	Source	Source Location	Needed for
Compressed air	Duty and standby arrangement of rotary screw-type compressors	General Shop Building	Provide air at a pressure of 100 psig[1] for plant services
Instrument air	Air withdrawn from the plant air receiver to an instrument air accumulator and dried in a duty and standby arrangement of driers and air filters	General Shop Building	Provide air for instruments
Steam	Natural gas-fired boiler	Hydrometallurgical Plant	Generates heat needed for startup of the autoclaves
Diesel fuel storage	Existing Locomotive Fuel Oil facility	Area 2 Shop	Diesel for locomotives
Gasoline storage	Existing storage facility – two 6,000-gallon tanks	Adjacent to the Main Gate	Gasoline for vehicles

Service	Source	Source Location	Needed for
Raw water	Water from Colby Lake via an existing pumping station and pipeline	Stored in the existing water reservoir at the Plant Site (Plant Reservoir)	Plant fire protections systems, plant potable water systems, make-up water for grinding and flotation process water and Hydrometallurgical Plant process water
Potable water	Existing processing plant potable water treatment plant would be refurbished and reactivated	Near the Plant Reservoir	Potable water distribution system includes the Area 1 and Area 2 shops
Fire protection	Existing fire protection system would be refurbished, reactivated, and extended to new buildings	Plant Reservoir	Area 1 and Area 2 shops have independent fire protection systems
Oxygen	770 tpd[2] Oxygen Plant. Plant process takes in ambient air, compresses it and separates the oxygen from nitrogen and other trace atmospheric gases. Oxygen would be transported via pipeline to plant processes and nitrogen and trace gases would be returned to the atmosphere.	Adjacent to Concentrator	Plant processes

[1] psig = Pounds per square inch gauge
[2] tpd = tons per day

3.2.2.3.7 Hydrometallurgical Residue Management

The hydrometallurgical process would generate residues from five sources:

- autoclave residue from the leach residue filter;
- high-purity gypsum from the solution-neutralizing filter (depending on the market, this could become a saleable product, but is currently planned to be managed as a waste);
- gypsum, iron, and aluminum hydroxide from the iron and aluminum filter;
- magnesium hydroxide precipitate from the magnesium removal tank; and
- other minor plant spillage sources.

In addition to the above-listed sources, solid wastes from the Mine Site WWTF would be recycled directly into the Hydrometallurgical Plant to recover metals, creating additional waste. The Mine Site WWTF solids would be similar to the hydrometallurgical residue, consisting primarily of gypsum, metal hydroxides, and calcite.

If all nickel flotation concentrate were used as feedstock, the projected hydrometallurgical residue generation rate would be 313,000 tons annually and up to total of 6,170,000 tons. The gypsum included with residue from solution neutralization may become a saleable product; however, it is currently proposed to be managed as part of the residue waste.

These wastes would be combined and disposed of in the Hydrometallurgical Residue Facility that would be located at the existing LTVSMC Emergency Basin, adjacent to the southern edge of the existing tailings Cell 2W. The Hydrometallurgical Residue Facility would consist of a double lined cell, developed incrementally as needed, expanding vertically and horizontally from the initial construction.

The first increment would be constructed over two to three construction seasons. Most of the site-preparation activities and major earthwork would occur in the first two construction seasons.

Placing the geosynthetic clay liner would occur in the third year of construction. The remaining earthwork and completion of the geomembrane liner installation for the upper elevations of the facility would occur as needed to maintain adequate capacity.

The Hydrometallurgical Residue Facility would be filled by pumping the combined hydrometallurgical residue as slurry from the Hydrometallurgical Plant. A pond would be maintained within the Hydrometallurgical Residue Facility so that the solids in the slurry would settle out, while the majority of the liquid would be recovered by a pump system and returned to the plant for reuse. The residue discharge point would be relocated as needed to distribute the residue evenly throughout the Hydrometallurgical Residue Facility.

During LTVSMC operations, fly ash, dredging spoil, and coal pile cleanup material were placed in a solid waste storage site (Coal Ash Landfill) upgradient and to the east of Cell 1E (see Figure 3.2-22). The location of this landfill would be inundated by tailings in approximately year 7 of Tailings Basin operation. Therefore, the contents would be relocated to the Hydrometallurgical Residue Facility prior to that time.

Plant Site water management, including management at the Hydrometallurgical Residue Facility, is discussed further in Sections 3.2.2.3.10 and 3.2.2.3.11 below.

Stability modeling and rationale for the design are discussed in Section 5.2.14. Final design is subject to permitting under the requirements of the MDNR Dam Safety Permit and Permit to Mine.

3.2.2.3.8 Required Process Services

The NorthMet Project Proposed Action would utilize two existing service facilities: the Area 1 Shop and the Area 2 Shop.

The former LTVSMC Area 1 Shop is an existing fully enclosed maintenance facility built specifically to handle maintenance and repair work on large mining equipment. A heavy-duty, low-bed transporter and tractor would be used to transport some equipment (e.g., dozers and front-end loaders) to the Area 1 Shop from the Mine Site. A haul truck retriever (large-scale tow-truck) would tow haul trucks that would be unable to move on their own; otherwise, haul trucks would be driven to the Area 1 Shop. It is estimated that each haul truck would be moved to the Area 1 Shop two times per year for major repairs. To access the Area 1 Shop, mine vehicles would follow an established route utilizing existing gravel and blacktopped roads through parts of the former LTVSMC taconite mine area.

Used oils and antifreeze/coolant, as well as residue from steam-cleaning equipment, would be collected and stored at the Area 1 Shop. Used oils, antifreeze/coolant, and solvents would be collected by a specialist contractor for recycling, while used filters, oily rags, and other oil-contaminated waste would be collected for proper off-site disposal in suitably licensed disposal facilities.

The former LTVSMC Area 2 Shop, located about 7 miles west of the Mine Site, would be reactivated to provide office space for mining and railroad operations supervision and management, as well as change house facilities, toilets, lunch rooms, first aid facility, emergency response center and training, and meeting rooms for mining and railroad crews. The Area 2 Shop facilities would include the Locomotive Fueling Station, Locomotive Service Building, and Mine Reporting Building. The Locomotive Fueling Station, where locomotives would be fueled and lubricated, would have a roof and sides, but would be open at the ends to allow access. The concrete floor, equipped with drip trays, would collect any spilled fuel and route it to a collection sump for proper disposal in the Plant Site area. It also has a 15,000-gallon bulk fuel storage tank with containment systems.

Other process inputs and services required for the Plant Site operations are summarized in Table 3.2-14.

3.2.2.3.9 Transport of Consumables and Products

A 1,500- to 2,000-hp GenSet locomotive, similar to the locomotives that would be hauling ore from the Mine Site to the Plant Site, would transfer loaded and empty cars carrying process consumables and concentrates to and from the interchange location with the Canadian National Railroad and the Plant Site. Cars carrying process consumables and concentrate would meet rail common carrier requirements.

Nickel and cobalt hydroxide and precious metal precipitate products would be shipped in sealed bulk bags or sealed containers. Copper and nickel concentrates would be shipped in solid-bottom rail cars with weather-tight covers. Cars would be checked before loading and any debris would be removed and holes plugged. Loading operations would be conducted in a building via a conveyor system. Car exteriors would be inspected before leaving the buildings and any concentrate on the car exterior would be recovered and returned to storage. The concentrate is expected to be 8 percent to 10 percent moisture, which is not expected to generate dust during loading.

The NorthMet Project Proposed Action would utilize the existing general shop facility previously used by LTVSMC for re-fueling, routine inspection, and maintenance of locomotives and ore cars. Locomotives needing major repair would either be sent off site or repaired by a contractor in the general shop facility.

3.2.2.3.10 Engineered Water Controls

The Plant Site would include water management features designed to control water potentially affected by sulfides and metal leachates from tailings and hydrometallurgical residue. Water contaminated with these materials would be sent to the Plant Site WWTP. Stormwater would be directed off site.

The following section describes the engineered controls. The flow and management of water is discussed in Section 3.2.2.3.11. Figure 3.2-5 through Figure 3.2-8 show the water management features and infrastructure.

<u>Tailings Basin</u>

The Beneficiation Plant would deposit tailings into the Tailings Basin. The tailings would contain water. Water would also be discharged to the Tailings Basin pond from the Mine Site. Direct precipitation, stormwater run-off, and water collected by the Tailings Basin seepage containment systems would also be directed to the Tailings Basin. Tailings Basin water is expected to seep downward and either emerge as surface seepage near the toe of the Tailings Basin or remain in the groundwater. A portion of groundwater seepage is modeled to bypass the containment system and eventually emerge in surface waters As shown in Figure 3.2-27, a water containment system would be installed around the western, northern, and portions of the eastern sides of the Tailings Basin dams to intercept the seepage that emerges as surface water near the toe (within several hundred ft) and greater than 90 percent of all of the seepage that remains in the ground as groundwater. The Tailings Basin containment system would consist of a cutoff wall placed through existing surficial deposits into bedrock, with a collection trench and drain pipe installed on the upgradient side on the cutoff wall. Figure 3.2-28 shows a schematic cross section of the containment system. At the Plant Site, the geologic conditions are favorable for such a containment system due to the presence of low permeability bedrock. Cross-section modeling of the containment systems performed by PolyMet and reviewed by the Co-leads provides strong evidence that the groundwater capture efficiency would be greater than 90 percent.

Along the eastern side of the Tailing Basin, high bedrock is predicted to eliminate most of the groundwater seepage. A containment system would be installed along the toe of slope of the Cell 1E northeast dam, where seepage to groundwater may occur.

Along the southern side, bedrock and surface topography create a narrow valley at the headwaters of Second Creek. Due to this topography and experience on the site, it is expected that all existing seepage from the Tailings Basin to the south emerges as surface seepage within a short distance of the embankment toe. An existing seepage management system currently captures the majority of the seepage leaving the Tailings Basin to the south. This system consists of a cutoff berm and trench placed approximately 200 to 250 ft downstream of the seepage face to collect this seepage. A seep collection sump, pump, and pipe system is being used to route this south seepage back into the Tailings Basin pond. During operations, PolyMet would pump this water to the Tailings Basin pond or to the WWTP. PolyMet and Cliffs Erie are currently working together to assess the efficiency of this seepage capture system. PolyMet has committed to collecting all of the seepage from the Tailings Basin in this area and would implement additional improvements if necessary. Improvements may include lining the existing upstream dam face with bentonite and injecting grout into the dam. A second dam could be constructed approximately 500 ft downstream of the existing dam where the geography is more constricted. This potential second dam may be earthen with a clay or concrete cutoff wall extending to bedrock.

The containment system around the western, northern, and portions of the eastern sides of the Tailings Basin and the southern seepage management system are collectively referred to as the Tailings Basin seepage containment systems. Pond elevation would be controlled by pumping any excess Tailings Basin pond water to the WWTP. An emergency overflow channel would be constructed as a backup means of controlling pond elevation, but discharge from the emergency overflow to the environment is not expected. The emergency overflow would be provided for protection of the dams in the rare event that freeboard within the Tailings Basin is not sufficient to contain all stormwater. Such instances have the potential to occur in the event of a probable maximum precipitation (PMP) rainfall event or some fraction thereof. The PMP rainfall events are rare and such an event has a low likelihood of being experienced during the life of the basin. The PMP does not have an assigned return period, but it is usually assumed by hydrologists to be on the order of 1,000s of years.

All groundwater and surface water seepage collected in the containment system around the Tailings Basin would be pumped back into the Tailings Basin pond or to the WWTP.

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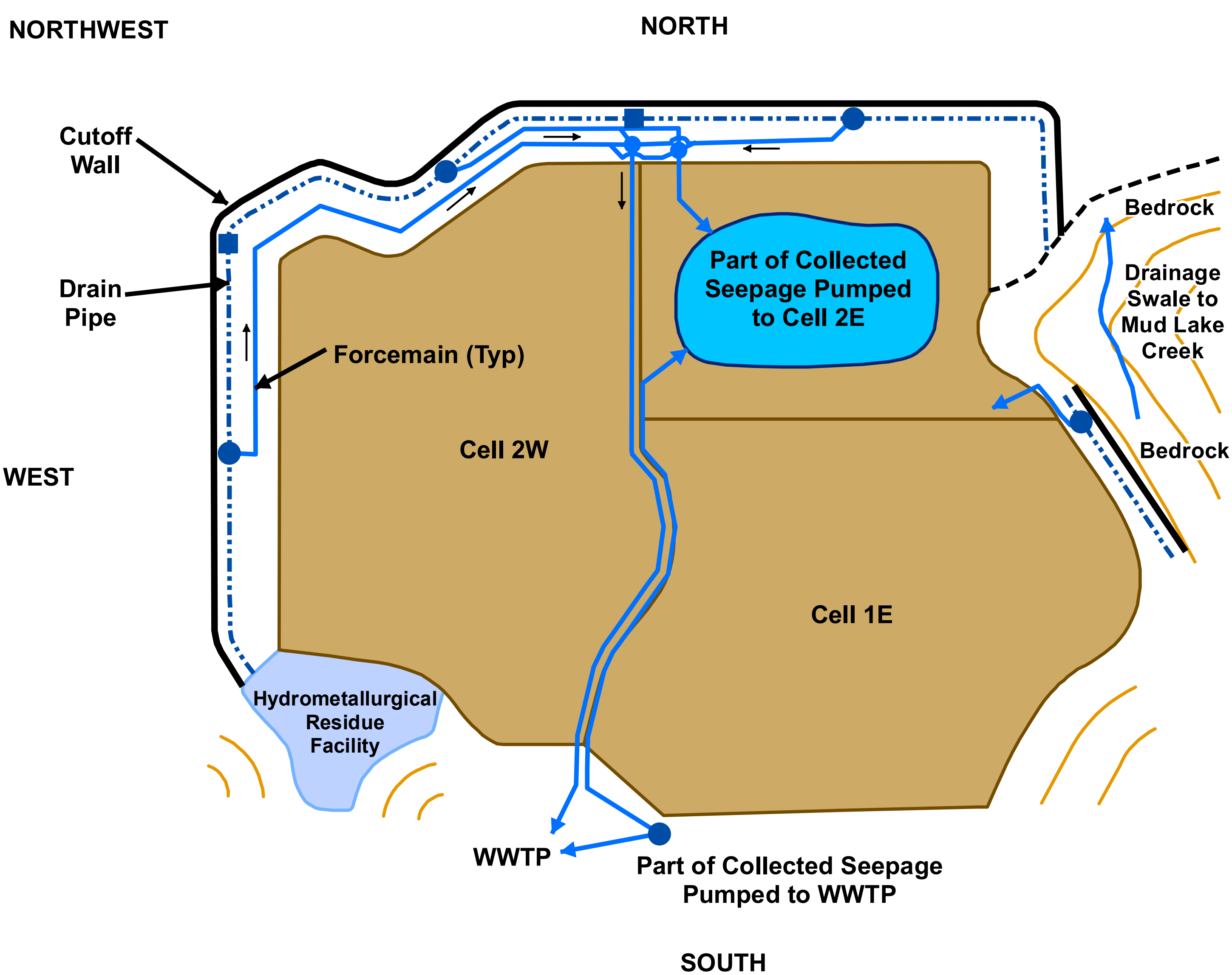

US Army Corps of Engineers
St. Paul District

Figure 3.2-27
Conceptual Plan View - Tailings Basin Groundwater Containment System
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June 2015

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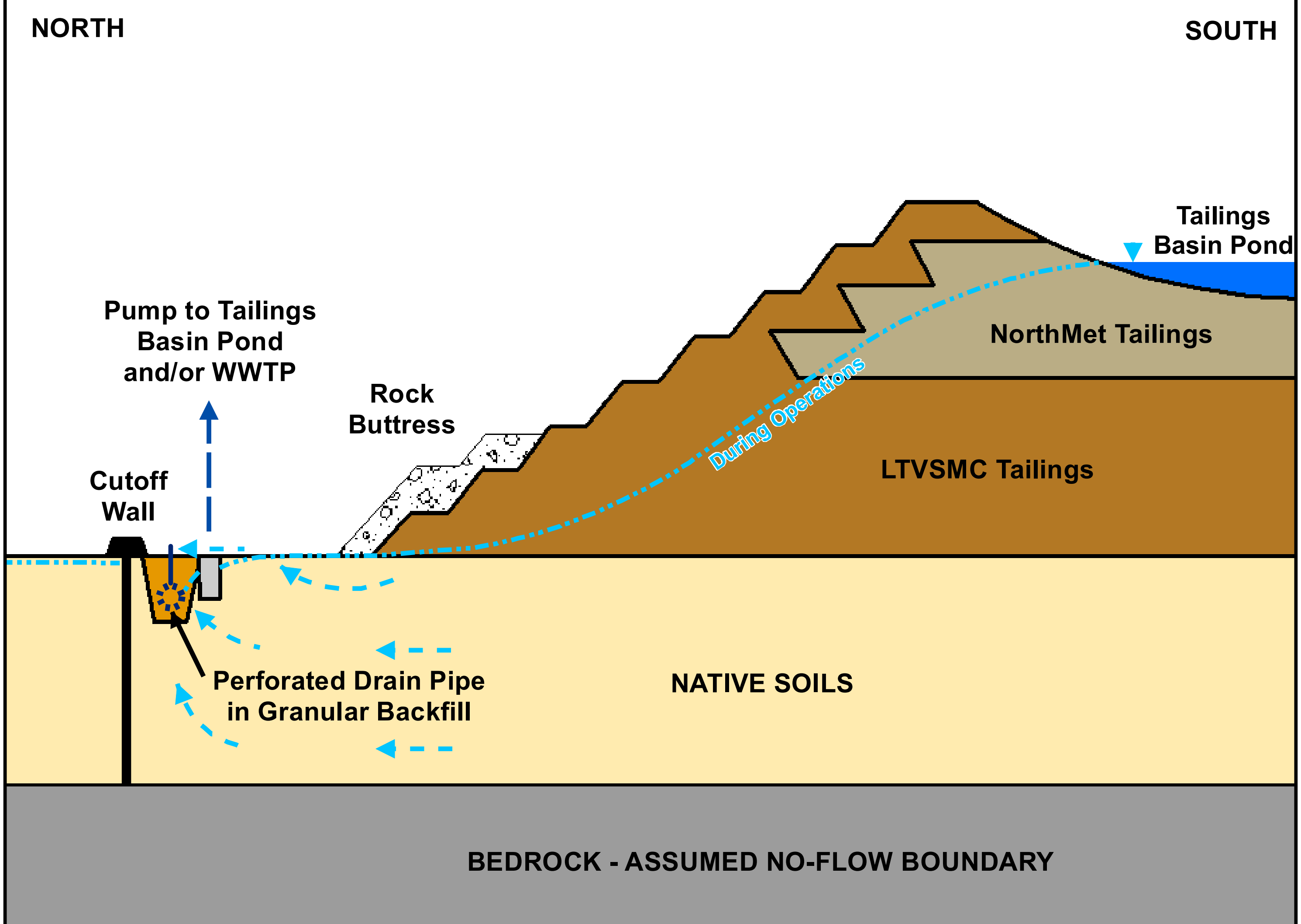

Not to Scale

Figure 3.2-28
Conceptual Cross Section - Tailings Basin Groundwater Containment System
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

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Hydrometallurgical Residue Facility

The Hydrometallurgical Residue Facility would be double-lined to eliminate the release of residue leachate. The double liner would consist of a composite liner system utilizing a geomembrane liner above a geosynthetic clay liner, with a second liner placed above the first, separated by a leakage collection system (see Figure 3.2-30). This would substantially remove hydraulic head from the lower liner and thereby virtually eliminate leakage to groundwater from the Hydrometallurgical Residue Facility. Leakage that is collected would be pumped back to the Hydrometallurgical Residue Facility pond, which is collected and pumped back for use at the Hydrometallurgical Plant.

PolyMet initiated laboratory testing to consider the chemical compatibility of the potential geosynthetic liner to be used with leakage from residue (PolyMet 2014r). Results indicated the use of a polymer-treated geosynthetic liner that is manufactured specifically in anticipation of the chemical characteristics of the pore water that would be contained within the residue. The hydraulic conductivity of the leakage collection system is not expected to degrade over time. Typical liner performance assumes a 500-year service life of the geomembrane; therefore, hydraulic conductivity of the liner is not expected to degrade over that time. Specific attributes would be determined during the geosynthetic clay layer development to achieve the desired performance before final installation.

Wastewater Treatment Plant

A WWTP would treat runoff, captured Tailings Basin seepage, and process water that could not be stored in the Tailings Basin. The WWTP would be constructed south of the Tailings Basin near the coarse-crusher and would include a RO unit or equivalently performing technology designed to meet water quality standards. The design of the WWTP could be adjusted to accommodate varying influent streams and discharge requirements.

The reject concentrate stream from the WWTP would be transported to the WWTF at the Mine Site via rail tank cars, which is described in more detail below.

3.2.2.3.11 Water Management

During operations, the Tailings Basin would be the primary source for water used in the beneficiation process. The primary sources of water to the Tailings Basin would include direct precipitation, stormwater, snowmelt, flotation process water used to transport flotation tailings to the Tailings Basin, treated process water from the Mine Site, and water collected by the Tailings Basin seepage containment systems.

The seepage containment systems that would be built around the Tailings Basin would result in a significant reduction in flow to four tributaries around the Tailings Basin that would require augmentation, including Unnamed Creek, Second Creek, Trimble Creek, and Mud Lake Creek. Flow to Unnamed Creek, Second Creek, and Trimble Creek would be augmented by WWTP effluent. Flow to Mud Lake Creek would be augmented by the construction of a drainage swale east of the Tailings Basin. Currently, an area east of Cell 1E drains into that cell. A drainage swale would be constructed near the east dam to reroute this watershed north to Mud Lake Creek. The primary purpose of this drainage swale would be to prevent water from pooling at the toe of the east dam; however, the swale would be constructed at the start of the NorthMet Project Proposed Action to augment flow to Mud Lake Creek.

To the extent possible, water ponded at the Hydrometallurgical Residue Facility would be returned to the Hydrometallurgical Plant; however, some losses would occur through evaporation or storage within the pores of the deposited residue. The double-liner system described above would virtually eliminate liner leakage to groundwater. Leakage collected by the double-liner system would be recycled to the hydrometallurgical process.

For the most part, water management within the Hydrometallurgical Plant would operate independently of water management within the Beneficiation Plant. The only exceptions would be the transfer of flotation concentrate from the Beneficiation Plant to the Hydrometallurgical Plant and the combining of filtered copper concentrate and solution from Au/PGE recovery in the copper cementation process step.

The flow and management of water at the Plant Site during operation is summarized on Figure 3.2-12 and Figure 3.2-13 in Section 3.2.2.1.

3.2.2.3.12 Reclamation and Long-term Closure Management

PolyMet has developed a Reclamation Plan, which would be submitted to the MDNR as part of its Permit to Mine. Reclamation Plans are also required for the Tailings Basin and the Hydrometallurgical Residue Facility. The Reclamation Plans would be finalized to provide details and a schedule for the final closure of the as-built facilities. In addition, PolyMet would also submit an annual contingency reclamation plan per *Minnesota Rules*, part 6132.1300, subpart 4, to identify activities that would be implemented if operations were to cease in that upcoming year.

Similar to the Mine Site (see Section 3.2.2.1.10), where possible, the Plant Site facilities have been designed and would be operated to allow for concurrent reclamation. This would leave a smaller portion of the disturbed area requiring reclamation at closure. Under the NorthMet Project Proposed Action, concurrent reclamation at the Plant Site would include designing and constructing the dams for the Tailings Basin and Hydrometallurgical Residue Facility for long-term management of those wastes and covering the dams of the Tailings Basin with bentonite as they are constructed.

At closure, PolyMet would first remove all infrastructure and facilities not approved for potential future use, followed by reclamation of disturbed lands. Reclamation objectives, which would be achieved during the closure process, would include rapidly establishing a self-sustaining plant community, controlling dust, controlling soil erosion, providing wildlife habitat, and minimizing the need for maintenance. Post-closure activities would include monitoring and maintenance of reclamation and water quality until the various facility features were deemed environmentally acceptable, in a self-sustaining and stable condition.

The water quality objective of closure is to provide mechanical or non-mechanical treatment for as long as necessary to meet regulatory standards at applicable groundwater and surface water compliance points. Water quality modeling performed in support of this FEIS indicates that water treatment systems would be needed indefinitely at the Mine Site and Plant Site. The water models constructed to assess the potential effects from the NorthMet Project Proposed Action were not designed to predict the duration of treatment nor do they capture all the factors that influence the duration of treatment (e.g., potential future regulatory and technological changes). Therefore, the models cannot be used to predict when treatment would end. Actual treatment requirements would be assessed on a recurring basis throughout operations, reclamation, and closure considering influent and effluent water quality and monitoring results. Those periodic assessments would be carried out to ensure continuous protection of groundwater and surface water quality and compliance with water quality-based effluent limits. The periodic assessment process would rely on monitoring results coupled with predictive modeling rather than the results of the predictive modeling alone. Regardless of the precise duration of effects or water treatment at either the Mine Site or Plant Site, there are measures available to address impacts to natural resources. PolyMet would be held accountable for maintenance and monitoring required under the permit and would not be released from financial assurance until all permit conditions have been met.

The reclamation and closure activities are discussed below.

Features that would remain at the Plant Site during the post-reclamation period are shown on Figure 3.2-29.

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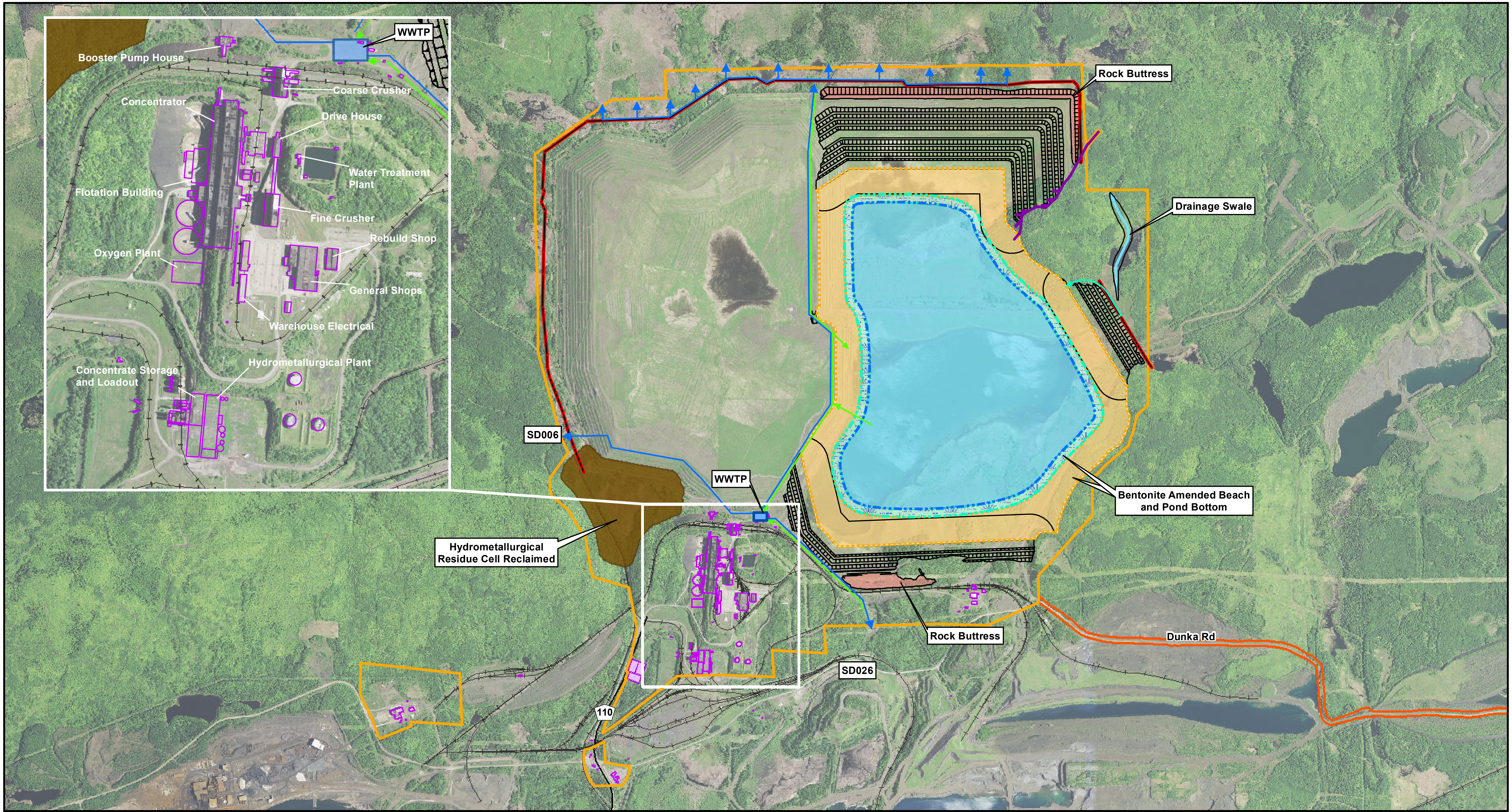

Plant Site
Wastewater Treatment Plant and Pump Station
Building
Transportation and Utility Corridor
Hydrometallurgical Residue Cell Reclaimed
Rock Buttress
Approximate Pond Area
Approximate Wetland Area
Approximate Upland Area
Containment System
Drainage Flow Direction
Tailings Basin Emergency Overflow
Treated Water Discharge
Seepage Water Pipe
Pipe to Treatment Plant
Existing Railroad

Minnesota DEPARTMENT OF NATURAL RESOURCES
US Army Corps of Engineers St. Paul District
FOREST SERVICE U S DEPARTMENT OF AGRICULTURE

This document is a working document. This document may change over time as a result of new information, further deliberation, or other factors not yet known to the Co-lead Agencies.

N S W E

0 1,000 2,000 4,000 Feet

Figure 3.2-29
Plant Site Layout - Long Term Closure
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June 2015

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Building and Structure Demolition and Equipment Removal

All buildings and structures not approved for potential future use would be removed and foundations would be razed and covered with a minimum of 2 ft of soil and vegetated according to *Minnesota Rules*, parts 6132.2700 and 6132.3200. Demolition waste from structure removal would be disposed of in the existing on-site demolition landfill (SW-619) located northwest of the Area 1 Shop at the Plant Site. Concrete from demolition, with the exception of oil-stained concrete, would be crushed and used for structural fill, placed in the basements of the coarse-crusher, concentrator, and the plant reservoir, or placed in landfills as required. Oil-stained concrete requires different handling and is addressed in the Special Material Disposal section below.

Most roads, parking areas, or storage pads built to access these facilities would be demolished according to the planned schedule or as approved by the MDNR Commissioner. Utility tunnels would be sealed and closed in place. Asphalt from paved surfaces would be removed and recycled and the disturbed areas would be reclaimed and vegetated according to *Minnesota Rules*, part 6132.2700. Railroad track and ties that were not used by common carriers would be removed and recycled. Any roads that may develop into unofficial off-road vehicle trails would require a variance from MDNR reclamation rules to allow a 15-ft-wide unpaved, unvegetated track down the centerline of the road. Such approvals would also be coordinated with the St. Louis County Mine Inspector's Office.

All plant, railroad, service, and electrical equipment would be scrapped, decommissioned, or sold. PolyMet would also close on-site sewer and water systems, power lines, pipelines (including hydrometallurgical residue pipelines), and culverts according to proper regulatory requirements.

Special Material Disposal

Special materials on-site at the time of reclamation would be disposed of as follows:

- Asbestos-containing materials (ACMs) – a detailed survey of ACMs (i.e., pipe and electrical insulation in former LTVSMC utility tunnels, siding, water-heating system insulation, lube system insulation, floor tile) has been completed of the existing LTVSMC facilities. New facilities would not have ACMs. A detailed inventory of ACM locations would be maintained as part of the NorthMet Project Proposed Action documentation. Appropriate controls would be put in place or ACMs would be removed intact, properly packaged, and disposed of in the on-site demolition landfill. ACM locations in the landfill would be noted on the property deed. Any ACMs found in utility tunnels would be sealed before the utility tunnel is closed.
- Nuclear sources (i.e., nuclear-density gauges used to measure slurry density during processing) – these sources would be removed and properly disposed of.
- Partially used paint, chemical, and petroleum products – these materials would be collected and properly recycled or disposed of.
- Fluorescent and sodium halide bulbs – these would be removed from fixtures, collected, and properly disposed of.

- Oil-stained concrete – this material would be tested to characterize the material for beneficial reuse such as structural fill. If the material does not meet the solid waste criteria for beneficial reuse, the oil-stained concrete would be removed and properly disposed of.

All special materials would be properly managed and/or disposed of in accordance with local, state, and federal regulations and requirements during reclamation activities.

Product and Product Tank Disposal

The reagent suppliers, which would be under contract to PolyMet, would remove any reagents remaining during reclamation. In many cases, the suppliers of chemicals and equipment would be responsible for furnishing tanks and would therefore be required to remove and dispose of those tanks during reclamation. Those tanks for which PolyMet would be responsible would be processed for demolition as follows:

- The tanks would be cleaned to remove remaining materials and sludge.
- The remaining materials, sludges, and wash materials would be sent to an appropriate recycling or waste-disposal facility.
- Large ASTs would be tested for lead paint prior to demolition and, where found, disposal and recycling would be modified to accommodate the lead content.
- All tanks would be disassembled for disposal or recycling, as appropriate.
- Below-grade foundations would be left in place and buried.
- Smaller ASTs would be cleaned and removed without disassembly.

Other Reclamation Details

There would be several places where concentrate having up to 20 percent sulfur could accumulate (i.e., dry-concentrate storage bins, froth launders and sumps, concentrate thickeners, concentrate filters). Because this would be a high-value material, there would be an effort to ship as much as could be recovered. However, material remaining in the equipment and process piping would be properly disposed of in the Hydrometallurgical Residue Facility or other MPCA-approved locations.

Cover and Revegetation of the Building Area

After demolition of Plant Site buildings, these areas would be reclaimed and vegetated according to *Minnesota Rules*, part 6132.2700. All areas would be stabilized as required for stormwater management. Roads and parking lots would be reclaimed and vegetated according to *Minnesota Rules*, part 6132.2700. Asphalt pavement would be recycled or properly disposed of.

Disturbed areas on the Plant Site would be seeded with a certain selection of grasses/forbs and a potentially different group of species for the slopes. The three groups of species would include a native, slow growth mix; a non-native, rapid growth mix; and a mix of both native and non-native species. Non-native species would be used to ensure dust control on areas that have a higher potential to erode.

Tailings Basin Reclamation

During reclamation of the Tailings Basin, fugitive dust would be controlled on the upland areas by mulching and permanent vegetation.

Inactive interior beach areas would be temporarily vegetated as necessary for fugitive dust control, using oats, winter wheat, annual ryegrass, white clover, redtop, and alsike clover, or some combination of these species for various times of the year. The exterior dam faces would be permanently vegetated by a qualified reclamation contractor according to requirements of the Reclamation Seeding Plan. Upland areas would be planted with permanent vegetation and mulched to control potential fugitive dust in accordance with requirements in the Fugitive Emissions Control Plan. Upland beach areas would be planted with the same potential three mixes as that mentioned for disturbed areas on the Plant Site (native, non-native, or mixed), while the dam slopes and benches would be planted with the same mix as that mentioned for the slopes of the Category 1 Stockpile.

Infiltration would be reduced through the dam faces, beaches, and pond bottom of the Tailings Basin by bentonite amendment as follows:

- the exterior face of the dams would be reclaimed progressively, with a bentonite layer added as they are constructed, to limit oxygen diffusion;
- exposed beaches and dam tops would be amended with a bentonite layer to limit oxygen diffusion; and
- the pond bottom would be covered with a bentonite layer to maintain a permanent pond that would limit oxygen diffusion. Water management would include maintenance of a pond and wetland within the reclaimed Tailings Basin, stormwater management, and continued operation of the WWTP and the groundwater containment system.

The pond would remain in the reclaimed Tailings Basin with a wetland around its perimeter. In general, the pond’s maximum lateral extent would be maintained to be no closer than 625 ft from the interior edge of the Cell 1E/2E dams. The pond and wetland would receive surface water runoff from the crest and beaches of the basin and natural terrain adjacent to the Tailings Basin. The pond and wetland would continue to lose water via seepage, but at a reduced rate compared to operations, as a result of the bentonite amendment of the tailings surface. Water would be pumped from the Tailings Basin pond to the WWTP prior to discharge.

Stormwater management would include grading to provide a gently sloping surface that would route surface water runoff to the interior of the basin, accommodate future differential settlement of the underlying tailings, and maintaining ponding of water in the reclaimed Tailings Basin pond for the development of constructed wetlands.

An emergency overflow channel would be constructed to carry stormwater from the pond to the adjacent wetland in case of an extreme storm or snowmelt event after reclamation. The channel would be sized and designed to safely discharge at a flow sufficient to protect the Tailings Basin dams and would be constructed into bedrock to protect the channel from erosion and minimize maintenance requirements. A riprap delta would be installed where the channel ends to distribute the stormwater. Additional sediment control and energy dissipation structures would be incorporated at the channel discharge point if needed based on final design determinations. The conceptual location of the spillway from the combined Cell 1E and Cell 2E to the adjoining land is shown on Figure 3.2-29.

The WWTP and the seepage containment systems would continue to operate during reclamation, although seepage rates would be progressively reduced. Seepage would be pumped back into the Tailings Basin pond, treated at the WWTP with discharge used for stream augmentation, as described in Sections 3.2.2.3.10 and 3.2.2.3.11), or sent to the Mine Site to aid in West Pit flooding (along with excess water from the WWTP not needed for stream augmentation). The WWTP and the seepage capture systems would be periodically inspected to ensure continuing integrity.

Hydrometallurgical Residue Facility Reclamation

Reclamation of the Hydrometallurgical Residue Facility would include removal of ponded water, removal of pore water from the residue, construction of the cover system, and establishment of vegetation and surface water runoff controls.

Once the Hydrometallurgical Residue Facility becomes full, it would be dewatered by an initial decanting of ponded water and then drainage from the residue would be collected using a geocomposite drainage net and system of sidewall riser and pump systems. Ponded water remaining in the Hydrometallurgical Residue Facility would be removed and treated at the WWTP. Some water in the residue void spaces would be retained in the residue (stored water) while the other portion would drain from the residue (drainage). Drainage would be collected from the base of the cells at the geocomposite drainage system and managed as described previously for ponded water.

Early in the residue dewatering process, access to the residue surface may be somewhat difficult due to its fine-grained characteristics. A temporary cover would be placed to limit infiltration of precipitation while dewatering progresses and the residue consolidates and settles. The barrier layer of the temporary cover, in addition to covering the deposited residue, would be extended over the dams to exclude rainwater infiltration back into the residue while also accommodating settlement of the temporary cover system. The settlement of the temporary cover would be monitored, and when the rate and magnitude of settlement has diminished, the final cover would be placed.

The rate of drainage would decrease over time as the pore water within the hydrometallurgical residue is collected and removed. Once the entire facility is closed, the volume of water from the drainage collection systems would decline. In the long term, the volume of water requiring treatment would decline to the point that the remaining reclamation activity may consist of periodic pumping of remaining drainage into tank trucks for transportation, treatment, and disposal, as appropriate, and of inspection of the closed cells to verify integrity of the reclamation systems.

The Hydrometallurgical Residue Facility area would be graded to a gently sloping surface. The cover would consist of a layer of NorthMet tailings and/or local till soil layer above the drained hydrometallurgical residue, placed to provide a suitable foundation layer for subsequent reclamation construction activity. This would be topped, if necessary, with a non-woven needle-punched geotextile fabric. Next, a geosynthetic clay barrier layer and 40-mil low-density polyethylene (LDPE) or similar agency-approved barrier layer system would be placed. Finally, additional LTVSMC tailings and/or local till soils would be placed to create a surface capable of sustaining a vegetated cover. The reclaimed Hydrometallurgical Residue Facility would be seeded with a certain selection of grasses/forbs and a potentially different group of species for the slopes. The three groups of species would include a native, slow growth mix; a non-native, rapid growth mix; and a mix of both native and non-native species. Non-native species would be used to ensure dust control on areas that have a higher potential to erode.

Turf and final cover would be inspected and maintained by mowing once per year or as needed, fertilizing when visual inspection indicates poor vegetation growth, and implementing repairs. A schematic cross section of the Hydrometallurgical Residue Facility post-closure is provided on Figure 3.2-30.

The cover would slope gently toward the site perimeter to accommodate natural drainage of the runoff. Final cover slopes on the Hydrometallurgical Residue Facility interior would be relatively shallow to minimize the velocity of surface water runoff flow and the associated erosion. Runoff channeled along the Hydrometallurgical Residue Facility perimeter would be routed down-slope via rip-rapped drainage swales or plug-resistant inlet structures and piping systems. Runoff from the Hydrometallurgical Residue Facility exterior dam slope (constructed of MDNR-approved material LTVSMC tailings or local till soils) would be routed to the surrounding natural drainage system.

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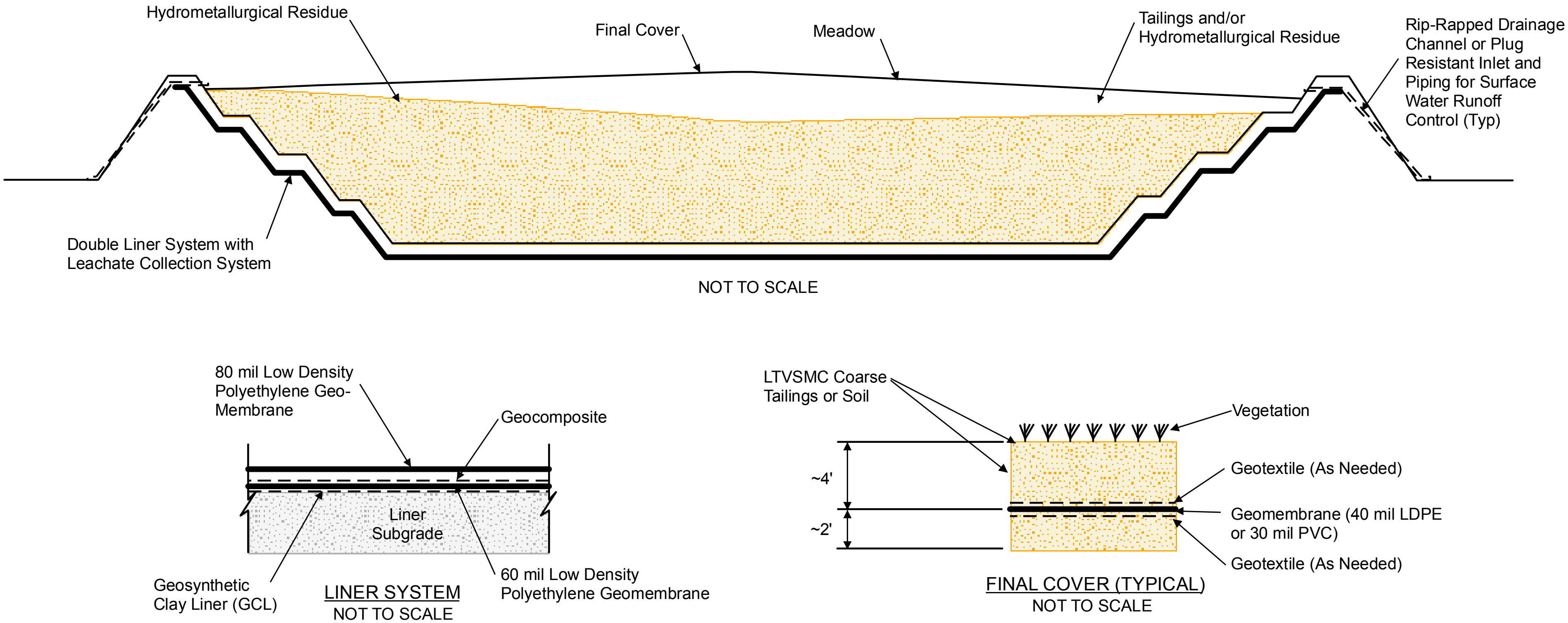

This document is a working document. This document may change over time as a result of new information, further deliberation, or other factors not yet known to the Co-lead Agencies.

Figure 3.2-30
Schematic Cross Section - Hydrometallurgical Residue Facility - Post Closure
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

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Water Management

During the reclamation phase, while the Tailings Basin is being reclaimed and the West Pit is being flooded (approximately years 21-52), the seepage from the Tailings Basin would continue to be collected. A portion of this water would be sent to the WWTP and treated, and a portion of the water would bypass the WWTP, where it would be blended back with the treated portion and pumped both to the West Pit and the Tailings Basin pond. Several years after the start of reclamation, the bottom of the Tailings Basin pond bottom would be lined with bentonite (see Section 3.2.2.3.12) and the pond water would be pumped to the WWTP, treated, and returned to the pond to the extent possible. The proposed water management for approximate years 31-52 is shown in Figure 3.2-18 in Section 3.2.2.1. Water in the Tailings Basin would be withdrawn, treated, and discharged as required to maintain pond levels.

At the Hydrometallurgical Residue Facility, a temporary cover would be placed to limit infiltration of precipitation while dewatering progresses and the residue consolidates and settles before the final cover is put in place. Drainage from the Hydrometallurgical Residue Facility would be pumped to the WWTP for treatment along with the Tailings Basin water. The rate of drainage would decrease over time as the pore water within the residue is collected and removed.

During the long-term maintenance phase, after the Tailings Basin has been reclaimed and hydrology has stabilized, the WWTP would be upgraded to include an evaporator, and Tailings Basin seepage would be collected and discharged via the WWTP until non-mechanical treatment has been demonstrated to provide appropriate treatment. Refer to the Transition from Mechanical to Non-Mechanical Treatment section under section 3.2.2.1.10 for more information on non-mechanical treatment. The proposed long-term water management (year 52 and beyond) is shown in Figure 3.2-19 in Section 3.2.2.1. The objective of the Tailings Basin cover would be to manage the constituent load from the tailings. The objective of the WWTP would be to treat Tailings Basin seepage that is captured by the seepage capture systems to meet effluent limits. Water from the drainage collection systems of the Hydrometallurgical Residue Facility is also directed to the WWTP for treatment to meet effluent limits. In the long term, reject concentrate from the WWTP RO unit or equivalently performing technology would be evaporated and the residual solids would be disposed of off-site.

The objective of closure is to provide mechanical or non-mechanical treatment for as long as necessary to meet regulatory standards at applicable groundwater and surface water compliance points. Water quality modeling performed in support of this FEIS indicates that water treatment systems would be needed indefinitely at the Mine Site and Plant Site. The water models constructed to assess the potential effects from the NorthMet Project Proposed Action were not designed to predict the duration of treatment nor do they capture all the factors that influence the duration of treatment (e.g., potential future regulatory and technological changes). Therefore, the models cannot be used to predict when treatment would end. Actual treatment requirements would be assessed on a recurring basis throughout operations, reclamation, and closure considering influent and effluent water quality and monitoring results. Those periodic assessments would be carried out to ensure continuous protection of groundwater and surface water quality and compliance with water quality-based effluent limits. The periodic assessment process would rely on monitoring results coupled with predictive modeling rather than the results of the predictive modeling alone. Regardless of the precise duration of effects or water treatment at either the Mine Site or Plant Site, there are measures available to address impacts to natural resources. PolyMet would be held accountable for maintenance and monitoring required under the permit and would not be released from financial assurance until all permit conditions have been met.

Post-reclamation Activities

Maintenance activities that would continue throughout reclamation and post-reclamation include dam slope erosion repair, woody species and tree removal on the Hydrometallurgical Residue Facility cover system, and Tailings Basin seepage capture systems operation and maintenance. PolyMet has committed to conduct demonstration projects during the Life of Mine and reclamation to establish non-mechanical water treatment systems to be used at the Plant Site. However, the WWTP would remain operational until water quality monitoring results meet permit requirements without the need for mechanical treatment.

PolyMet would be held accountable to maintenance and monitoring required under permit and would not be released until all conditions have been met.

3.2.2.4 *Financial Assurance*

Minnesota Rules, part 6132.1200, require that before a Permit to Mine can be issued, financial assurance instruments covering the estimated cost of reclamation, should the mine be required to close for any reason at any time, must be submitted and approved by the MDNR. There are no applicable federal financial assurance requirements that would be incorporated into the Permit to Mine. Financial assurance could be required indefinitely and could include self-sustaining instruments as discussed in the following sections.

Financial assurances for the direct wetland impact mitigation would be required until success of the mitigation sites can be assured. While this wetland mitigation would be expected to be approved and constructed in advance of any authorized wetland impacts, it is unclear whether these sites would be well enough established for financial assurances to be waived. The USACE would also consider the application of financial assurances for potential indirect wetland effects and monitoring. Both the USACE and state would require consideration of financial assurances during the permitting process.

The level of engineering design and planning required to calculate detailed financial assurance amounts is not currently available, but would be evaluated in detail during the permitting process. The following sections have been prepared to outline the purpose and requirement of financial assurance, including the rules and criteria that would be used in determining financial assurance and the risk analysis involved, as well as how PolyMet would calculate financial assurance during the permitting process.

3.2.2.4.1 Cost Coverage and Estimation

Financial assurance must cover the reclamation and post-reclamation activities that would incur costs to execute required funding. These activities include (but are not limited to):

- Implementation of corrective actions that may become necessary to address any permit non-compliance;
- Demolition of all structures;

- Remediation of any sites where petroleum products, reagents, additives, or other potential pollutants may have been released;
- Implementation of reclamation such as:
  - Fencing the perimeters;
  - Sloping and seeding the overburden portion of the pit walls;
  - Constructing the East Pit outlet structure;
  - Shaping and covering the Category 1 Stockpile;
  - Removing culverts, dikes, ditches, and ponds, followed by grading and seeding;
  - Constructing mitigation wetlands on the vacated stockpile locations;
  - Closing and covering the Hydrometallurgical Residue Facility;
  - Reseeding all areas; and
  - Reclaiming the Tailings Basin.
- Long-term post-closure monitoring and maintenance including:
  - Monitoring and maintenance of the covers, slopes and containment systems of the Category 1 Stockpile, Hydrometallurgical Residue Facility, and Tailings Basin;
  - Treatment of East Pit water and West Pit water in the WWTF;
  - Collecting and pumping water from the Tailings Basin to the WWTP for discharge or transfer to the Mine Site for pit flooding;
  - Off-site disposal of pore water from Hydrometallurgical Residue Facility;
  - Monitoring and reporting groundwater and surface water quality; and
  - Developing and implementing non-mechanical water treatment systems.
- Project management and site security for the above.

Reclamation and post-reclamation costs are required, under the Permit to Mine, to be updated on an annual basis to account for the proceeding year's activities. This requires estimating the contingency funds required for closure and post-closure activities in the event of unplanned closure during the course of the year. Revisions would capture annual changes in contingency reclamation activities and costs such as:

- An annual increase in Mine Site provisions as mining proceeds and the amount of disturbance, size of permanent stockpile, and volume of temporary stockpiles to be backfilled increase.
- An increase in Tailings Basin provisions as the beach and pond areas increase.
- A potential decrease in Mine Site provisions as ongoing reclamation (e.g., backfilling of temporary stockpiles) is completed as contemplated in the Mining and Reclamation Plan. This is expected to occur as the facility nears reclamation.

The final Reclamation Plan (to be applied at the end of mining to cover the closure process and post-closure activities) and the Contingency Reclamation Cost Estimate (contingency for mine closure prior to the planned 20-year Life of Mine) would be developed by PolyMet and its consultants based on detailed engineering studies that would be finalized through the permitting process. As required, PolyMet would ensure that the financial assurance amount is established as a function of (but not limited to) the following three main variables:

- extent of surface disturbance and potential releases from waste storage facilities;
- reclamation and long-term care standards (including mechanical water treatment); and
- reasonable assessment of the costs to execute the Contingency Reclamation Plan.

PolyMet has developed preliminary cost estimate ranges that address the above items for hypothetical closure at years 1, 11, and 20. These estimates are provided in Table 3.2-15 below. In addition to the cost of physical closure and reclamation activities as shown in Table 3.2-15, annual post-closure monitoring and maintenance is estimated to be in the range of $3.5m - $6m per year.

The cost estimates would be finalized by the MDNR during the permitting processes.

Table 3.2-15 Preliminary Cost Estimate for Closure

	Year of Closure (end of year)			Annual Post-closure Monitoring and Maintenance
	Year 1	**Year 11**	**Year 20**	
Estimated Range	$50m - $90m	$160m - $200m	$120m - $170m	$3.5m - $6m

Source: Foth 2013.

3.2.2.4.2 Financial Assurance Instruments

The financial instruments must be robust enough to address a wide variety of contingencies such as (but not limited to):

- Physical difficulties in implementing reclamation plans;
- Escalating standards of closure, reclamation, and long-term monitoring;
- Unanticipated liabilities;
- Unplanned cessation of mining;
- Failure of the mining company; and
- Failure or limitations on the ability of third parties to pay reclamation costs.

The financial assurance instruments for the NorthMet Project Proposed Action must:

- Be available and made payable to the MDNR when needed;
- Be sufficient to cover the costs estimated;
- Be fully valid, binding, and enforceable under state and federal law;
- Not be dischargeable through bankruptcy; and

- Be approved by the MDNR.

PolyMet intends to propose financial instruments based on appropriateness and compatibility with the specific activities for which assurance is being provided. It is likely that different instruments would be proposed to assure different components of the reclamation cost estimate and so would likely use more than one instrument at any point in time. For example, while insurance policies may not be appropriate for primary assurance, they could provide meaningful additional support over and above the expected costs or activities. Commonly accepted financial assurance instruments, such as the following, would be proposed:

- Surety bonds;
- Irrevocable letters of credit;
- Cash and cash equivalents;
- Trust funds;
- Insurance policies; or
- A combination thereof.

3.2.2.4.3 Cessation of Financial Assurance

PolyMet may cancel financial assurance only upon approval by the MDNR after it is replaced by an alternative mechanism or after being released (in whole or in part) from financial assurance.

MDNR would release PolyMet from the responsibility to maintain financial assurance when the MDNR determines, through inspection of the mining area, that:

- All reclamation activities have been completed in accordance with the Permit to Mine;
- Conditions necessitating post-reclamation monitoring and maintenance no longer exist and are not likely to recur; and
- Corrective actions have been successfully completed and monitoring of those corrective actions are no longer needed.

3.2.3 *NorthMet Project Alternatives*

Both federal and state law require agencies to consider reasonable alternatives as part of their respective responsibilities. The purpose of the alternatives process is to allow for the identification and consideration of other reasonable alternative means to achieve the project Purpose and Need and that could also improve environmental and/or socioeconomic benefits. Alternatives offer decision makers and the public options to the proposal and include a no action alternative that considers the effects that would occur if the project is not approved.

This section describes the process by which the Co-lead Agencies identified, screened, and determined alternatives to the NorthMet Project Proposed Action that would be carried forward for analysis in this FEIS.

3.2.3.1 *Process Overview*

NEPA and the CEQ regulations (40 CFR 1500-1508) require that a “range of alternatives” must be considered in the EIS. NEPA does not prescribe any minimum number of alternatives, other than that the no action alternative must be included (40 CFR 1502.14) (CEQ 1981).

Under MEPA, the MEQB statutes and rules (*Minnesota Statutes,* chapter 116D, sections 04 and 045; and Minnesota Rules, part 4410, subpart 0200 through 7500) require that an EIS consider at least one alternative from each of the following categories (State of Minnesota 2009):

- Alternative sites;
- Alternative technologies;
- Modified designs or layouts;
- Modified scale or magnitude; and
- Alternatives incorporating reasonable mitigation measures.

Under both NEPA and the CEQ regulations, and MEQB Rules for MEPA, alternatives may include a number of individual mitigation measures that collectively constitute a major change to the proposed action and would provide decision makers a meaningful choice. Single resource-specific mitigation measures do not normally require a separate alternative to be considered and evaluated in an EIS.

3.2.3.1.1 Identification

Alternatives may be identified at any time throughout the EIS process, including during the scoping process, which is used to identify issues that trigger the analysis of effects and the development of potential alternatives. Alternatives may also be identified by either the proponent or the Co-lead Agencies at any other time during the process as a result of gaining new information regarding the project’s effects or for other reasons.

Alternatives to the NorthMet Project Proposed Action were identified in accordance with the requirements of NEPA and the CEQ regulations and Forest Service NEPA regulations at 36 CFR 220.5e(1) and MEQB Rules for MEPA. Alternatives identified and considered for the NorthMet Project Proposed Action are described in Section 3.2.3.2 through Section 3.2.3.5 below.

3.2.3.1.2 Screening

Once identified, alternatives for the NorthMet Project Proposed Action were screened against the following criteria to determine if they warranted further evaluation:

- <u>Purpose and Need</u> – Each alternative was assessed as to whether it would meet the Purpose and Need for the project.
- <u>Technical feasibility</u> – Each alternative was assessed as to whether it could be implemented using currently available technology based on the current level of knowledge.
- <u>Economic feasibility</u> – Each alternative was assessed as to whether it could meet economic and financial requirements to construct and operate the proposed project, including whether the cost of implementing the alternative would be economically feasible to meet the Purpose and Need.

- Availability – Each alternative was assessed as to whether surface rights, mineral rights, technologies, and other resources required are currently available.
- Environmental or socioeconomic benefits – Each alternative was assessed to determine if it offered substantial environmental or socioeconomic benefits over other alternatives, including the NorthMet Project Proposed Action.

Some alternatives needed to be screened more than others to inform a conclusive decision on whether or not to analyze them in detail in this FEIS. This process was iterative in that alternatives continued to be screened as they passed through initial filters and as the project evolved.

Alternatives that did not meet the screening criteria were not considered reasonable and were eliminated from detailed analysis in this FEIS. Alternatives that met the screening criteria were fully analyzed and compared equally in the EIS. The general screening and assessment process applied to alternatives identified for the NorthMet Project Proposed Action is shown in Figure 3.2-31. The process ultimately informs decision-makers during the identification of an agency-preferred alternative in a DEIS (or SDEIS), if one exists, and in this FEIS unless another law prohibits the expression of such a preference (40 CFR 1502.14(e)). MEPA does not require identification of a preferred alternative.

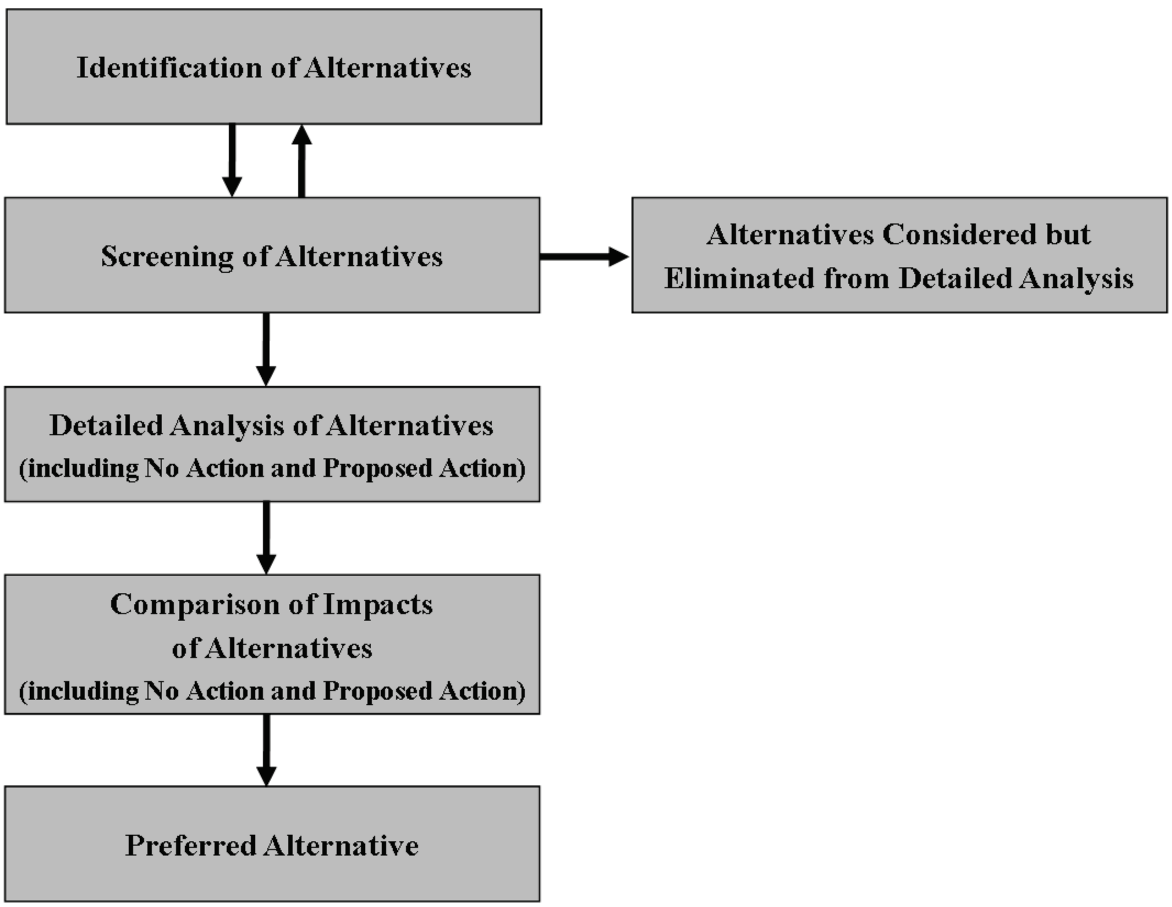

Figure 3.2-31 Alternative Assessment Process

3.2.3.1.3 NorthMet Project Alternatives Analyzed in this FEIS

As discussed in the following sections (after the No Action Alternative section below), the NorthMet Project Proposed Action incorporates activities and environmental impact mitigation measures that have been evaluated and developed through the EIS process.

The alternatives and mitigation measures identified and considered were either incorporated into the NorthMet Project Proposed Action as they offered benefits to the outcomes of the project, or they were eliminated from detailed evaluation because they did not offer measurable or substantial environmental benefits over other alternatives (including the NorthMet Project Proposed Action), they were not reasonable (i.e., weren't economically or technically feasible in accordance with CEQ guidelines), or would not meet the Purpose and Need.

As a result of screening and analysis, the NorthMet Project No Action Alternative (i.e., the NorthMet Project Proposed Action would not occur) is the only alternative to the NorthMet Project Proposed Action evaluated in detail in this FEIS. Tailings Basin closure cap alternatives were reconsidered, and underground mining and backfilling the West Pit with Category 1 waste rock were considered in more detail, but remained eliminated.

3.2.3.2 *NorthMet Project No Action Alternative*

Under the NorthMet Project No Action Alternative, the NorthMet Project Proposed Action would not occur. The consideration of a No Action Alternative is required to be evaluated in this FEIS in accordance with NEPA and MEPA.

If the NorthMet Project Proposed Action is not approved, the Mine Site would be returned to pre-exploration conditions under the requirements of exploration approvals to reclaim surface disturbance associated with exploratory and development drilling activities. Other existing surface uses would be allowed to continue consistent with the Forest Plan.

No further upgrades or new segments would be constructed along the existing power transmission line, railroad, or Dunka Road, which would continue to be used by their private owners.

At the brownfield Plant Site, Cliffs Erie would continue to complete closure and reclamation activities as specified under state permits and plans and the Cliffs Erie Consent Decree. This would include completing activities for the localized affected areas under the Minnesota Voluntary Investigation and Cleanup (VIC) Program, removal of the former Plant Site building, and management of seepage at the Tailings Basin embankment.

3.2.3.3 *Development of the NorthMet Project Proposed Action and Alternatives*

The NorthMet Project Proposed Action and alternatives were developed during project scoping in 2005. Potential effects were analyzed and discussed in the 2009 DEIS (MDNR and USACE 2009). Following public and agency comment on the DEIS, evolving MPCA water quality guidance, project refinements made by PolyMet, and the addition of the Land Exchange Proposed Action, the Co-lead Agencies decided to prepare an SDEIS before this FEIS.

3.2.3.3.1 Summary of Alternatives Analysis from the FSDD

The MEPA scoping process for the NorthMet Project Proposed Action began with the June 2005 publication of a Scoping Environmental Assessment Worksheet (EAW) and a Draft Scoping

Decision Document. The NEPA scoping process began in July 2005 with the publication by the U.S. Army Corps of Engineers (USACE) of a Notice of Intent to prepare an EIS for the NorthMet Project Proposed Action. The agencies engaged in public review and comment of these documents, including identification of potential project alternatives.

On October 25, 2005, after consideration of potential project alternatives and environmental effects, the agencies published a Final Scoping Decision Document (FSDD) that describes various alternatives in each of the categories required by Minnesota law – alternative sites, alternative technologies, modified designs or layouts, modified scale or magnitude, and alternatives incorporating mitigation measures (see Section 3.2.3.1). As discussed below, the scoping document explains why some of these alternatives were eliminated from further consideration, while others were carried forward for more detailed study in the 2009 DEIS.

Site Alternatives – The FSDD explains that, because the mineralization dictates the location of the Mine Site, an alternative site would not meet the NorthMet Project Proposed Action's Purpose and Need and should be eliminated from further consideration. An alternative Plant Site was likewise eliminated from further consideration because the re-use of an existing facility would have fewer environmental effects than other greenfield sites. Two alternative waste rock disposal sites and one alternative Tailings Basin site were carried forward for further consideration in the DEIS.

Technology Alternatives – Two alternative technologies were carried forward for the NorthMet Project Proposed Action. It was decided that alternative hydrometallurgical technologies would not be evaluated, concluding that there were no known alternatives that would have significant environmental benefits over the NorthMet Project Proposed Action.

An underground mining alternative was also evaluated, noting that "If the cost of developing an underground mining alternative were so high that [PolyMet] could not develop the project, this alternative would not meet the Purpose and Need of the project." (MDNR 2005)

Modified Designs or Layouts – The Co-lead Agencies eliminated alternative designs for the Transportation and Utility Corridor and the Plant Site, neither of which offered environmental benefits greater than those offered by the NorthMet Project Proposed Action. With respect to the Mine Site, the agencies considered a number of different design and layout modifications, including using two mine pits instead of three, chemical modification of reactive waste rock piles and co-disposal of reactive waste rock on a lined Tailings Basin, pre-treatment of certain types of wastewater, and use of reactive wastewater as make-up water for the Plant Site. Each of these alternatives, along with several technical design reports, was slated for further consideration as possible alternatives in the DEIS.

Scale or Magnitude Alternatives – The FSDD evaluated the possibility of changing the scope (size) of the NorthMet Project Proposed Action, but concluded that the return on investment for a smaller scale project was infeasible. Accordingly, the FSDD concluded that a reduced scale would not meet the Purpose and Need for the project.

Alternatives Incorporating Mitigation Measures – In addition to alternatives to the NorthMet Project Proposed Action, the FSDD also included alternatives that incorporated reasonable mitigation measures. The first of these is proposed monitoring programs for waste rock stockpiles and the Tailings Basin. The second mitigation measure included a lined tailings storage facility within the Tailings Basin and continued testing to determine tailings reactivity.

Both of these mitigation measures were carried forward for additional consideration in the DEIS. Because these measures amounted to only minor changes to the NorthMet Project Proposed Action, they were not carried forward as full alternatives. Instead, they were evaluated as part of the NorthMet Project Proposed Action.

3.2.3.3.2 Summary of Alternatives Analysis from the 2009 DEIS

Following the publication of the FSDD in 2005, PolyMet provided a project description to the Co-lead Agencies. Over the next three years, PolyMet continued to gather data and consult with the Co-Lead Agencies, which led to several modifications to the NorthMet Project Proposed Action. Among these modifications was the incorporation of certain mitigation measures, as well as the two mine pit alternatives, into the NorthMet Project Proposed Action. In addition to the NorthMet Project No Action Alternative, the DEIS analyzed the following alternatives to the NorthMet Project Proposed Action:

Mine Site Alternative – The Mine Site Alternative consisted of modifications to the Mine Site design or layout intended to reduce potential effects on surface water and groundwater. The Mine Site Alterative proposed, among other things, sub-aqueous disposal of the most reactive waste rock and lined, temporary stockpiles for this waste rock.

Tailings Basin Alternative – The Tailings Basin Alternative included various modifications to the Tailings Basin intended to increase geotechnical stability and capture seepage from the Tailings Basin. The Tailings Basin Alternative resulted from the comprehensive mitigation planning effort by the Co-lead Agencies, and included input from all Cooperating Agencies and consulting tribes. The DEIS evaluated 27 individual mitigation measures (DEIS Table 3.2-2) developed from this effort and 11 combinations of individual mitigation measures that were considered (MDNR and USACE 2009, Table 3.2-3) before selecting the Tailings Basin Alternative.

Alternatives Considered but Eliminated from Detailed Analysis in the EIS – On the basis of analysis performed in connection with the 2009 DEIS, several of the alternatives identified in the FSDD were eliminated from further consideration. These included 1) alternative waste rock disposal sites; 2) the underground mining alternative, which was found to have costs so high that it failed to meet the Purpose and Need of the project; and 3) pretreatment of runoff and use as make-up water at the Mine Site.

3.2.3.3.3 Refinement of the Proposed Action after the 2009 DEIS

The main refinements to the NorthMet Project Proposed Action from the DEIS and the SDEIS involve improved waste and water management at both the Mine Site and Plant Site. These measures were identified in part in the Mine Site Alternative and Tailings Basin Alternative, as described in the DEIS, and later combined to form a Co-lead Draft Alternative which PolyMet subsequently incorporated into the NorthMet Project Proposed Action (refer to Section 2.3.2 for more information). Concurrent impact assessment and modeling identified additional project refinements and mitigation measures. PolyMet also incorporated these changes into the NorthMet Project Proposed Action analyzed in the SDEIS.

The development of the NorthMet Project Proposed Action, including consideration and incorporation of alternatives is shown in Figure 3.2-32. The evolution of the NorthMet Project Proposed Action from the DEIS to the SDEIS is summarized in Table 3.2-16. The general method, rate, volume, and duration of mining, transportation, and processing of ore did not change substantially from that proposed in the DEIS. It should be noted that Table 3.2-16 is only for comparison purposes and shows only features that changed from the NorthMet Project Proposed Action as found in the DEIS to the SDEIS NorthMet Project Proposed Action and does not represent a complete summary of the current NorthMet Project Proposed Action.

A number of other alternatives were eliminated from further consideration because they did not meet the screening criteria as discussed above. These alternatives are detailed below in Table 3.2-17.

3.2.3.3.4 Refinement of the Proposed Action after the 2013 SDEIS

The NorthMet Project Proposed Action has been modified since the SDEIS has been published (PolyMet 2015a). These modifications include:

- Modifying the ore grinding circuit to include a SAG mill, which would replace an existing rod mill and ball mill circuit at the Plant Site;
- Relocating the Coal Ash Landfill from its current location on the east side of Tailings Basin Cell 1E to the Hydrometallurgical Residue Facility;
- Extending the Tailings Basin containment system to a portion of the east side of Tailings Basin Cell 1E to collect potential seepage in this area;
- Modifying the stream augmentation plan such that only treated water would be discharged to the three Embarrass River tributaries (Trimble Creek, Unnamed Creek, and Mud Lake Creek) and Second Creek;
- Refurbishment of existing rail cars to reduce potential for ore spillage;
- Clarifying that the design of the sewage treatment system would include refurbishing the existing collection system and replacing the existing LTVSMC mechanical sewage treatment plant with a stabilization pond facility, which would discharge to the Tailings Basin; and
- Incorporating CDSM as an engineering measure to stabilize the existing tailings and peat layers in the northern dams of the LTVSMC Tailings Basin prior to the use of that facility for the NorthMet tailings.

These measures have been identified as potential improvements or mitigation measures to be incorporated into the NorthMet Project Proposed Action.

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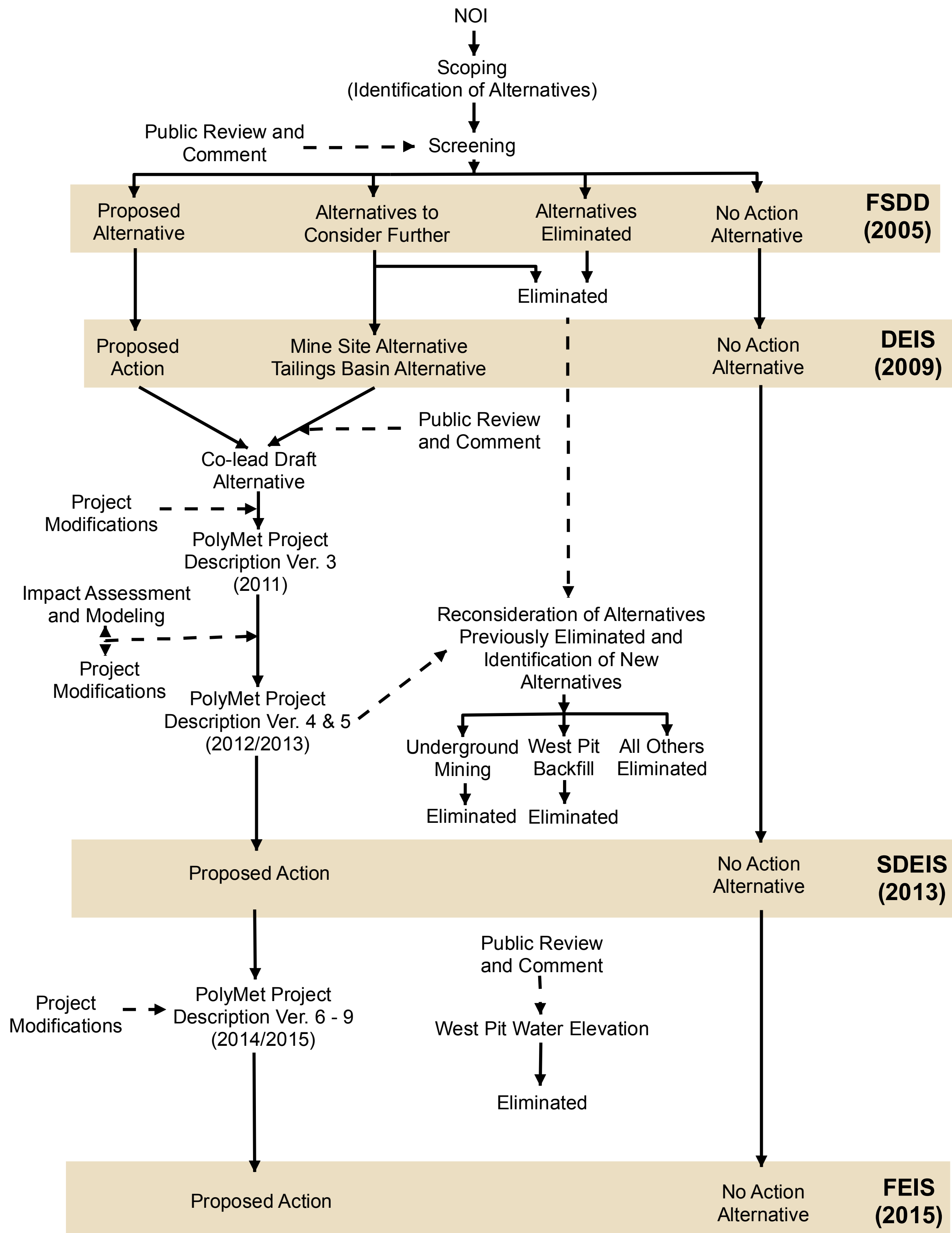

US Army Corps of Engineers
St. Paul District

Figure 3.2-32
Development of Proposed Action and Alternatives for the Project
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

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2458 ***Table 3.2-16 Comparison of DEIS, SDEIS, and FEIS for the NorthMet Project Proposed Action***

DEIS Proposed Action	NorthMet Project Proposed Action as Presented in SDEIS Only	NorthMet Project Proposed Action as Presented in FEIS Only	DEIS to FEIS Comparison of Environmental Consequences
Mine Site			
• Category 1 and 2 waste rock would be stored in a permanent soil-lined/soil-covered stockpile (Category 1/2 Stockpile) north of the west pit (years 1-11) • Category 1 and 2 waste rock generated after year 11 would be backfilled to the East Pit • Category 3 waste rock would be placed on a permanent lined/covered stockpile (east of the East Pit) or Category 3 Lean Ore Stockpile (southeast of the East Pit) • Category 4 waste rock would be stored on a permanent, lined and covered waste rock stockpile (south of the East Pit) • Category 4 lean ore would be hauled to the Rail Transfer Hopper or stored on the Lean Ore Surge Pile • Saturated overburden would be placed in the Category 1/2 Stockpile. • A WWTF used to treat process water collected from lined stockpiles would be located on the south side	• Category 1 waste rock mined from years 1-13 would be stored in an unlined, permanent stockpile north of the West Pit. The stockpile would have a geomembrane cover system at completion and surface water and groundwater collection system would encompass the entire stockpile and direct water to the Mine Site WWTF. • Category 2/3 waste rock mined from years 1-11 stored in a temporary stockpile (with a geomembrane liner system) southeast of the mine pits. • Category 4 waste rock mined from years 1-11 stored in a temporary stockpile (with a geomembrane liner system) on the top of the un-mined Central Pit. • The temporary Category 2/3 Stockpile and Category 4 Stockpile and all new waste rock mined in years 11-20 would be backfilled into the East Pit and Central Pit and stored subaqueously. • Saturated overburden would be used as approved by the MDNR or placed in stockpiles with geomembrane liners (Category 2/3 Stockpile or Category 4 Stockpile). • WWTF located south of the West Pit and Central Pit, east of the Overburden Storage and Laydown Area, and immediately adjacent to the Rail Transfer Hopper. It would be	• As per the SDEIS.	• Elimination of three permanent stockpiles and highest sulfur rock backfilled to East and Central pits, which would be flooded for subaqueous disposal • Reduction in wetland effects • Capture and treatment of most (estimated to be above 90 percent capture) of groundwater and surface seepage from stockpiles • Minimization of the long-term water flow through the permanent stockpile, resulting in substantial reduction of stockpile seepage volumes to be treated and improvement in West Pit water quality post closure.

DEIS Proposed Action	NorthMet Project Proposed Action as Presented in SDEIS Only	NorthMet Project Proposed Action as Presented in FEIS Only	DEIS to FEIS Comparison of Environmental Consequences
of the West Pit, west of the Overburden Storage and Laydown Area	upgraded to include RO or equivalent technology that would meet water quality targets after closure.		

DEIS Proposed Action	NorthMet Project Proposed Action as Presented in SDEIS Only	NorthMet Project Proposed Action as Presented in FEIS Only	DEIS to FEIS Comparison of Environmental Consequences
Plant Site			
• Upgrading existing and constructing new processing facilities located at the former LTVSMC processing plant • Seepage from the toe of the Tailings Basin collected through a series of header pipes, recovery trenches, and vertical extraction wells returning seepage to the tailings basin • No Tailings Basin cover proposed • Hydrometallurgical Residue Facility located on top of the existing LTVSMC Tailings Basin Cell 2W	• As per the DEIS, with some minor changes to the layout of processing facilities, the addition of a new WWTP (RO or equivalent technology that would meet water quality targets) and only one autoclave -- Copper concentrate would not be further processed. • Added rock buttressing at the Tailings Basin to increase geotechnical stability. • Surface seep system at the southern Tailings Basin dam, and surface water and groundwater containment system constructed around the north and west Tailings Basin dams capturing all surface and greater than 90 percent of all groundwater seepage, which would be directed to a new Plant Site WWTP. Treated water returned to the Tailings Basin or discharged to wetlands north of the Tailings Basin groundwater containment system to supplement a reduction in flow in that area. • During the construction of the Tailings Basin embankments, a bentonite amended oxygen barrier layer (at a depth of 30 inches from the surface of the dams) would be installed on exterior sides of dams. • During closure, bentonite would be incorporated into beach and pond areas of the Tailings Basin to reduce the influx of oxygen and water. • Hydrometallurgical processing would only include one autoclave instead of	• As per the SDEIS, with some minor changes to processing facilities and the Plant Site layout, including the addition of a new SAG mill and updating the sanitary sewage treatment system. • Relocation of the contents of the Coal Ash Landfill to the Hydrometallurgical Residue Facility prior to its current site being covered with NorthMet Project Proposed Actin tailings. • Incorporation of CDSM at the Tailings Basin to increase geotechnical stability. • Added surface seepage management system along the east Tailings Basin dams capturing all surface and greater than 90 percent of all groundwater seepage, which would be directed to the WWTP. • Using only treated water from the WWTP to augment flows affected by the containment system	• New building layout better utilizing disturbed ground meaning reduced wetland effects • Elimination of major air emission sources and electrical users • Capture and treatment of greater than 90 percent of groundwater, and all surface seepage from Tailings Basin • Improvement in the foundation stability of the Tailings Basin • Augmentation of flow effects to wetlands adjacent to the Tailings Basin using treated water • Improvement in the foundation stability of the Hydrometallurgical Residue Facility, which eliminates concerns about liner failure and provides a virtually zero leakage liner system

DEIS Proposed Action	NorthMet Project Proposed Action as Presented in SDEIS Only	NorthMet Project Proposed Action as Presented in FEIS Only	DEIS to FEIS Comparison of Environmental Consequences
	two, reducing residue in half. • Hydrometallurgical Residue Facility would be located in the footprint of the existing LTVSMC Emergency Basin immediately southwest of the existing LTVSMC Cell 2W of the Tailings Basin.		

3.2.3.4 *Post-DEIS Reconsideration of Previously Eliminated Alternatives*

In response to Cooperating Agency comments and the evolution of the NorthMet Project Proposed Action since the DEIS, the Co-lead Agencies reviewed previously identified alternatives against the current NorthMet Project Proposed Action to determine whether any of them should be reconsidered.

Some alternatives considered include various wet and dry cover options for the Tailings Basin at closure. Many specific mitigation measures were identified and considered individually and in combination. One particular combination of mitigation measures was identified and carried forward in the DEIS as the Tailings Basin Alternative. In preparing the SDEIS, a multidisciplinary Co-lead Agency workgroup evaluated and compared three wet and three dry cover options to address several modified water management and geotechnical stability requirements. Of these, the recommended option involved a wet cover with bentonite amended beach, side slopes, and pond. PolyMet adopted this recommended wet cap option as part of the NorthMet Project Proposed Action.

In response to a change in applicability of water quality impact criteria, PolyMet further revised the NorthMet Project Proposed Action to include collection of substantially all Tailings Basin surface and groundwater seepage from the existing LTVSMC Tailings Basin and the proposed NorthMet Tailings Basin by a vertical hydraulic barrier constructed from the ground surface down to the top of bedrock. PolyMet also proposed enhanced mechanical water treatment using RO or equivalent technology that would meet water quality targets, which would remove substantially all of the constituents in the captured seepage. This combination of the wet cap option along with collection and treatment engineering controls were shown in modeling to meet water quality evaluation criteria with a few exceptions (see Section 5.2.2). Additionally, PolyMet enhanced the design of the proposed Tailings Basin rock buttress, and it was shown in modeling to provide adequate geotechnical stability (see Section 5.2.14). The other wet and dry cap options did not offer meaningful environmental benefits, and, in fact, seepage from the dry caps was predicted under the current model design to result in substantially higher concentrations which would make the future transition from mechanical (RO or equivalent technology that would meet water quality targets) to non-mechanical water treatment more difficult during post-closure (ERM 2010).

As addressed below, the Underground Mining Alternative and backfilling the West Pit with Category 1 waste rock were considered further, again in response to Cooperating Agencies and stakeholder comments received on the DEIS. However, following further analysis, these remain eliminated from full analysis in this FEIS.

Other alternatives were either incorporated (at least in part) to the NorthMet Project Proposed Action and are therefore no longer relevant, or remain eliminated as the changes to the NorthMet Project Proposed Action would not affect the rationale previously used to eliminate them.

The outcomes of reconsideration of previously eliminated alternatives are shown in Table 3.2-17. The types of alternatives considered against the MEPA-required alternative types are shown in Table 3.2-18.

In response to comments received on the SDEIS, the NorthMet Project Proposed Action was refined to include some additional engineering design or mitigation measures (Section 3.2.3.3.4). Co-lead Agency analysis of these refinements indicated that they would further improve the environmental performance of the NorthMet Project Proposed Action and therefore did not trigger reconsideration of alternatives previously eliminated.

Table 3.2-17 Previous NorthMet Project Alternatives Screened for this FEIS

Reference[1]	**Alternative**	**Previous Screening Outcome**	**SDEIS Screening Outcome (remains applicable for this FEIS)**
	DEIS Proposed Action	Analyzed in the DEIS	Partially incorporated into the SDEIS NorthMet Project Proposed Action, with improved waste rock and water management and further refined through identification of improved mitigation measures such as the full bentonite amendment cover for the Tailings Basin.
	DEIS Mine Site Alternative		
	DEIS Tailings Basin Alternative		
TB1	Wet Tailings Basin cover at closure using a bentonite beach, side slope and pond amendment	Analyzed since the DEIS	
E18	Use of low sulfur waste rock as construction material	Eliminated in the DEIS	Partially incorporated into the SDEIS NorthMet Project Proposed Action. Category 1 Waste Rock may be used if approved by the MDNR in circumstances where contact water is controlled and treated.
E7	Underground mining the NorthMet Deposit (Underground Mining Alternative)	Eliminated in the DEIS	Continues to be eliminated. Reconsidered but not economically feasible. Refer to Underground Mining Alternative in Section 3.2.3.4.1 and Appendix B for more information.
E20	Disposal of waste rock and/or tailings in the West Pit (West Pit Backfill)	Eliminated in the DEIS	Continues to be eliminated. Reconsidered but would not offer substantial environmental benefit. Refer to West Pit Backfill Alternative in Section 3.2.3.4.2.
E3	Alternative mine pit location	Eliminated in FSDD	Continues to be eliminated. No changes to the NorthMet Project Proposed Action design affect these alternatives.
E12, E13	Alternative ore transport (conveyors vs. trucks)		
E21	Smaller mine and ore processing facility		
E4	Alternative Processing Plant site location		
E8	Other hydrometallurgical technologies		
E10	Process the Category 3 and 4 lean ore and waste rock through the Processing Plant		
E9	Concentrate-only operations mode		

Reference[1]	Alternative	Previous Screening Outcome	SDEIS Screening Outcome (remains applicable for this FEIS)
E11	Alternative designs and layouts for the ore processing plant		
E1	Off-site, non-reactive waste rock disposal	Eliminated in the DEIS	
E2	Off-site, subaqueous in-pit disposal of reactive waste rock		
E6	Off-site, subaqueous in-pit co-disposal of reactive waste rock/tailings/ overburden		
E5	Off-site, subaqueous in-pit tailings disposal		
E14	Co-disposal of reactive waste rock and tailings on a lined Tailing Basin		
E17	Use of Mine Site reactive runoff as make-up water for the Processing Plant with a single wastewater treatment at the Processing Plant		
E15	Pretreatment of Mine Site reactive runoff and discharge to Babbitt or Hoyt Lakes POTW		
E16	Pretreatment of Tailings Basin process water and discharge to the City of Hoyt Lakes POTW		
E19	Use non-contact stormwater from detention pond at Mine Site as process water		
TB2	Wet Tailings Basin cover at closure using a bentonite side slope and pond amendment	Analyzed since the DEIS	These alternatives were reconsidered and continue to be eliminated since they do not afford meaningful environmental benefits compared to the enhanced engineering controls (seepage collection and RO mechanical water treatment) built into the NorthMet Project Proposed Action. Further, dry cap seepage is predicted to result in substantially higher concentrations, under current model design, which would make the future transition from mechanical (RO) to non-mechanical water treatment more difficult during post-closure.
TB3	Wet Tailings Basin cover at closure using a bentonite beach and pond amendment		
TB4	Dry Tailings Basin cover at closure using a surface bentonite amendment		
TB5	Dry Tailings Basin cover at closure using a geomembrane		
TB6	Dry Tailings Basin cover at closure using a geosynthetic clay liner		

[1] "E" alternatives are from Table 3.2-4 in the DEIS; "TB" options are from ERM 2010.

POTW = Publicly Owned Treatment Works

Per MEPA rules, projects must consider five types of alternatives and determine which activities would address those alternatives. Table 3.2-18 below identifies which alternatives considered addressed the five MEPA alternative types.

Table 3.2-18 MEPA Alternatives Types Considered for the NorthMet Project Proposed Action

Project Activity[1]	Alternative Sites	Alternative Technology	Modified Designs or Layouts	Modified Scale or Magnitude	Alternatives Incorporating Mitigation Measures
Mining	E3	E7, E13		E21	
Waste Rock Management	E1,E2, E6		E10, E14, E18, E20		DEIS Mine Site Alternative
Mine Site Processing Plant Water Management			E15, E17, E19		
Transportation and Utility Corridor		E12			
Processing and Plant Site Water Management	E4	E8, E9	E11, E16		
Tailings Management	E15, E5		TB1,TB2, TB3, TB4, TB5, TB6		DEIS Tailings Basin Alternative

[1] For further information see Table 3.2-17.

3.2.3.4.1 Underground Mining Alternative

The Underground Mining Alternative was considered but eliminated as alternative E7 in Table 3.2-4 of the DEIS (MDNR and USACE 2009). It was eliminated from further consideration in the DEIS as it was determined that it would not offer substantial environmental or socioeconomic benefits compared to the NorthMet Project Proposed Action. The DEIS further concluded that the significantly lower rate of ore production required for an underground mining alternative would not meet the Purpose and Need of the project.

The Underground Mining Alternative was reconsidered for the SDEIS due to a high level of interest from Cooperating Agencies and stakeholders and because it was identified in the Land Exchange Scoping Report (USFS 2011a) as requiring further assessment. This alternative would involve mining the NorthMet Deposit as defined by the proposed open pit boundary. While the mineralized zone extends beyond the proposed open pit boundary, the geology outside of the open pit has not been characterized enough to support a mine plan and is beyond the boundaries of the NorthMet Project area, so it is not reasonable to include for consideration for the Underground Mining Alternative.

An underground mine, within the proposed open pit boundary (shell), would result in a smaller surface footprint, thus offering environmental benefits over the NorthMet Project Proposed Action through reduced effects on wetlands, vegetation, and wildlife habitat. An underground mine would also have lower production rates compared to the proposed open pit, resulting in less fugitive air emissions, and less waste rock and processing waste (tailings and hydrometallurgical residue), thus reducing the scale and duration of potential water quality effects. A smaller mining operation would also reduce the scale and duration of mining and the associated socioeconomic benefits.

PolyMet conducted an Economic Assessment of Conceptual Underground Mining Option for the NorthMet Project Proposed Action that concluded underground mining would not be economically feasible given the specific characteristics of the NorthMet Deposit (Foth 2012). That is, the tonnage/volume and grade (amount of metals) of rock would not generate enough revenue to pay for all costs associated with underground mining. The assessment used metal prices calculated in June 2012 that are consistent with the National Instrument 43-101 reporting standard used for public disclosure of information relating to mineral properties on stock exchanges supervised by the Canadian Securities Administrators. Certified mining engineers with the MDNR reviewed PolyMet's Economic Assessment of Conceptual Underground Mining Option and agreed with the statements made, as well as agreed that the outcome is consistent with early studies of the NorthMet Deposit, general rules for assessment of economic viability, and similar mining operations elsewhere.

The Co-lead Agencies prepared a position paper that concludes that the Underground Mining Alternative is not considered to be a reasonable alternative because it would not be economically viable and therefore it would also not meet the Purpose and Need (MDNR et al. 2013a). For these reasons, and for the reasons stated in the DEIS and SDEIS, the Underground Mining Alternative remains eliminated from further evaluation in this FEIS.

The PolyMet Economic Assessment of Conceptual Underground Mining Option is attached to the Co-lead position paper: Underground Mining Alternative Assessment for the NorthMet Mining Project and Land Exchange Environmental Impact Statement (MDNR et al. 2013a) provided in Appendix B.

3.2.3.4.2 West Pit Backfill

The option to utilize the West Pit for mining and processing waste disposal was considered but eliminated as alternative E20 in Table 3.2-4 of the DEIS (MDNR and USACE 2009). It was eliminated from further consideration in the DEIS as it was determined that it would not offer substantial environmental or socioeconomic benefits as compared to the NorthMet Project Proposed Action (MDNR et al. 2013b). Furthermore, the DEIS noted that there are additional mineral resources in the West Pit that would effectively be lost if the pit was used for waste rock and/or tailings disposal. The option to backfill the West Pit with Category 1 waste rock that would otherwise be permanently stored in the Category 1 Stockpile under the SDEIS NorthMet Project Proposed Action was raised by the Bands as a potential mitigation option to minimize surface footprint effects including wetlands, improve surface water and groundwater quality outcomes, potentially eliminate a managed West Pit overflow, and reduce project costs.

In response to the Bands' request, the Co-lead Agencies reconsidered the option to backfill the West Pit against the same screening criteria used for all potential alternatives (see Section 3.2.3.1). Further consideration concluded that the West Pit would have sufficient capacity to accept all of the Category 1 Stockpile material, but for safety and operational reasons under the proposed mine plan, the West Pit would not be available for backfilling until the end of mining, still including a pit lake approximately 105 ft deep. Therefore, the full Category 1 Stockpile would still be required for the 20 year Life of Mine. As such, throughout operations of the mine, compared to the NorthMet Project Proposed Action, there would be no change to:

- the temporal surface footprint effects of the Category 1 Stockpile,
- off-site mitigation requirements for affected wetlands, and
- water management requirements associated with the Category 1 Stockpile until it is removed and backfilled into the West Pit.

After mining is completed:

- Removal of the Category 1 Stockpile would allow for reclamation of the affected surface footprint, including potential to recreate wetland areas and restore function, and, as noted above, the prior effect would have been offset through mitigation required for the initial effect. The generation of wetland credits in this area has the potential to be used on a contingency basis, but compensatory credit would not be considered up front.
- The volume of material in the Category 1 Stockpile would not be enough to fill the West Pit so there would still be some pit lake.
- Backfilling would affect the water quality in the West Pit by increasing constituent loads, so additional mechanical treatment of water in the West Pit may be required for a certain timeframe following backfilling. However, there would be no effect on surface water quality discharged to the environment because mechanical treatment of water from the West Pit would still be required in the long term.
- Moving the waste rock from the stockpile into the West Pit would result in prolonged dust, air, and noise emissions, but these would be unlikely to exceed the respective maximum years modeled during operations.
- While there may be potential for additional jobs required for backfilling, they would be unlikely to offer substantial socioeconomic benefits.
- Removal of the Category 1 Stockpile would improve visual aesthetics.
- Backfilling the West Pit would encumber private mineral resources that are deeper than the proposed West Pit. Such an encumbrance is in conflict with the terms of PolyMet’s current private mineral leases. The PolyMet lease agreements could be renegotiated, which might involve monetary compensation for the mineral owners if minerals are encumbered.
- The cost of physically backfilling the West Pit and other associated costs, including those for additional mechanical water treatment (required to treat increased constituent loads) and financial assurance requirements, could affect the ability of PolyMet to secure financing.

Based on the above, the opportunity to reclaim wetlands and vegetation at the Category 1 Stockpile footprint area would be the only measurable environmental benefit offered by backfilling the Category 1 Stockpile into the West Pit. However, because of the temporal effect that the stockpile would have, those effects would be required to be mitigated regardless of future backfilling or not. Furthermore, the potential environmental benefit is moot or outweighed because encumbrance is not allowed in PolyMet’s private mineral leases and because the costs associated with backfilling, additional water treatment (rates), and encumbrance compensation determined in revised lease agreements may affect the ability of PolyMet to secure financing (MDNR et al. 2013b). As such, the option to backfill the West Pit was eliminated from further consideration in the SDEIS and remains so in this FEIS.

3.2.3.5 *Identification of New Alternatives*

Since receiving PolyMet's NorthMet Project Proposed Action analyzed in the SDEIS, the Co-lead Agencies considered whether any other alternatives beyond those previously proposed should be carried forward for detailed analysis. No reasonable alternatives were identified that would potentially offer substantial environmental benefits compared to the NorthMet Project Proposed Action.

3.2.3.6 *Post Closure Pumping of the West Pit*

One additional potential alternative (or mitigation measure) was considered in response to public comments received on the SDEIS (MDNR et al. 2014). Perpetual pumping of the West Pit post closure to eliminate potential seepage of West Pit water into surficial and bedrock groundwater flowpaths to the Partridge River was screened in the manner outlined in Section 3.2.3.1.2. The screening assessment indicated that perpetual pumping would meet the Purpose and Need, would be technically and economically feasible, and would meet the availability criteria; however, it would not offer a significant environmental benefit compared to the NorthMet Project Proposed Action.

Under the perpetual pumping alternative, the water quality of the West Pit lake would likely be worse, resulting in additional treatment needs compared to the NorthMet Project Proposed Action. With the proposed engineering controls, the water quality model predicts the NorthMet Project Proposed Action would not exceed evaluation criteria. The NorthMet Project Proposed Action would allow for pilot testing of non-mechanical treatment of West Pit lake overflow as a long-term water quality treatment option. Additional loading to the West Pit lake would impede transition to non-mechanical treatment. Finally, under the perpetual pumping approach some wetland effects would become permanent, as wetlands near the West Pit would only be temporarily affected under the NorthMet Project Proposed Action. For these reasons, the Post Closure Pumping of the West Pit Alternative remains eliminated from further evaluation in this FEIS.

3.3 LAND EXCHANGE DETAILED DESCRIPTION

3.3.1 *Overview*

The Land Exchange Proposed Action would involve exchange of a single 6,650.2-acre (GLO) tract of federal land (encompassing most of the NorthMet Project Mine Site) for up to approximately 6,722.5 acres (GLO) of privately owned, non-federal lands located within five different tracts throughout the proclamation boundary of the Superior National Forest within St. Louis, Lake, and Cook counties of northeastern Minnesota. Appraisal reports completed in 2013 indicate that the Land Exchange Proposed Action would meet federal value requirements if all five non-federal land tracts (6,722.5 (GLO) acres) offered by PolyMet would be exchanged for 6,650.2 (GLO) acres of federal land. If the ROD approves the Land Exchange Proposed Action, a current appraisal, approved by the USFS, would be required to verify equal value. Appraisals must conform to Uniform Appraisal Standards for Federal Land Acquisitions and the Uniform Standards of Professional Appraisal Practice of the Appraisal Foundation. The final proposed configuration of land would be determined after the market value of the parcels is determined by appraisals and the environmental analysis has been completed. This information would be presented in the ROD.

Several alternatives to the Land Exchange Proposed Action were identified and screened through scoping in 2010. The following alternatives are evaluated in detail in this SDEIS:

- Land Exchange No Action Alternative, under which no land exchange would occur; and
- Land Exchange Alternative B, under which a smaller amount of federal lands would be exchanged for the NorthMet mine activities instead of the 6,650.2 acres (GLO) of federal lands proposed.

A summary of the Land Exchange Proposed Action, Land Exchange Alternative B, and the No Action Alternative is provided in Table 3.3-1.

The Land Exchange Proposed Action is a connected action to the NorthMet Project Proposed Action.

Table 3.3-1 Summary of the Land Exchange Proposed Action Alternatives

Project Component	Location and Existing Land Use	Land Exchange Proposed Action	Land Exchange Alternative B	No Action Alternative
Federal land	Undeveloped federal land located between the Northshore Mine and the LTVSMC railroad Land is allocated under General Forest –Longer Rotation and General Forest Management Area in the Forest Plan	Exchange 6,650.2 acres (GLO) of federal lands to private ownership (PolyMet)	Exchange a smaller amount of federal lands (4,887.3 acres (GLO)) to private ownership (PolyMet)	No Land Exchange Current public land would remain under USFS management
Non-federal land	Predominantly forest and wetland habitat Interspersed with federal land within the proclamation boundary of the Superior National Forest St. Louis, Lake, and Cook counties	Exchange consists of up to 6,722.5 acres (GLO) from private to federal ownership Consists of up to five non-federal land tracts of land	Exchange consists of 4,651.5 acres (GLO) of non-federal lands in one tract (Tract 1) from non-federal to federal ownership	No Land Exchange Current non-federal lands would remain under non-federal ownership

3.3.1.1 *Development of Land Exchange Proposal*

The boundaries of the federal tract were proposed by the USFS so that any federal lands that PolyMet proposed to surface mine at the NorthMet Project Mine Site would be conveyed to PolyMet. In addition, all federal lands within the same Township to the west of the NorthMet Project Mine Site and north of the LTVSMC Railroad Grade were proposed for exchange. The additional lands were included to avoid intermingled and inefficient ownership patterns that would result by retaining isolated federal lands without legal access immediately south of the Superior National Forest Proclamation Boundary. The additional proposed lands are also impacted by past and ongoing mining activities including being subject to special use permits. The recommendation for the boundaries of the federal lands was based on the following standards and guidelines in the Forest Plan.

As stated in G-LA-3 (Forest Plan, page 2-52), the following National Forest System land is generally not needed for other resource management objectives and is potentially available for conveyance through exchange or other means (not listed in order of importance).

(a) Land inside or adjacent to communities or intensively developed private land, and chiefly valuable for non-National Forest System purposes.

(b) Parcels that would serve a greater public need in state, county, city, or other federal agency ownership.

(c) Inaccessible parcels isolated from other National Forest System land and intermingled with private land.

(d) Parcels that would reduce the need for landline maintenance and corner monumentation, result in more logical and efficient management, and improve land ownership pattern.

(e) Tracts that would be difficult or expensive to manage due to ROW problems, complex special use permits, or tracts with significant property boundary issues.

(f) On a case-by-case basis, land beneath or adjacent to resorts and summer home groups, currently under special use permits, may be considered for conveyance.

Specifically, the federal lands proposed for exchange appear to meet criteria a, c, d, and e.

PolyMet initially proposed two non-federal tracts for exchange: Hay Lake (Tract 1) and McFarland Lake (Tract 5). Both parcels were intended to meet land adjustment standards and guidelines for acquisition in the Forest Plan (D-LA-1, Forest Plan, page 2-51). That guidance is intended to achieve the following Desired Condition:

> The amount and spatial arrangement of National Forest System land within the proclamation boundary of the Forest are sufficient to protect resource values and interests, improve management effectiveness, eliminate conflicts, and reduce the costs of administering landline and managing resources.

Standards and Guidelines to achieve this Desired Condition provide that land acquisitions would generally be guided by the following criteria (G-LA-2, Forest Plan, pages 51-52):

- Priority 1 (a, b, and c are not listed in order of importance)

  1(a) Land needed for habitat for federally listed endangered, threatened, proposed, or candidate species or for RFSS.

  1(b) Land needed to protect significant historical and cultural resources, when these resources are threatened or when management may be enhanced by public ownership.

  1(c) Land needed to protect and manage administratively or Congressionally designated, unique, proposed, or recommended areas.

- Priority 2 (a thru f are not listed in order of importance)
  - Key tracts that would promote more effective management and would meet specific needs for management, such as:

  2(a) Land that enhances recreation opportunities, public access, and aesthetic values.

  2(b) Land needed to enhance or promote watershed restoration or watershed improvements that affect the management of National Forest System land riparian areas.

  2(c) Environmentally sensitive and/or ecologically rare lands and habitats.

  2(d) Wetlands.

  2(e) Land and associated riparian ecosystems on water frontage such as lakes and major streams.

  2(f) Land needed to achieve ownership patterns that would lower resource management costs.

- Priority 3

  3(a) All other land desirable for inclusion in the National Forest System.

A feasibility analysis, completed by the USFS in November 2009, assessed the potential for a land exchange between the USFS and PolyMet. The feasibility analysis evaluated the federal tract that was proposed by the USFS and the two non-federal tracts that were proposed by PolyMet for conformance with the Forest Plan, which included current and future uses of the properties. A preliminary monetary valuation indicated that additional parcels might be needed to bring the market value of the non-federal land to within 25 percent of the market value of the federal land as required by 36 CFR 254.12. The analysis also recommended supplementing the exchange with additional non-federal parcels that would increase the amount of wetlands coming into federal ownership to achieve a quantitative balance (no net loss) of wetland acres as a means of complying with EO 11990.

PolyMet ought additional lands that could be offered to the USFS that met the standards and guidelines for land adjustment in the Forest Plan. In particular, for non-federal parcels to be offered by PolyMet, the following goals were emphasized: adding wetlands, increasing connectivity between existing USFS ownership, and increasing boundary management efficiencies. Tracts 2, 3, and 4 were added subsequent to the feasibility analysis and prior to public scoping. Initial screening of the non-federal lands suggested the following relationship of the lands to standards and guidelines in the Forest Plan.

- Hay Lake (Tract 1) is a large, contiguous parcel with public access that offers a large percentage of highly functioning wetland habitat and wild rice resources. This parcel meets criteria 1(b), 2(a), (b), (c), (d), (e), and (f) for land acquisition in G-LA-2.
- McFarland Lake (Tract 5) meets criteria 1(c), 2(a), (e), and (f) for land acquisition in G-LA-2 because it protects a lake that includes a popular entry point to the BWCAW.
- Lake County Lands (Tract 2), Wolf Lands (Tract 3), and Hunting Club (Tract 4) meet criteria 2(a), (d), and (f) for land acquisition in G-LA-2.

All of the non-federal lands adjoin current USFS ownership and simplify management by consolidating land ownership patterns.

3.3.2 *Land Exchange Proposed Action*

The Land Exchange Proposed Action would occur between the United States, through the USFS as the manager of the federal lands, and PolyMet, as the owner of the non-federal lands. The key characteristics of the Land Exchange Proposed Action are highlighted in Table 3.3-2, shown on Figure 3.3-1, and discussed in the following sections.

As previously indicated, GLO acres represent the acreages associated with the legal descriptions of the parcels based on original surveys performed by GLO surveyors between 1858 and 1907. As such, GLO acreages are being used as part of the project description and would also be used to define the real estate transaction if the Land Exchange Proposed Action was approved. The analysis of effects presented in the subsequent Chapters is based upon GIS data. GIS values indicate the size of the Land Exchange Proposed Action parcels as computed geometrically using mapping software, which may be different than the GLO legal acreage. Unless noted as GLO acres, all values shown in the document are derived from GIS data.

Table 3.3-2 Legal Description and Acreage of Parcels Included in the Land Exchange Proposed Action

Tract	Parcel Name	Legal Description (4th P.M.)	Total Acres[1] (GLO)	Total Acres[1] (GIS, for Analysis Purposes)
Federal lands		T.60N., R13W (Secs. 33-35) T.59N, R.13W (Secs. 1-6) T.59N, R.12W (Sec. 6) T.59N, R.13W (Secs. 7-12) T.59N, R.12W (Sec. 7) T.59N, R.13W (Secs. 17, 18)	6,650.2	6,495.4
Non-federal lands			6,722.5	7,075.0
Tract 1	Hay Lake Lands	T.59N, R.16W (Secs. 9, 16, 19, 20-22, 27-33)	4,651.5	4,926.3
Tract 2	Lake County North	T.57N, R.12W (Secs. 5, 6)	199.5	265.0
	Lake County South	T.56N, R.9W (Sec. 17)	120.0	116.9
Tract 3	Wolf Lands 1	T.57N, R.11W (Sec. 8)	120.0	125.8
	Wolf Lands 2	T.58N, R.10W (Secs. 10, 14, 15, 22, 23)	760.0	767.9
	Wolf Lands 3	T.59N, R.9W (Secs. 30, 31)	279.4	277.4
	Wolf Lands 4	T.59N, R.9W (Secs. 7, 8, 17, 18)	400.0	404.7
Tract 4	Hunting Club Lands	T.66N, R.17W (Sec. 7)	160.0	160.2
Tract 5	McFarland Lake Lands	T.64N, R.3W (Sec. 9)	32.1	30.8

[1] GLO acreages are being used as part of the project description and would also be used to define the real estate transaction if the Land Exchange Proposed Action is approved. The analysis of effects presented in the subsequent Chapters is based upon GIS data.

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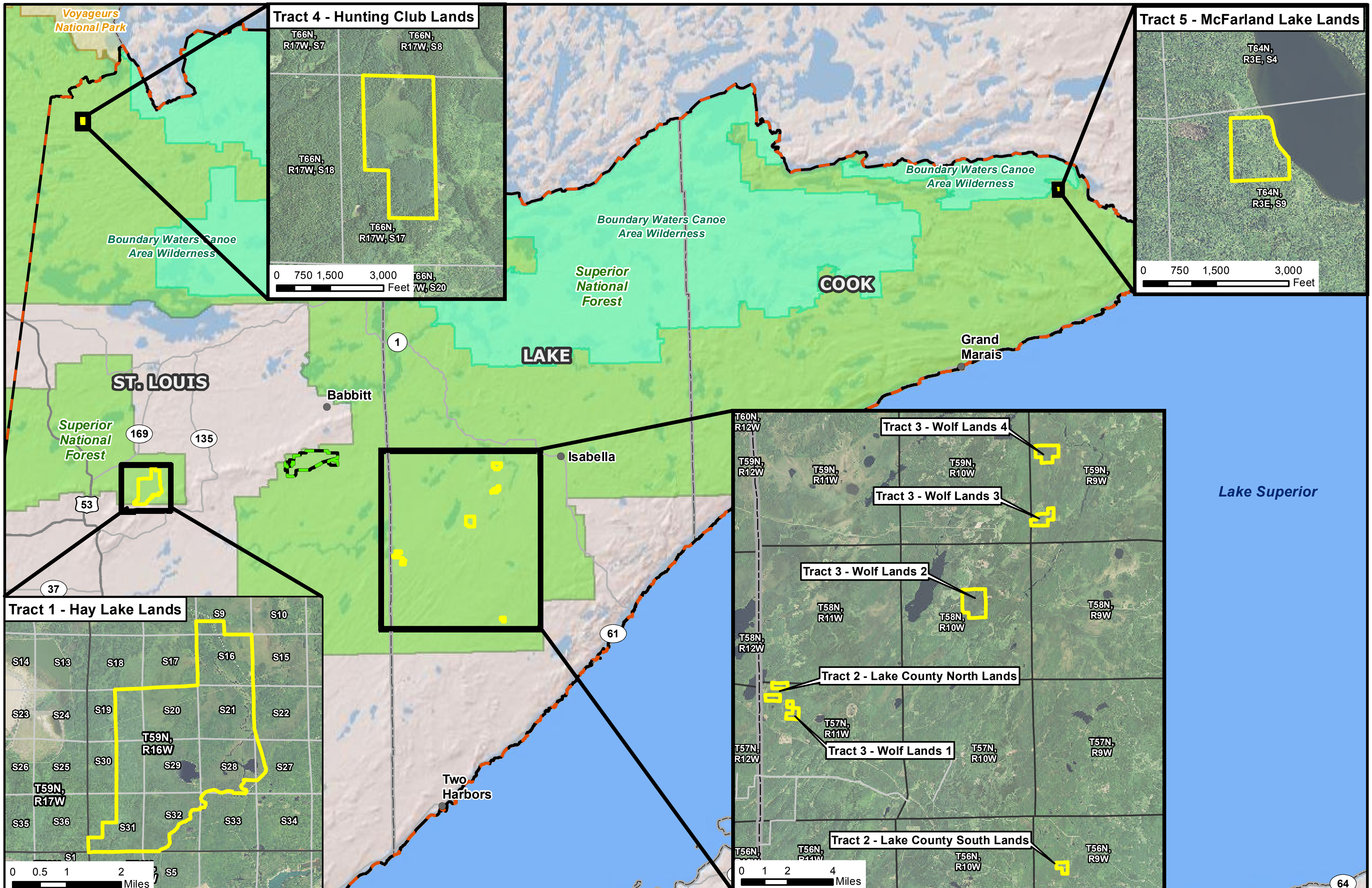

Federal Lands

Non-federal Lands

1854 Ceded Territory

Boundary Waters Canoe Area Wilderness

National Forest

US Army Corps of Engineers St. Paul District

This document is a working document. This document may change over time as a result of new information, further deliberation, or other factors not yet known to the Co-lead Agencies.

N W E S

0 2 4 8 Miles

Figure 3.3-1
Land Exchange Proposed Action Parcels
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

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3.3.2.1 *Federal Lands Proposed for Exchange*

The federal lands proposed for the Land Exchange Proposed Action are a single contiguous area of 6,650.2 acres (GLO) of land located within the western/central part of the Superior National Forest, approximately 6 miles south of Babbitt in St. Louis County, Minnesota. The federal lands are located in Township 59 North, Range 12 West, Sections 6 and 7; Township 59 North, Range 13 West, Sections 1-12, 17, and 18; and Township 60 North, Range 13 West, Sections 33, 34, and 35 (see Table 3.3-2 and Figures 3.3-1 and 3.3-2).

The federal lands encompass much of the One Hundred Mile Swamp (see Section 4.3.3 and Figure 4.3.3-1), a large black spruce, tamarack, and cedar wetland, and also contain Mud Lake. Yelp Creek and the Partridge River flow through the property.

The federal lands are located adjacent to historic mining projects on the Mesabi Iron Range and are mostly surrounded by privately held land used for mining and other industrial purposes; portions of the east and southwest areas of the federal lands are bordered by Superior National Forest lands. The federal lands lie immediately south of the Superior National Forest proclamation boundary and are bounded on the south by the former LTVSMC railroad and Dunka Road, which are NorthMet Project area features. Access to the federal lands is primarily via Dunka Road, which is privately owned, and the former LTVSMC railroad by permission of private landowners. Privately owned properties to the north and west of the federal lands have been extensively affected over the years by surface mining, including mine pits, waste rock stockpiles, Tailings Basins, processing facilities, railroad grades, and other general mining activities. There is a 115-acre block of privately owned land located within the northwestern portion of the federal lands that is not part of the Land Exchange Proposed Action.

A land exchange is a change of ownership of land; once an exchange occurs, the federal land then becomes private land, allowing the private landowner to use the land in accordance with necessary local, state, and federal permits and approvals. Any future work on the exchanged lands, which could include mining on these lands, would require the necessary permits and/or approvals from state and federal agencies. Most mineral rights within the federal lands are privately held. The United States owns 181 acres of mineral rights on lands that are not part of the NorthMet Project Proposed Action mine pits. The USFS would reserve ownership of these 181 acres of mineral rights. These mineral rights are located near the eastern boundary of the federal lands north of Dunka Road and near the southeast corner of the federal lands south of Dunka Road (see Figure 3.2-3).

Lands conveyed from federal ownership would no longer be under federal control and therefore would not be managed under the Forest Plan and/or be influenced by the authority (the Weeks Act) under which the United States acquired them. While the federal lands, if transferred to PolyMet, would still be located within the proclamation boundary of the Superior National Forest, they would be private lands and no longer managed by the USFS.

3.3.2.2 *Non-federal Lands Proposed for Exchange*

The Land Exchange Proposed Action includes up to five tracts of non-federal lands in St. Louis, Lake, and Cook counties that contain 6,722.5 acres (GLO) (see Table 3.3-2); however, the final exchange, if approved, could include fewer than 6,722.5 acres (GLO) of non-federal land depending on the results of the environmental analysis and real estate appraisals. Appraisal reports completed in 2013 indicate that the Land Exchange Proposed Action would meet federal value requirements if all five non-federal land tracts (6,722.5 (GLO) acres) offered by PolyMet would be exchanged for 6,650.2 (GLO) acres of federal land. If the ROD approves the Land Exchange Proposed Action, a current appraisal, approved by the USFS, would be required to verify equal value. Appraisals must conform to Uniform Appraisal Standards for Federal Land Acquisitions and the Uniform Standards of Professional Appraisal Practice of the Appraisal Foundation. The final proposed configuration of land would be determined after the market value of the parcels is determined by appraisals and would be presented in the final ROD. As shown in Figure 3.3-1, all of the lands proposed for exchange are located within the 1854 Ceded Territory of northeastern Minnesota.

PolyMet currently owns a portion of the non-federal lands proposed for exchange; however, all rights, titles, and interests of the remaining non-federal lands proposed for exchange have been assigned to PolyMet. All of the non-federal lands except Tract 4 have severed mineral and surface ownership.

There are no activities proposed on the non-federal lands as part of the Land Exchange Proposed Action. The non-federal lands would be incorporated with adjacent federal ownership and managed in accordance with the Forest Plan for that particular management area. Management areas provide context within which the USFS makes implementation decisions (described through desired conditions, objectives, standards, and guidelines) for an area of common direction. Management Areas on the Superior National Forest are mapped and described in Chapter 3 of the Forest Plan. The majority (86 percent) of the non-federal lands would be allocated to the General Forest Management Area, with the balance of the lands allocated to General Forest – Longer Rotation (7 percent), candidate Research Natural Areas (cRNAs) (4 percent), and Riparian Emphasis Areas (3 percent). More information on Management Areas is presented in Chapters 4 and 5. Details of the tracts are summarized below.

3.3.2.2.1 Tract 1 – Hay Lake Lands

Tract 1 – Hay Lake Lands (Tract 1) is the largest tract of non-federal lands consisting of 4,651.5 acres (GLO) within St. Louis County. Tract 1 consists of a single area of land located within the southeastern portion of the Superior National Forest (Laurentian Ranger District) proclamation boundary west of and adjoining County Road (CR) 715 and north of the town of Biwabik (see Figures 3.3-1 and 3.3-3). Access to the tract is available along its eastern edge via CR 715, although access to the interior is generally limited by vegetation.

PolyMet is the owner of Tract 1, with the tract subject to a mortgage in favor of Iron Range Resources and Rehabilitation Board (IRRRB), which would have to be satisfied at closing of the Land Exchange Proposed Action.

3.3.2.2.2 Tract 2 – Lake County Lands

Tract 2 – Lake County Lands (Tract 2) consists of 319.5 acres (GLO) of land made up of four distinct parcels of lands within Lake County, Minnesota, formerly owned by Lake County (see Figures 3.3-1 and 3.3-3). The three northern parcels are referred to as Lake County North and the southern parcel is referred to as Lake County South. Tract 2 includes various 40-acre parcels within the Superior National Forest (Laurentian and Tofte Ranger Districts) proclamation boundary southeast of Seven Beaver Lake that are mostly surrounded by lands managed by the Superior National Forest and other wetland habitats.

The Tract 2 parcels are tax forfeit lands being purchased in the name of Lake-Forest Enterprise, Inc. on a land contract from Lake County. There is an assignment on file with Andresen and Butterworth, PA which assigns all rights, title, and interest in these lands to PolyMet.

3.3.2.2.3 Tract 3 – Wolf Lands

Tract 3 – Wolf Lands (Tract 3) consists of 1,559.4 acres (GLO) of land made up of four distinct parcels of land within Lake County, Minnesota (see Figures 3.3-1, 3.3-3, and 3.3-4). Tract 3 lands are located within the Laurentian and Tofte Ranger Districts, west and southwest of Isabella and are referred to as Wolf Lands 1, Wolf Lands 2, Wolf Lands 3, and Wolf Lands 4.

The Tract 3 parcels are being purchased in the name of Lake-Forest Enterprise, Inc., through options from Wolf Lands, Inc. There is an assignment on file with Andresen and Butterworth, PA which assigns all right, title, and interest in these lands to PolyMet.

3.3.2.2.4 Tract 4 – Hunting Club Lands

Tract 4 – Hunting Club Lands (Tract 4) is a single parcel of 160.0 acres (GLO) of land within St. Louis County, surrounded by Superior National Forest-managed lands and is within the LaCroix Ranger District, approximately 5 miles southwest of Crane Lake (see Figures 3.3-1 and 3.3-4). Two small, unnamed lakes are partially included in the tract, as well as a high percentage of wetland habitat.

PolyMet is the owner of Tract 4 and the parcel is not subject to any financing.

3.3.2.2.5 Tract 5 – McFarland Lake Lands

Tract 5 – McFarland Lake Lands (Tract 5) is a single parcel of land, 32.1 acres (GLO) in size within the Gunflint Ranger District in northeastern Cook County (see Figures 3.3-1 and 3.3-4).

The tract is adjacent to Superior National Forest ownership and includes lakefront property on McFarland Lake, an entry point to the BWCAW. Access to the property is available by water from a landing off CR 16 (Arrowhead Trail), approximately 10 miles north of Hovland. The tract is not developed apart from a 20- by 40-ft wood-frame bunkhouse and outhouse that would be removed prior to finalizing the real estate transaction of the Land Exchange Proposed Action.

PolyMet is the owner of Tract 5, with the tract subject to a mortgage in favor of the IRRRB, which would have to be satisfied at closing of the Land Exchange Proposed Action.

3.3.3 *Land Exchange Proposed Action Alternatives*

The Land Exchange Proposed Action and alternatives were developed initially through scoping (refer to Chapter 2 for more information). Public comments received in response to the scoping of the Land Exchange Proposed Action provided suggestions for alternative methods for achieving the Purpose and Need for the Land Exchange. Some of these alternatives were determined to be outside the scope of the Purpose and Need (see Section 1.3.2.2). In addition, the alternatives were determined to have been duplicative of the alternatives considered in detail or determined to be components that would cause unnecessary environmental harm.

Two alternatives to the Land Exchange Proposed Action: the Land Exchange No Action Alternative and Land Exchange Alternative B are evaluated in detail in the SDEIS. The ROD from the USFS will contain the rationale for the selected alternative and how the public interest is served under 36 CFR 254.3(b). As stated in Section 1.4.3, factors that must be considered include: the opportunity to achieve better management of federal lands and resources, to meet the needs of state and local residents and their economies, and to secure important objectives, including but not limited to: protection of fish and wildlife habitats, cultural resources, watersheds, and wilderness and aesthetic values; enhancement of recreation opportunities and public access; consolidation of lands and/or interests in lands, such as mineral and timber interests, for more logical and efficient management and development; consolidation of split estates; expansion of communities; accommodation of existing or planned land use authorizations; promotion of multiple-use values; implementations of applicable Forest Land and Resource Management Plans; and fulfillment of public needs. See 36 CFR 254.3(b) and 254.4(c)(4). Table 7.3.5-1 of this FEIS presents a comparison of how the alternatives address these factors.

Other alternatives considered were eliminated from further analysis for one or more of the following reasons:

- Did not meet Land Exchange Purpose and Need;
- Did not comply with laws relating to federal land exchanges; or
- In the case of one suggested alternative to limit the federal land exchanged, the suggestion was modified to form Land Exchange Alternative B.

The alternatives that are evaluated in the SDEIS are both discussed below.

3.3.3.1 *Land Exchange No Action Alternative*

As stated previously, NEPA requires that the No Action Alternative be evaluated; in this case, this alternative means that the Land Exchange Proposed Action would not take place. For the purposes of analysis, the environmental effects resulting from taking no action are compared to the effects of permitting the Land Exchange Proposed Action and alternatives to the Land Exchange Proposed Action. Under the Land Exchange No Action Alternative, no lands would be exchanged and the NorthMet Project Proposed Action would not proceed.

The federal government would not convey federal lands to PolyMet and the USFS would continue managing these lands as has been done in the past. The level of development and acceptable activities would be regulated by USFS and Superior National Forest policies. Management would include vegetation management, mineral exploration, recreation, wildlife, watershed, and other uses identified in the Forest Plan. These lands are in General Forest – Longer Rotation and the General Forest Management Areas. Furthermore, the federal government would not acquire the five tracts of non-federal lands and the lands would remain as private lands under the Land Exchange No Action Alternative.

3.3.3.2 *Land Exchange Alternative B*

Land Exchange Alternative B was derived from the Mine Site Exchange Only Alternative (refer to Section 3.3.3.3) that was developed to address concerns raised during scoping. This alternative would convey fewer acres of federal lands for fewer acres of non-federal land.

An issue that was raised through scoping for the proposed land exchange was that the USFS did not need to exchange the entire tract of federal lands included in the Land Exchange Proposed

Action to accommodate the proposed Mine Site and development. Commenters noted that not all of the acres proposed for exchange would be needed for developing the NorthMet Project Mine Site. Commenters stated that if there would be a land exchange, the USFS should exchange only the minimum amount of National Forest System lands needed for the Mine Site. The Land Exchange Alternative B addresses this issue by only including lands necessary for the Mine Site with less emphasis on minimizing the amount of USFS landlines and consolidating National Forest System lands ownership patterns. Compared to the Land Exchange Proposed Action, approximately 1,835.2 fewer acres (GLO) of National Forest System lands would be exchanged as part of Land Exchange Alternative B.

Land exchanges are based on equal value; consequently, because there would be fewer federal acres available to be conveyed, there would be fewer acres of private land that would be acquired. The federal government would convey 4,833.7 acres (GLO) of federal lands to PolyMet, and the USFS would no longer manage these lands. The federal government would acquire 4,651.5 acres (GLO) of non-federal lands in one parcel, Tract 1. Tract 1 was selected for this alternative for the following reasons:

- it would be almost equal in size to the smaller federal parcel;
- it would provide wetlands; and
- it is likely that Tract 1 would have a higher per-acre value than the smaller federal parcel because of its access to a county road and its potential for waterfront properties.

The configuration of the smaller federal parcel is considered the smallest the boundary can be while still meeting the underlying Purpose and Need for the Land Exchange (see Figure 3.3-2). Under this alternative, approximately 1,750 acres to the west of the Mine Site would remain under federal ownership. This remaining federal tract would become an isolated piece of federal land with limited or difficult access through private property (see Figure 3.3-2). As with the Land Exchange Proposed Action, the USFS would reserve ownership of 181 acres of mineral rights on scattered parcels in the federal lands. These minerals are located outside of the NorthMet Project Proposed Action mine pits.

Appraisal reports completed in 2013 indicate that the Land Exchange Alternative B would meet the federal value requirements if non-federal Tract 1 (4,651.5 [GLO] acres), would be exchanged for a smaller federal parcel of 4,887.3 (GLO) acres. If the ROD approves the Land Exchange, a current appraisal, approved by the USFS, would be required to verify equal value. Appraisals must conform to Uniform Appraisal Standards for Federal Land Acquisitions and the Uniform Standards of Professional Appraisal Practice of the Appraisal Foundation.

The environmental consequences of Land Exchange Alternative B are evaluated in Chapters 5 and 6 of this SDEIS.

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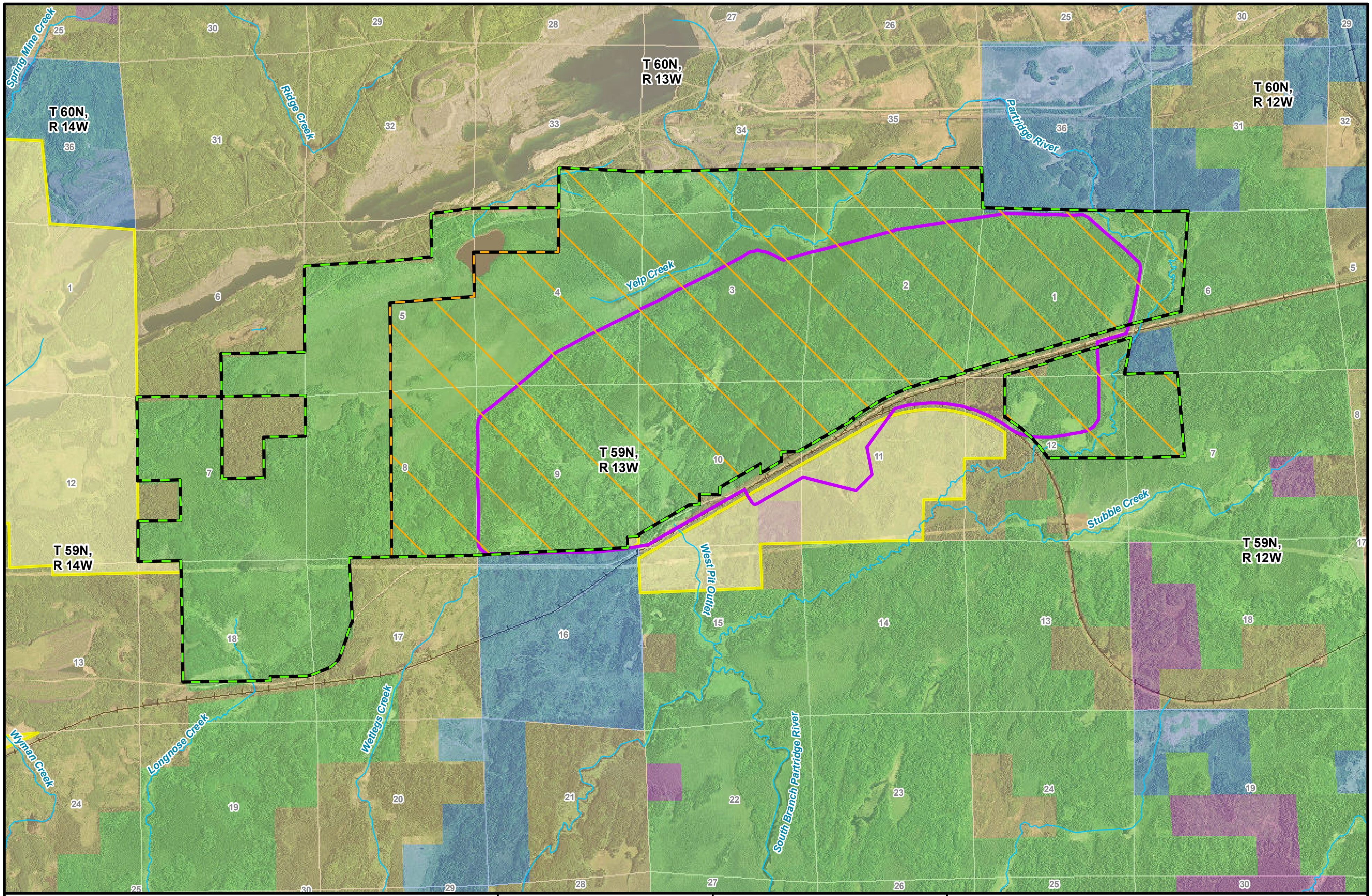

Federal Lands
Alternative B: Smaller Federal Parcel
Mine Site
Stream/River
Section Label
National Forest Ownership
County Ownership
State of Minnesota Ownership
Other Ownership
PolyMet Owned/Leased Area

US Army Corps of Engineers
St. Paul District

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Figure 3.3-2
Land Exchange Proposed Action and Alternative B Parcels
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

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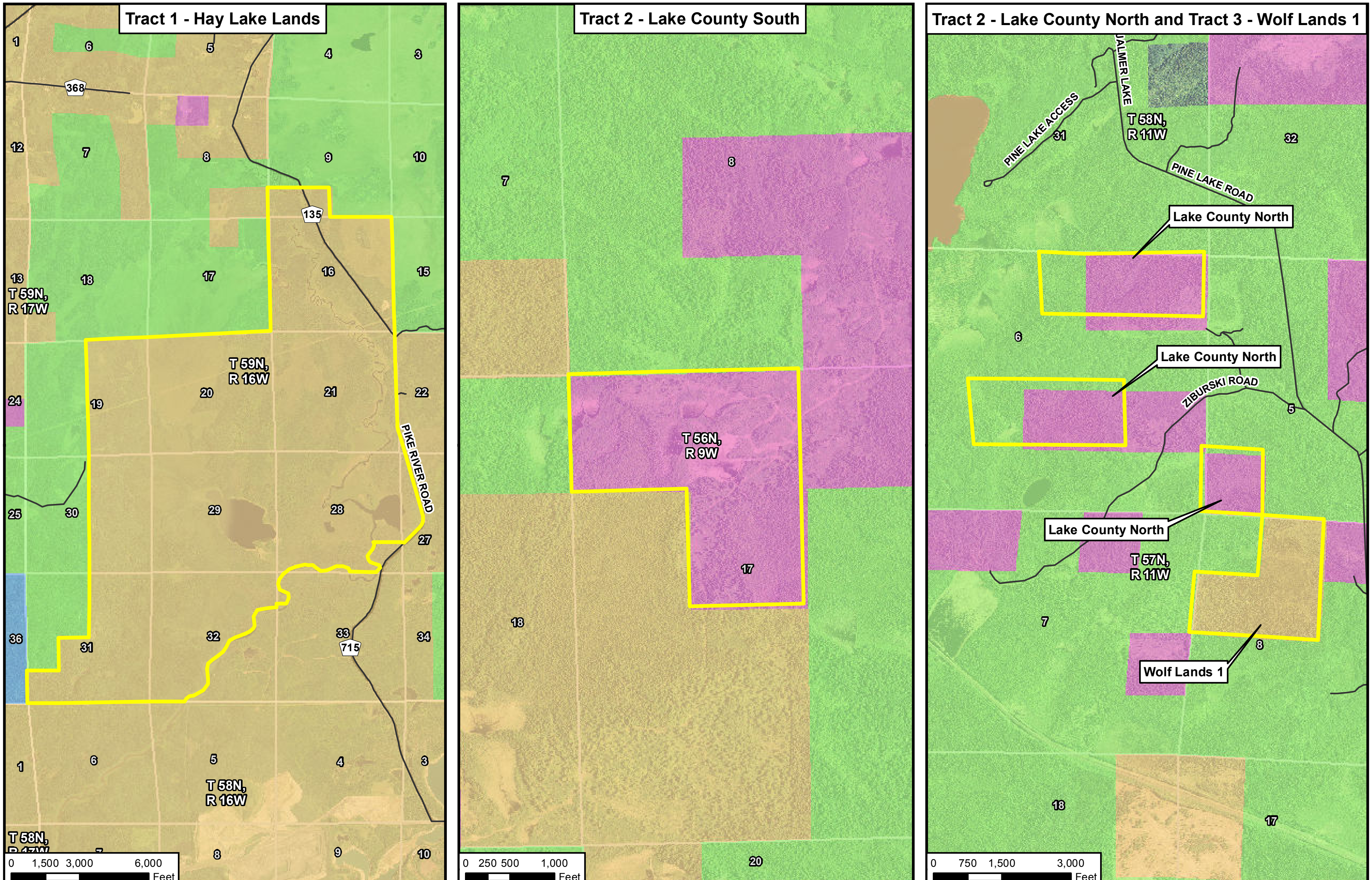

Non-federal Lands
Section Boundary
1 Section Label
National Forest Ownership
County Ownership
State of Minnesota Ownership
Other Ownership

US Army Corps of Engineers St. Paul District

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Figure 3.3-3
Ownership of Tracts 1, 2 and 3
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

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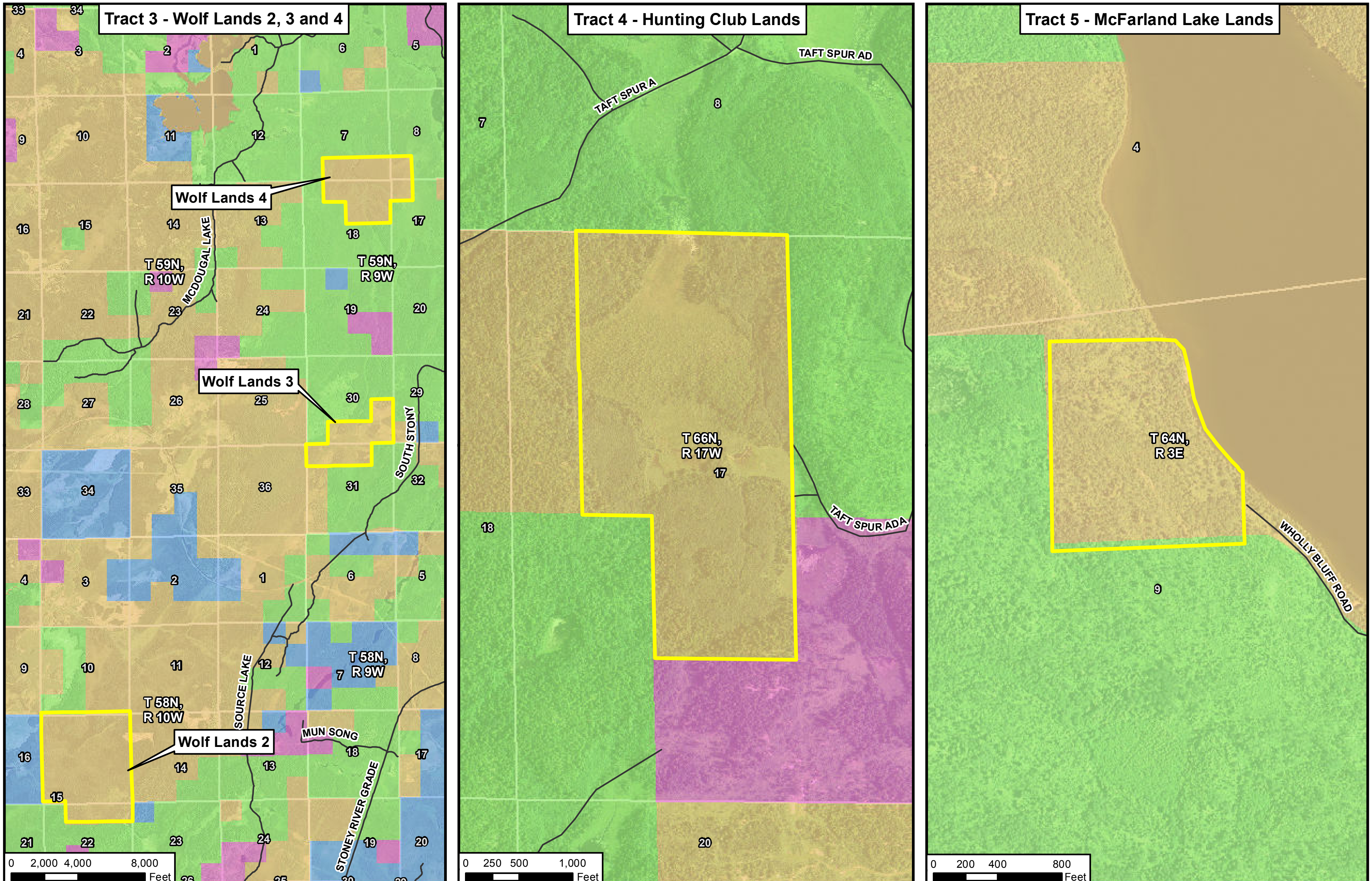

Non-federal Lands	National Forest Ownership
Section Boundary	County Ownership
1 Section Label	State of Minnesota Ownership
	Other Ownership

This document is a working document. This document may change over time as a result of new information, further deliberation, or other factors not yet known to the Co-lead Agencies.

Figure 3.3-4
Ownership of Tracts 3, 4 and 5
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

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3.3.3.3 *Alternatives Considered but Eliminated from Detailed Analysis*

The following alternatives were considered by the interdisciplinary team, but have been eliminated from further consideration because the proposals could not be acted upon at this time, were represented in the alternatives analyzed in detail, or did not meet the Purpose and Need.

3.3.3.3.1 Direct Purchase Alternative

This alternative, as called for in USFS guidance (FSH 5409.13, Section 33.41a), would involve the USFS directly purchasing the non-federal parcels—i.e., the privately owned parcels identified for exchange to help meet USFS management objectives. The direct purchase alternative would not resolve the conflict between the United States and the proposed development of the private mineral estate at the federal parcel. For this reason, this alternative would not meet the Purpose and Need of the proposed Land Exchange, and thus it was eliminated from further consideration.

3.3.3.3.2 Single Contiguous Non-federal Parcel

PolyMet's proposed assemblage of land for the exchange was based on the standards and guidelines for land adjustment in the Forest Plan. The acquisition of a single contiguous non-federal parcel was not one of the priority criteria. Instead, the Forest Plan defines the desired condition for land adjustment in terms of the overall amount and spatial arrangement of National Forest System lands within the proclamation boundary. Moreover, PolyMet was not able to identify any single large tracts of land for sale. Therefore, this alternative was eliminated from further consideration.

3.3.3.3.3 Other Non-federal Lands

The exchange of the federal lands for multiple non-federal parcels that have wetlands and habitat more similar to the federal lands than the proposed non-federal lands was eliminated from detailed consideration for several reasons. The Land Exchange Proposed Action was developed to match "like acres" with "like acres" (i.e., those with similar wetland and habitat types) to the extent possible with lands that were available for acquisition and that met Forest Plan standards and guidelines for land adjustment. Without identifying specific lands, this alternative is theoretical only and would not meaningfully add to the range of alternatives considered. Therefore, this alternative was eliminated from detailed analysis.

3.3.3.3.4 Mine Site Exchange-Only

The Mine Site exchange-only alternative would have conveyed fewer acres of federal lands to address comments raised during the scoping period. Under this alternative, the federal government would have conveyed only the federal land (that is, 2,719 of the 3,015 acres) that would actually be used for the NorthMet Project Proposed Action.

The Mine Site proposal identifies the minimum area physically needed for mine features. However, environmental assessment of the NorthMet Project Proposed Action identified the potential for air quality effects at the Mine Site boundary. A larger land exchange area would mitigate potential air quality issues; consequently, this alternative was eliminated from further consideration because it would not provide an adequate buffer. It was modified to Land Exchange Alternative B described in Section 3.3.3.2 and further evaluated in the SDEIS.

3.3.3.3.5 Full Exchange with Restrictions

Consistent with the Land Exchange Proposed Action, under this alternative, the federal government would have conveyed the entire federal tract (6,650 acres (GLO)), but would have placed use restrictions on a portion of the conveyed lands. This alternative was initially developed by the USFS during the 2009 Feasibility Analysis for the Land Exchange to compensate for a wetland imbalance when only the non-federal Tract 1 and Tract 5 were being proposed by the applicant as part of the Land Exchange Proposed Action. This imbalance has since been resolved through the addition of Tracts 2, 3, and 4 to the Land Exchange Proposed Action. Furthermore, this alternative is not substantially different from Alternative B, where the smaller federal parcel exchange would be protective of the One Hundred Mile Swamp. Therefore, this alternative was eliminated from detailed analysis as it would have had substantially similar effects to alternatives already analyzed.

3.3.3.3.6 Underground Mining Alternative

The potential for an underground mine to be developed on federal lands (through permitting) instead of the proposed surface mining was raised by public comment through both the Land Exchange scoping process and the comment periods for both the DEIS and SDEIS. Commenters suggested that a land exchange would not be needed if underground mining was proposed for the NorthMet Deposit.

Underground mining was eliminated as an alternative to the NorthMet Project Proposed Action because it was found to be economically infeasible (refer to Section 3.2.3.4 and Appendix B). Consequently, it is not a reasonable alternative to the Land Exchange Proposed Action.

4.0 AFFECTED ENVIRONMENT

4.1 INTRODUCTION

Pursuant to the requirements of NEPA regulations at 40 CFR 1502.15 and *Minnesota Rules*, part 4410.2300, Chapter 4 describes the affected environment of the NorthMet Project Proposed Action and Land Exchange Proposed Action. The information within this chapter provides context to the analyses of the environmental consequences addressed in Chapter 5. Resource topics were identified through scoping for both the NorthMet Project Proposed Action and Land Exchange Proposed Action, development of the DEIS and SDEIS, and public comments. Refer to Chapter 2 for more information on the EIS development process. The discussion of the affected environment is limited to those resources that may be subject to potential environmental effects from either the NorthMet Project Proposed Action or Land Exchange Proposed Action.

Table 4.1-1 lists the structure of Chapter 4 with respect to the NorthMet Project Proposed Action and Land Exchange Proposed Action. Section 4.2 describes the existing conditions for the natural and human environment that may be affected, directly or indirectly, by the NorthMet Project Proposed Action. Section 4.3 describes the existing conditions of the same natural and human environment resources as in Section 4.2, but specific to the areas that may be affected, directly or indirectly, by the Land Exchange Proposed Action or Land Exchange Alternative B.

As previously indicated, the land exchange acreages used in the Project Description section are described in GLO acreages, while the acreages used in the Affected Environment and Environmental Consequences sections are described in GIS acreages. GLO acres represent the acreages associated with the legal descriptions of the parcels based on original surveys performed by GLO surveyors between 1858 and 1907. As such, GLO acreages are being used as part of the project description and would also be used to define the real estate transaction if the Land Exchange Proposed Action were approved. The affected environment presented in Section 4.3 is based upon GIS data. GIS values indicate the size of the federal and non-federal parcels as computed geometrically using mapping software, which may be different than the GLO legal acreage. Unless noted as GLO acres, all values shown are derived from GIS data.

The proposed lands to be exchanged are described in below in Section 4.3; however, the final proposed configuration of land would be determined after the market value of the parcels is determined by appraisals and the environmental analysis has been completed. This information will be presented in the ROD.

Table 4.1-1 Resource Topic Areas Discussed in Chapter 4

Resource Topic	NorthMet Project Proposed Action	Land Exchange Proposed Action
Land Use	4.2.1	4.3.1
Water Resources	4.2.2	4.3.2
Wetlands	4.2.3	4.3.3
Vegetation	4.2.4	4.3.4
Wildlife	4.2.5	4.3.5
Aquatic Species	4.2.6	4.3.6
Air Quality	4.2.7	4.3.7
Noise and Vibration	4.2.8	4.3.8
Cultural Resources	4.2.9	4.3.9
Socioeconomics	4.2.10	4.3.10
Recreation and Visual Resources	4.2.11	4.3.11
Wilderness and Special Designation Areas	4.2.12	4.3.12
Hazardous Materials	4.2.13	4.3.13
Geotechnical Stability	4.2.14	4.3.14

4.2 NORTHMET PROJECT

4.2.1 Land Use

This section describes the lands that may be affected by the NorthMet Project Proposed Action. Local, federal, and tribal management frameworks regulate the use of the lands. The Mine Site, Transportation and Utility Corridor, Plant Site, and non-federal lands fall within the 1854 Ceded Territory. The Mine Site and a portion of the Transportation and Utility Corridor fall within the Superior National Forest and are managed by the Forest Plan.

The Plant Site and existing LTVSMC Tailings Basin are located in a brownfield area dominated by the existing facilities and infrastructure of the former LTVSMC processing plant. In 2002, Cliffs Erie conducted a Phase I Environmental Site Assessment (Phase I ESA) of the former LTVSMC processing plant and identified 62 potential AOCs. The Legacy Contamination discussion in Section 4.2.1.4.2 elaborates on the status of AOCs.

4.2.1.1 Regulatory Considerations

The lands that may experience direct or indirect effects from the NorthMet Project Proposed Action (as well as the non-federal lands evaluated in Section 4.3.1) are located within the following jurisdictions:

- The cities of Babbitt and Hoyt Lakes;
- The 1854 Treaty Authority (including the 1854 Ceded Territories Conservation Code);
- Fond du Lac Tribal Conservation Codes for 1854 Ceded Territories;
- St. Louis, Lake, and Cook counties; and
- Superior National Forest.

County and municipal land use controls are described in Section 4.2.1.1.1; federal and tribal management frameworks are described in Section 4.2.1.1.2. Table 4.2.1-1 summarizes the relationship between these land use controls and project components.

Table 4.2.1-1 Land Use Controls Affecting the NorthMet Project Proposed Action

	Mine Site	Plant Site	Transportation and Utility Corridor
City of Hoyt Lakes Zoning Ordinance		X	X
City of Babbitt Zoning Ordinance	X		X
City of Babbitt Comprehensive Land Use Plan	X		X
St. Louis County Comprehensive Land Use Plan	X	X	X
Land and Resource Management Plan for Superior National Forest	X		X
1854 Treaty Authority	X	X	X

4.2.1.1.1 Local Land Use Management

Land use is regulated by municipal or county zoning ordinance, while comprehensive land use plans provide additional guidance for future development (League of Minnesota Cities 2011). A zoning designation identifies a list of allowed uses. If a proposed activity is one of these allowed uses, then it can be developed “as of right.” If a potential use is not specifically allowed, the zoning ordinance will indicate that a variance or some similar action is required. The lands potentially directly affected by the NorthMet Project Proposed Action are in areas currently zoned for mining and/or industrial use. Some of these areas have already been affected by historic mining activity.

The federal lands are within the Partridge River Watershed, which is a tributary of the Upper St. Louis River. While St. Louis County Comprehensive Land Use Plan does not apply to federal lands, it would if the lands were acquired by PolyMet through the Land Exchange Proposed Action or Land Exchange Alternative B. In addition, other non-federal lands within the watershed are covered by the Comprehensive Land Use Plan’s guidance. The Plan emphasizes active management of development in the watershed to promote preservation and improvement of water quality, recreational opportunities, ecological health, and archaeological resources (St. Louis County 2013).

4.2.1.1.2 Federal and Tribal Land Use Management

The Mine Site, Transportation and Utility Corridor, Plant Site, and non-federal lands are within the territory ceded by the 1854 Treaty between the U.S. Government and the Chippewa of Lake Superior. Hunting, fishing, gathering, and other traditional uses under the 1854 Treaty are exercised on public lands within this territory, and on private lands with the permission of the land owner.

In addition, a portion of the Mine Site and Transportation and Utility Corridor are within the Superior National Forest. As such, they are governed by the Forest Plan. The Forest Plan uses the management area framework to define the management approach for the Superior National Forest. The Forest Plan provides direction on desired conditions for forestry resources, mineral resources and extractive activity, vegetative communities, wildlife management, public recreation opportunities, and visual character, among other characteristics (USFS 2004b).

4.2.1.2 Mine Site

The federal lands, comprising 6,495.4 acres, are located in St. Louis County, approximately 70 miles north of the City of Duluth, 20 miles south of the BWCAW, 6 miles south of the City of Babbitt, and less than 2 miles south of the Northshore Mine. The federal lands are bounded on the south by the Transportation and Utility Corridor.

Except for an area south of the Transportation and Utility Corridor (see Section 4.2.1.3 below), the Mine Site is contained within the federal lands on part of the Superior National Forest and within the municipal limits of the City of Babbitt (see Figure 4.2.1-1). Most of the Mine Site and adjoining federal lands are part of the General Forest – Longer Rotation Management Area, while the remainder is within the General Forest Management Area (see Figure 4.3.1-1).

The General Forest – Longer Rotation Management Area is characterized by a diverse array of land and resource management uses, goods and services (including commercial goods), scenic quality, developed and dispersed recreation opportunities, and habitat for wildlife and fish. Roads open to public travel in this management area provide access to resources and road recreation opportunities. Non-motorized recreation opportunities also exist. The USFS allows exploration, development, and production of mineral resources on National Forest lands used for timber production under conditions where the activities "are conducted in an environmentally sound manner so that they may contribute to economic growth and national defense" (USFS 2004b).

The characteristics and use of the General Forest Management Area are similar to the General Forest – Longer Rotation Management Area, except that timber harvests are more frequent, more uniform in age, and more extensive. The General Forest Management Area has the highest amount of young forest and the largest sized timber harvest units.

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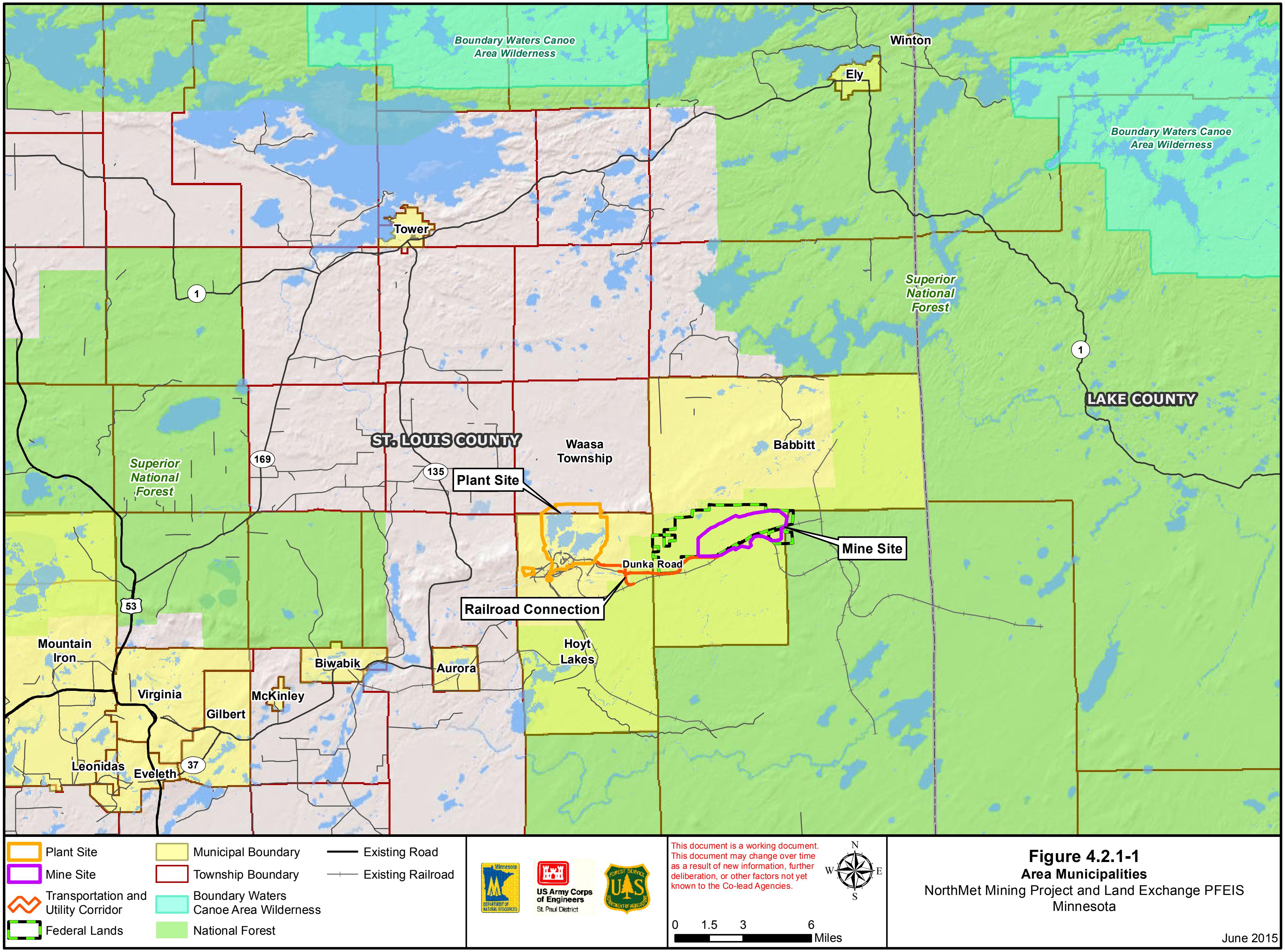

Figure 4.2.1-1
Area Municipalities
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

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Federal lands designated for the Mine Site have been subject to mineral exploration since 1969. As of 2011 (the most recent year for which data were available), this exploration included 123 exploration drill sites, soil borings, and the construction of approximately 0.5 mile of temporary road access. Final reclamation of the closed portions of the temporary access roads has been completed (USFS 2011a). There is no known existing contamination by hazardous materials at the Mine Site.

The federal lands are a part of the territory ceded by the Chippewa of Lake Superior to the United States in 1854 (1854 Treaty Authority 2006). The Chippewa reserve rights to hunt, fish, and gather on public lands (and on private land with permission) in the 1854 Ceded Territory. Tribal harvest levels and other activities are governed by either individual tribal entities (in the case of the Fond du Lac Band) or the 1854 General Codes and subsequent Amendments under the 1854 Treaty Authority (in the case of the Grand Portage and Bois Forte Bands [MDNR 2011o]).

The City of Babbitt's zoning ordinance classifies the Mine Site area as a Mineral Mining district. This allows for existing and potential mineral mining, processing, and tailings and waste disposal, as well as accessory and support activities needed for the proper operation of mining activities outside the limits of open pit and ore formations. The zoning ordinance falls within the city's broader Comprehensive Land Use Plan, which was revised in 2014 (Arrowhead 2014). The draft plan includes goals and objectives in support of mining-related economic development opportunities.

Use of the area surrounding the Mine Site is varied. The area to the north/northwest of the Mine Site is within the City of Babbitt Mineral Mining district. The district includes part of the Plant Site and the Transportation and Utility Corridor, and the Northshore Mine (City of Babbitt 1996). The area to the east of the Mine Site is Superior National Forest land that is within the General Forest – Longer Rotation Management Area. The area to the south of the federal lands is within the City of Babbitt's Mineral Mining district and is a mix of private use (railroad and buffer area), Superior National Forest land within the General Forest Management Area, and state-owned lands.

4.2.1.3 Transportation and Utility Corridor

The Transportation and Utility Corridor connects the Plant Site and Mine Site, and includes Dunka Road, and a railroad connection.. The corridor traverses an area that straddles the boundary between the City of Babbitt and City of Hoyt Lakes (see Figure 4.2.1-1). The corridor passes through private, state, and Superior National Forest lands, some of which were previously mined. The private lands are within the City of Babbitt Mineral Mining zoning district and the City of Hoyt Lakes Mineral Mining district. The Superior National Forest areas are within the General Forest – Longer Rotation Management Area.

Dunka Road is a private road, with segments owned and leased by Cliffs Erie, PolyMet, and Minnesota Power. It serves as the access point for USFS Roads 125, 108, and 109, which are used for forest maintenance in the area of the Mine Site. Dunka Road also provides access to an existing electrical transmission line that runs parallel to and south of the road. The railroad is privately owned and in operating condition, but has not been extensively used since operations at LTVSMC ceased in 2001.

The Transportation and Utility Corridor crosses over Wyman, Longnose, and Wetlegs Creeks, which drain to the Partridge River, a tributary of the Upper St. Louis River (see Figure 3.2-1). It therefore also falls within the jurisdiction of the St. Louis County Comprehensive Land Use Plan in the management of the St. Louis River Watershed (see Section 4.2.1.1 above).

4.2.1.4 Plant Site

4.2.1.4.1 Summary of Land Use Conditions

The Plant Site is west of the Mine Site, in an area dominated by the existing facilities and infrastructure of the former LTVSMC processing plant and Tailings Basin, along with additional acreage purchased for the purpose of plant upgrade and buffer zones. The site is characterized by historical heavy industrial use, with extensive mechanical facilities, rail lines, mine workings, tailings storage, and closed pits. The majority of the Plant Site is located within the incorporated limits of the City of Hoyt Lakes and governed by the City of Hoyt Lakes Zoning Ordinance, last updated in 2010 (Hoyt Lakes Planning Commission 2010). The City does not have a comprehensive land use plan. The Hoyt Lakes portion of the Plant Site is in the City's Mineral Mining district, which identifies areas of existing and potential mineral mining, processing, tailings and waste disposal, and related activities, outside of the boundaries of the open mine pit and ore formations themselves.

The northern section of the Tailings Basin within the Plant Site is located within unincorporated Waasa Township (see Figure 4.2.1-1) and governed by the St. Louis County Comprehensive Land Use Plan. This area of the county is zoned for industrial use (the IND-4 zoning district; St. Louis County 2011). This district designates land for mining and quarrying, manufacturing, mineral exploration and evaluation, and a number of other related activities.

The Plant Site is accessible by Dunka Road from the east and from County Road 666 from the south. The Plant Site drains to the Partridge and Embarrass rivers, tributaries of the Upper St. Louis River. It therefore is within the jurisdiction of the St. Louis County Comprehensive Land Use Plan in the management of the St. Louis River Watershed (see Section 4.2.1.1 above).

The NorthMet Project Proposed Action includes the use of an existing water pipeline which runs from the northernmost section of Colby Lake northward to the Plant Site. The pipeline corridor is within the City of Hoyt Lakes Mineral Mining district. Colby Lake is an in-stream lake within the Partridge River. The corridor therefore is within the jurisdiction of the St. Louis County Comprehensive Land Use Plan in the management of the St. Louis River Watershed.

4.2.1.4.2 Legacy Contamination

In 2002, Cliffs Erie commissioned a Phase I ESA of the former LTVSMC processing plant and improvements (NTS 2002), which identified 62 potential AOCs. Designation as an AOC means that these areas require further investigation, but does not necessarily mean that contamination occurred in the past or is currently present.

As shown in Table 4.2.1-2, PolyMet would assume responsibility for 29 of the 62 AOCs upon acquiring the property from Cliffs Erie (Barr 2007e). Of the 29 AOCs to be acquired, four have been closed or received a no further action letter from the MPCA; one is a permitted former landfill under post-closure monitoring pursuant to the Minnesota solid waste landfill requirements; and 14require further investigation, including AOC #8, another closed permitted landfill, which requires further investigation to assess a groundwater plume. Table 4.2.1-2 summarizes the potential issues and status of these AOCs. PolyMet intends to continue the VIC program initiated by LTVSMC and continued by Cliffs Erie, and would investigate and remediate as necessary these AOCs on a schedule approved by the MPCA.

All historic and any potentially operational AOCs not already addressed by the start of mine closure would be investigated and remediated as necessary. The MDNR has indicated that any associated cleanup costs for the legacy AOCs would be included in the financial assurance requirements for any Permit to Mine issued to PolyMet for the NorthMet Project Proposed Action (Watkins, Pers. Comm., April 13, 2009).

The status of the remaining 33 AOCs for which PolyMet does not have any responsibility are as follows:

- Eleven sites have been closed through the VIC program;
- Five sites have been closed through the Petroleum Remediation Program;
- Four sites have completed initial investigations, sampling plans in place, and are awaiting MPCA review;
- Nine sites have not yet been investigated;
- One site has a status that is unknown or not readily available;
- One site has a limited no action determination;
- One site is being managed through the NPDES program; and
- One site would likely require additional remediation (i.e., Pellet Plant).

Table 4.2.1-3 summarizes the potential issues and status of these AOCs.

Additionally, the LTVSMC Tailings Basin seeps are being managed under the Cliffs Erie Consent Order using short-term measures until long-term mitigation measures are determined.

Table 4.2.1-2 NorthMet Project Proposed Action Area of Concern Summary List for Voluntary Investigation and Cleanup Program

AOC	Location	Site Description	Identified Potential Issues	Status
1	Area 1	Area 1 Shops and Reporting	Domestic septic systems and drain field.	*No actions have been taken with regard to this site.*
6	Area 1	Oily Waste Disposal Area	Waste from general shop area floor drains.	No actions have been taken with regard to this site.
7	Area 1	Bull Gear Disposal Area	One time 1970s disposal of heavy lubricant.	No actions have been taken with regard to this site.
8	Area 1	Private Landfill	Permitted industrial waste landfill that operated until 1993. Identified presence of groundwater plume.	The closed LTVSMC Private Landfill exists within the site of active permitted Industrial Waste Landfill (SW-619). Monitoring activities for the closed LTVSMC Private Landfill are incorporated into the active SW-619 permit (held by Cliffs Erie). Work plan submitted to MPCA to define the extent of the facility's groundwater plume, assess the stability of the groundwater, and assess the ability of the gas vents to aid in the remediation of the groundwater plume.
9	Area 1	Area 1 RR Panel Yard	Railroad tie disposal area co-mingled with scrap metal, wood, and demolition debris.	Scrap and trash were disposed. Some items remain to be removed. A SAP was submitted to the MPCA and was implemented. A historic release was identified. Further recommendations for cleanup are ongoing to the MPCA.
10	Area 1	Area 1 Airport	Some areas of soil staining.	No actions have been taken with regard to this site.
11	Area 1	Stoker Coal Ash Disposal	Disposal area until 1980s with marginal cover.	No actions have been taken with regard to this site.
12	Area 1	Mill Rejects Area	Solid waste from concentrator building.	Site closed: No Further Action required.
13	Area 2/2E/3	2001 Storage Area	Some areas of soil staining.	No actions have been taken with regard to this site.
14	Area 2/2E/3	Large Equipment Paint Area	Buildup of blasting sand.	No actions have been taken with regard to this site.
24	Area 5	Area 5 Reporting	Scrap and salvage area with some stained soils.	Site closed through the VIC program in letter dated 7/30/08.
25	Area 5	Area 5 Loading Pocket & Storage	Some areas of stained soils along rail siding.	Site closed through the VIC program in letter dated 7/30/08.
35	Plant Site	Dunka WWTP Sludge Staging Area	Little evidence of any residue remaining.	Water treatment plant sludge residue removed.

AOC	Location	Site Description	Identified Potential Issues	Status
36	Plant Site	Coal Ash Landfill	Cover appears to be in good condition.	Permitted Landfill. Closed and subject to post-closure monitoring.
37	Plant Site	Line 9 Area 5 Petroleum Contaminated Soil	Permitted petroleum land application site with 25,000 cubic yards of soils.	The MPCA sent a closure letter for this site on February 24, 2006.
38	Plant Site	Area 2 Shops	Contains a locomotive fueling station and a septic system.	*Petroleum impacted soil excavation has been completed. Additional evaluation of non-petroleum contamination needed.*
40	Plant Site	Heavy Duty Garage	Formerly used for equipment maintenance.	Building and one UST removed. Site reuse planned. Further investigation at PolyMet closure. *No actions have been taken with regard to this site.*
42	Plant Site	Bunker C Tank Farm	Large ASTs which previously contained #4 and #6 fuel oil.	*Petroleum Remediation closed the site January 2012. Contamination remains at the site.*
43	Plant Site	Administration Building	One heating oil UST was abandoned in place.	Facility still in use. Further investigation at PolyMet closure. *No additional actions have been taken with regard to this site.*
44	Plant Site	Main Gate Vehicle Fueling Area	Contains several AST used for fueling trucks.	Facility still in use. Further investigation at PolyMet closure. *No additional actions have been taken with regard to this site.*
46	Plant Site	Plant Site Proper/General Shops	Former taconite processing area – no specific issues identified.	Reuse planned. Further investigation at PolyMet closure. *No additional actions have been taken with regard to this site.*
47	Tailings Basin	Tailings Basin Reporting	Septic system remains.	Two USTs removed. *No additional actions have been taken with regard to this site.*
48	Tailings Basin	Transformers	Several transformers present, but records indicate that they do not contain PCBs.	No actions have been taken with regard to this site.
49	Tailings Basin	Coarse Crusher Petroleum Contaminated Soil Stockpile	Contained floor sweepings (containing oil).	All contaminated soil was removed in 1990s.
50	Tailings Basin	Emergency Basin	Received water from process sumps in the Concentrator during power outages and emergency conditions, and storm water outfall.	A SAP was submitted to the MPCA and was implemented. *MPCA VIC program is waiting for an investigation report summarizing the work.*
51	Tailings Basin	Salvage and Scrap Areas	Some areas of soil staining.	No actions have been taken with regard to this site.
52	Tailings Basin	Cell 2W Salvage Area	Several small stained soil areas as well as the remnants of a mobile AST.	No actions have been taken with regard to this site.
53	Tailings Basin	Cell 2W Horrnfels waste rock	Sulfide waste rock disposed under a MPCA/MDNR approved plan.	NPDES monitoring ongoing.

AOC	Location	Site Description	Identified Potential Issues	Status
59	Colby Lake	Colby Lake Pumping Station	One transformer remaining.	One heating oil AST removed in 1970. Reuse planned, further investigation at PolyMet closure. *No additional actions have been taken with regard to this site.*

Sources: NTS 2002; Scott 2009h; Pers. Comm., 2011; Pers. Comm., 2014.

Italic text in Table 4.2.1-2 indicates that the “Identified Potential Issues” and “Status” have been updated since the SDEIS.
PCB = Polychlorinated biphenylPRP = Potentially Responsible Party
SAP = Sampling and Analysis Plan
UST = Underground storage tank

Table 4.2.1-3 Non-NorthMet Project Areas of Concern Status

AOC	Responsible Party	Site Description	Issues	Status
2	Mesabi Nugget	Area 1 petroleum contaminated soil	Petroleum contaminated soil.	*SAP submitted and approved. MPCA waiting for results report.*
3	Mesabi Nugget	Sludge site	Sludge contaminated soil.	*No actions have been taken with regard to this site*.
4	Mesabi Nugget	1004 storage area	Soil staining and debris.	*Workplan submitted November 2013. MPCA waiting for results report.*
5	Mesabi Nugget	Roofing disposal site	Roofing debris.	*Workplan submitted November 2013. MPCA waiting for results report.*
15	Cliffs Erie	Railroad storage area	Debris.	No action to date.
16	Cliffs Erie	Area 2 vibratory loading pocket		*Limited No Action Determination for Soil sent May 20, 2008.*
17	Cliffs Erie	Area 2 truck fueling		*Petroleum release L#16490 closed.*
18	Cliffs Erie	Area 2 superpocket		*Petroleum release evaluated and L#16490 closed.*
19	Mesabi Nugget	Area 2WX reporting		Site closed through the VIC program in letter dated 7/31/08.
20	Mesabi Nugget	Area 2WX shovel salvage		Site closed through the VIC program in letter dated 7/31/08.
21	Mesabi Nugget	Area 2WX truck fueling		Site closed through the VIC program.
22	Mesabi Nugget	Area 2WX vibratory loading pocket		Site closed through the VIC program in letter dated 7/31/08.
23	Mesabi Nugget	Area 2WX superpocket		Site closed through the VIC program.
26	Mesabi Nugget	Area 6 truck fueling		Site closed through the VIC program.
27	Mesabi Nugget	Area 6 misfired blast		Site closed through the VIC program.
28	Mesabi Nugget	Area 9S former Aurora dump site	Debris.	*No actions to date*.
29	Mesabi Nugget	Stockpile #9021	Debris related to Aurora dump site.	*Workplan has been approved. MPCA is waiting for investigation report.*
30	Mesabi Nugget	Pre-taconite plant	Debris.	*Closed in VIC and Petroleum Remediation programs.*
31	Mesabi Nugget	Area 9N vibratory loading pocket	Septic tank and drain field.	Unknown.
32	Duluth Metals	Dunka shops and reporting	Demolition debris, closed leak site.	*No actions have been taken with regard to this site*.
33	Duluth Metals	North loading pocket – Dunka	Abandoned wells and septic	*No actions have been taken with regard to this site*.

AOC	Responsible Party	Site Description	Issues	Status
			system.	
34	Duluth Metals	South loading pocket – Dunka	Abandoned wells and septic system.	*No actions have been taken with regard to this site*.
39	Cliffs Erie	Knox Railroad fueling station		*Petroleum contaminated soil excavated and soil to land treatment area. Site is closed.*
41	Cliffs Erie	Oxygen plant		*Closed in VIC and Petroleum Remediation programs.*
45	Cliffs Erie	Pellet storage area and load-out	Soil staining and petroleum residue.	No action to date.
54	Cliffs Erie	Taconite Harbor marine fueling ASTs		*Approximately 2500 cubic yards of petroleum contaminated soil excavated and disposed. L#12252 closed.*
55	Cliffs Erie	Taconite Harbor oil track		*Petroleum contaminated soil removed from tracks. L#12252 closed.*
56	Cliffs Erie	Coal ash landfill - Taconite Harbor		Managed through *Solid Waste and/or* NPDES permit, no VIC action.
57	Cliffs Erie	Murphy City	Soil staining, well and septic system.	*Closed petroleum L#6423. No VIC action to date.*
58	Cliffs Erie	Rail lubricators	Stained soil.	No action to date.
60	Cliffs Erie	Brick recycling area		Site closed through the VIC program.
61	Cliffs Erie	PCB ditch investigation (pellet plant)		Site closed through the VIC program.
62	Cliffs Erie	Pellet plant	Soil staining and debris.	*No actions have been taken with regard to this site*.

Sources: NTS 2002; Scott 2009h; Pers. Comm., 2011; Pers. Comm., 2014.

Italic text in Table 4.2.1-2 indicates that the “Identified Potential Issues” and “Status” have been updated since the SDEIS.
PCB = Polychlorinated biphenyl
PRP = Potentially Responsible Party
SAP = Sampling and Analysis Plan
UST = Underground storage tank

Cliffs Erie received a permit (SW-625) in 2006 from the MPCA to locate two individual land treatment sites within Cell 2W of the existing LTVSMC Tailings Basin. This facility is being used to land farm petroleum-contaminated (i.e., diesel fuel) soils excavated from AOCs #38 (Area 2 Shops) and #39 (Knox Railroad fueling station).

In May 2009, Cliffs Erie conducted a detailed assessment of both surface and groundwater quality at the existing LTVSMC Tailings Basin, including testing for volatile organic compounds (VOCs), SVOCs, PCBs, and other parameters to determine if there was any organic contamination that could be transported off site via stormwater runoff or groundwater seepage. The laboratory analyses showed no evidence of organic contamination leaving the site (Cliffs Erie 2009). Based on the investigations and laboratory analyses to date, which include sampling at seven monitoring wells, 14 surface discharges, 12 internal waste streams, and six downstream surface water monitoring stations, and visual observation and limited field analyses at 33 seeps at or near the existing LTVSMC Tailings Basin, no off-site contamination has been documented. The extent of on-site contamination from the legacy sites appears to be limited to localized soils and groundwater.

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4.2.2 Water Resources

This section describes the existing groundwater and surface water hydrology and water quality within the Partridge River and Embarrass River watersheds because these watersheds are expected to be affected by the NorthMet Project Proposed Action. The Partridge River and Embarrass River are headwaters to the St. Louis River. The Mine Site, Transportation and Utility Corridor, the former LTVSMC processing plant, and a small portion of the existing LTVSMC Tailings Basin drain to the Partridge River Watershed (see Section 4.2.2.2), while most of the Tailings Basin and the Emergency Basin drain to the Embarrass River Watershed (see Section 4.2.2.3).

The presence of perennial streams and watershed divides at both the Mine Site and Plant Site constrains the hydrologic effects of the NorthMet Project Proposed Action to the Partridge River and Embarrass River watersheds. There are two hydrologic barriers between the Mine Site and the Rainy River watershed (which is hydrologically connected to the BWCAW), including:

- High ground north of the Partridge River that creates a watershed divide separating the Lake Superior Basin and Rainy River Watershed, and prevents surface water from passing between the two. This major watershed divide is included in the National Atlas, as well as USGS and MDNR data sets.
- Yelp Creek and the Partridge River encircle the northern, eastern, and southern sides of the Mine Site. These streams are thought to be a hydrologic "sink" for groundwater and surface water originating at the Mine Site. Surface runoff or groundwater seepage leaving the Mine Site would follow a gradient into Yelp Creek or the Partridge River, as opposed to continuing towards the watershed divide. The position of One Hundred Mile Swamp as continuous across this boundary does not equate to a hydrologic connection.

4.2.2.1 Regional Setting

4.2.2.1.1 Meteorological Conditions

The NorthMet Project area is located near the headwaters of the Partridge River and Embarrass River watersheds at an approximate elevation of 1,600 ft amsl. Meteorological data are available for the NorthMet Project area from two weather stations operated by the National Weather Service. The Babbitt 2SE weather station is located approximately 5 miles from the Mine Site and has 39 years of records. The Hoyt Lakes 5N weather station is located approximately 1 mile from the Plant Site and has 27 years of records (see Figure 4.2.2-1).

Table 4.2.2-1 shows the monthly and annual average air temperature and precipitation for the two National Weather Service stations. Precipitation averages approximately 28 inches annually. Snowfall in the NorthMet Project area typically occurs between October and April. Estimates of annual average evaporation for northern Minnesota range from 18 inches (Siegel and Ericson 1980) to 22 inches (SCS 1975).

Table 4.2.2-1 Normal Monthly and Annual Average Air Temperature and Precipitation Near the NorthMet Project

Station Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Air Temperature (°F)													
Babbitt 2 SE	5.5	12.3	23.8	39.2	52.8	61.5	66.5	64.4	54.5	44.4	27.1	11.8	38.7
Hoyt Lakes 5N	1.5	9.0	22.4	37.5	50.6	59.0	64.6	61.9	52.3	41.8	25.3	9.5	36.3
Precipitation (inches)													
Babbitt 2 SE	0.91	0.74	1.07	1.99	3.17	4.17	3.67	3.98	3.40	2.60	1.73	1.04	28.47
Hoyt Lakes 5N	0.95	0.66	1.23	2.08	3.23	3.96	3.86	3.86	3.36	2.75	1.25	0.97	28.16

Source: WRCC 2012.

Notes:
°F = Degrees Fahrenheit
Period of Record: Babbitt = 1948 to 1986; Hoyt Lakes = 1958 to 1984.

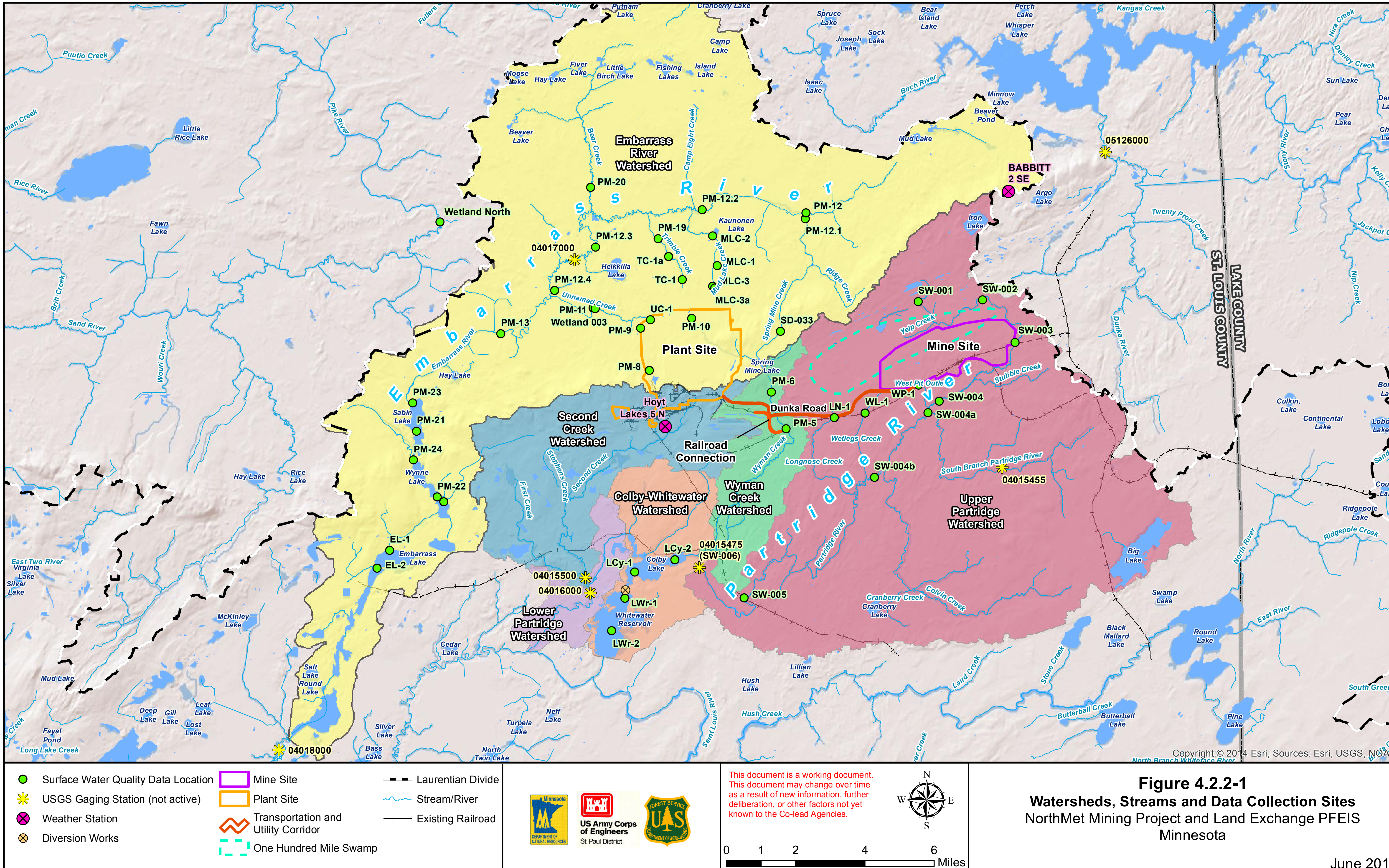

Figure 4.2.2-1
Watersheds, Streams and Data Collection Sites
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

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4.2.2.1.2 Water Resource Use Classifications

A key element of water quality management is "use classification," which identifies beneficial uses for which a waterbody must be protected. The State of Minnesota has adopted a framework that identifies a broad range of potential uses, including:

- Domestic consumption – Class 1;
- Aquatic life and recreation – Class 2;
- Industrial consumption – Class 3;
- Agriculture and wildlife – Class 4;
- Aesthetics and navigation – Class 5;
- Other uses – Class 6; and
- Limited resource value – Class 7.

These classes can be further divided into subclasses with letter designations. The use classifications are not intended to imply a priority rank to the uses.

<u>Groundwater</u>

Following *Minnesota Rules* 7060.0200, it is the policy of the State of Minnesota to consider the actual or potential use of groundwater for potable water supply as constituting the highest priority use and, as such, to provide maximum protection to all underground waters. Therefore, all groundwater is considered to have one beneficial use, domestic consumption (Class 1).

The MDNR has water allocation priorities defined under statute 103G.261 as follows:

(a) The commissioner shall adopt rules for allocation of waters based on the following priorities for the consumptive appropriation and use of water:

> (1) first priority, domestic water supply, excluding industrial and commercial uses of municipal water supply, and use for power production that meets the contingency planning provisions of section 103G.285, subdivision 6;
>
> (2) second priority, a use of water that involves consumption of less than 10,000 gallons of water per day;
>
> (3) third priority, agricultural irrigation and processing of agricultural products involving consumption in excess of 10,000 gallons per day;
>
> (4) fourth priority, power production in excess of the use provided for in the contingency plan developed under section 103G.285, subdivision 6;
>
> (5) fifth priority, uses other than agricultural irrigation, processing of agricultural products, and power production, involving consumption in excess of 10,000 gallons per day; and
>
> (6) sixth priority, nonessential uses.

(b) For the purposes of this section, "consumption" means water withdrawn from a supply that is lost for immediate further use in the area.

(c) Appropriation and use of surface water from streams during periods of flood flows and high water levels must be encouraged subject to consideration of the purposes for use, quantities to be used, and the number of persons appropriating water.

(d) Appropriation and use of surface water from lakes of less than 500 acres in surface area must be discouraged.

(e) The treatment and reuse of water for non-consumptive uses shall be encouraged.

Principal groundwater resources in the NorthMet Project area are contained in bedrock geologic units and overlying surficial glacial deposits, which are also referred to as unconsolidated deposits. The water table is primarily located within the unconsolidated deposits; however, it is also likely located within the bedrock in areas of local bedrock highs. This means that saturated conditions exist within the unconsolidated deposits and in the underlying bedrock. Recharge to the bedrock is by infiltration of precipitation in outcrop areas and leakage from the overlying surficial aquifer (Siegel and Ericson 1980).

Surface Water

All surface waters in Minnesota are classified and protected for multiple beneficial uses. *Minnesota Rules* 7050.0470 lists individual waters and their associated use classifications. However, only a limited subset of all waters are actually listed, which include trout waters, surface waters protected for drinking water use, outstanding resource value waters, and Class 7 limited-resource-value waters. All of the remaining surface waters of the State, which include most of the waters of the State, are considered "unlisted waters." These unlisted surface waters are uniformly classified as Class 2B (cold or warm water sport or commercial fishing), 3C (industrial cooling and materials transport), 4A (irrigation use), 4B (livestock and wildlife use), 5 (aesthetics and navigation), and 6 (other uses) waters.

In the NorthMet Project area, most of the rivers and streams are unlisted. The two listed waterbodies in the NorthMet Project area are Colby Lake and Wyman Creek. Colby Lake, which is used for domestic consumption by the City of Hoyt Lakes, is designated as Classes 1B (treated with simple chlorination for domestic consumption) and 2Bd (cool or warm water sportfish and drinking water) waters as well as the other default Classes 3C, 4A, 4B, 5, and 6. Wyman Creek, which is a designated trout stream, is designated as Classes 1B as well as 2A (aquatic life and recreation), 3B (industrial consumption-moderate treatment), as well as the other default classes 3C, 4A, 4B, 5, and 6 (*Minnesota Rules*, part 7050.0470).

All NorthMet Project area waters are also designated Outstanding International Resource Waters (*Minnesota Rules*, parts 7050.0460 and 7052.0300), which prohibits any new or expanded point source discharges of bioaccumulative substances of immediate concern (i.e., mercury) unless a nondegradation demonstration is completed and approved by the MPCA.

In addition to the above water use classifications for establishment of state water quality standards (*Minnesota Rules*, Chapters 7050 and 7052), certain waters of the state are also classified by the MDNR as Public Waters. Public Waters are all water basins, wetlands, and watercourses that meet the criteria set forth in Minnesota Statutes, section 103G.005, subdivision 15, and that are identified on Public Water Inventory maps authorized by Minnesota Statutes, section 103G.201 (see Figure 4.2.2-2). Any proposed activity that alters the course, current, or cross section of a mapped Public Water is subject to a variety of state regulations (*Minnesota*

Rules, Chapter 6115), depending on the proposed activity. The Public Waters program does not regulate water quality.

Impaired Waters

The federal CWA requires states to adopt water quality standards to protect waters from pollution. These standards, which are typically based on the beneficial use classifications described above, define how much of a pollutant can be in the water and still meet beneficial uses, such as drinking water, fishing, and swimming. Water quality standards are the fundamental tools used to assess the quality of all surface waters. States must monitor and assess the water quality of their waters to identify those that are "impaired" (i.e., not fully supporting their beneficial uses).

Section 303(d) of the CWA requires states to publish and update a list of impaired waters for which a Total Maximum Daily Load (TMDL) Study is needed. This list, known as the "303(d) List" or "TMDL List" is updated every two years via assessment of water quality data and an extensive public participation process. The final 2012 TMDL List (MPCA 2012n) was developed by the MPCA and approved by the USEPA in July 2013. If the extent of the violations of standards for any water exceeds the guidelines described in the Guidance Manual (MPCA 2014), those surface waters are considered to be "impaired." The goal of the MPCA is to protect high-quality waters and improve the quality of impaired waters so water quality standards are met and beneficial uses are maintained and restored, where these uses are attainable.

Table 4.2.2-2 shows the waters within the Embarrass River and Partridge River watersheds that are on the final 2012 TMDL List (see Figure 4.2.2-1).

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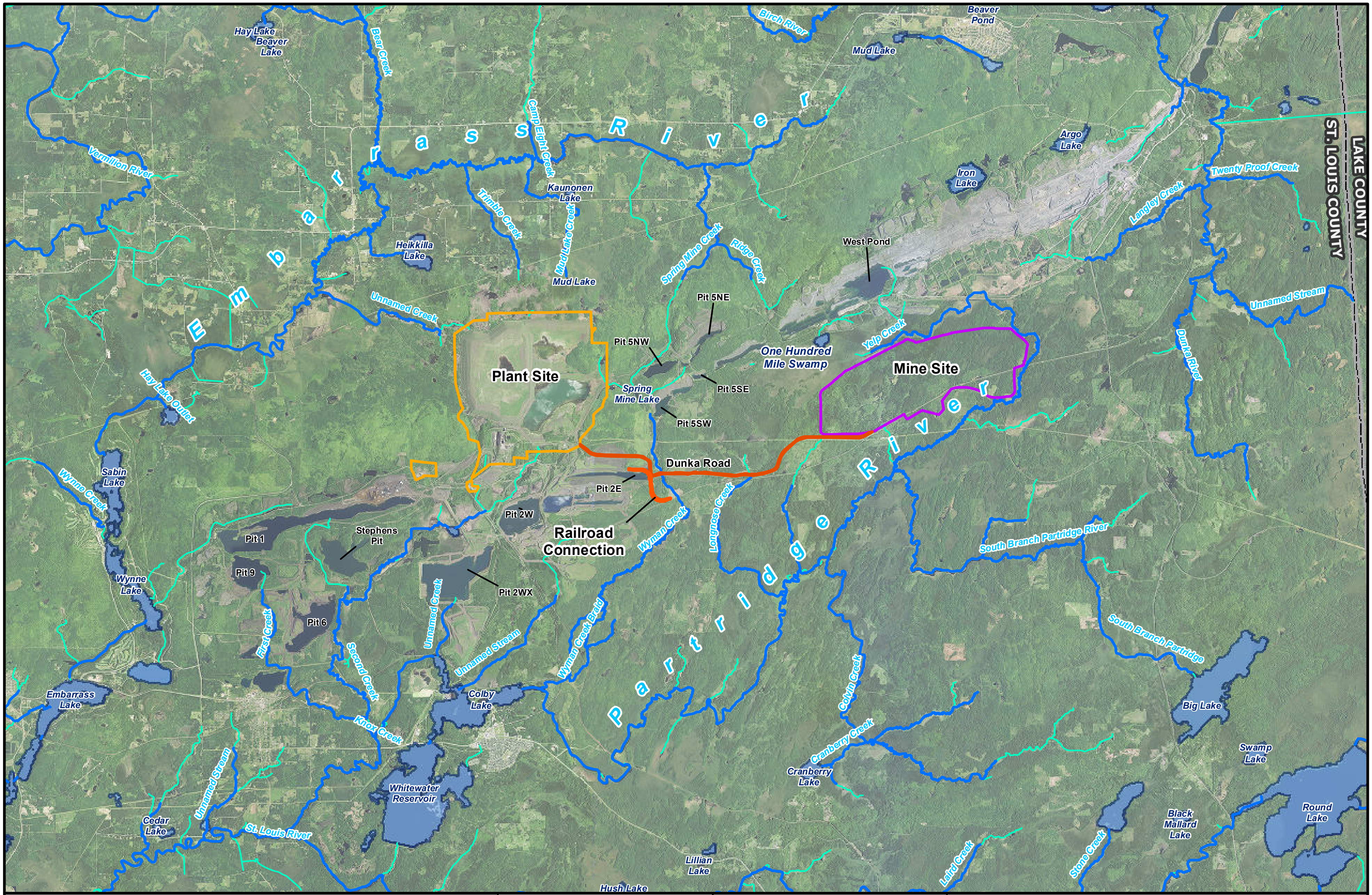

MDNR Designated Public Waters Inventory (PWI) Stream/River

Non MDNR Designated Public Waters Inventory (PWI) Stream/River

MDNR Designated Public Waters Inventory (PWI) Lake/Wetland

Mine Site

Plant Site

Transportation and Utility Corridor

US Army Corps of Engineers
St. Paul District

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Figure 4.2.2-2

MDNR-Designated Public Waters

NorthMet Mining Project and Land Exchange PFEIS

Minnesota

June 2015

146 -Page Intentionally Left Blank-

Table 4.2.2-2 Impaired Waters within the Embarrass River and Partridge River Watersheds

Water Name	Affected Designated Use	Pollutant/Stressor	TMDL Target Date
Embarrass River: headwaters to Embarrass Lake	Aquatic Life	Fishes Bioassessments	2015
Sabin/Wynne Lake (MDNR designated as one Lake)	Aquatic Consumption	Mercury in fish tissue	2025
Embarrass Lake	Aquatic Consumption	Mercury in fish tissue	2015
Esquagama Lake	Aquatic Consumption	Mercury in fish tissue	2025
Wyman Creek: headwaters to Colby Lake	Aquatic Life	Fishes Bioassessments	2015
Colby Lake or Whitewater Reservoir[1]	Aquatic Consumption	Mercury in fish tissue	2025
St. Louis River: Partridge River To Embarrass River	Aquatic Consumption	Mercury in fish tissue	2025
Spring Mine Creek: from Ridge Creek to Embarrass River	Aquatic Life	Fishes Bioassessments; Aquatic Macroinvertebrates Bioassessments	2015

Note:
[1] Both Colby Lake and Whitewater Reservoir are included on the 2012 Inventory of All Impaired Waters List; however, only Colby Lake is on the final 2012 TMDL List. Whitewater Reservoir has a USEPA Category of 4A, meaning fish tissue levels are low enough that it is included under the Statewide Mercury TMDL and no further TMDL is needed.

The "mercury in fish tissue" pollutant listed in Table 4.2.2-2 indicates that the mercury content in sampled fish tissue from these waters was found to be above the state's human health chronic standard. See Section 4.2.6.4 for additional information about mercury in water and fish. The pollutants listed in the table as "Fishes Bioassessments" or "Aquatic Macroinvertebrates Bioassessments" reflect an impaired fish and/or benthic macroinvertebrate population, based on Index of Biological Integrity (IBI) monitoring and assessment, without a specific cause, or stressor, yet being identified. (The MPCA has developed fish and invertebrate IBI scores to assess the aquatic life use of rivers and streams in Minnesota. Monitoring the aquatic community, via biological and chemical monitoring, is a direct way to assess aquatic life use support. The aquatic community integrates the cumulative effect of pollutants, habitat alteration, and hydrological modification of a waterbody over time. The IBI incorporates multiple attributes of the aquatic community, called metrics, which are used to create a cumulative IBI score for each sample location. The MPCA has developed assessment thresholds or biocriteria for aquatic use. In general, an IBI score above the assessment threshold indicates aquatic life use support, while a score below indicates non-support (MPCA 2014). When stressors become known through further investigations and studies, the TMDL can be completed and consideration can be given to permit conditions for individual projects, as warranted.

4.2.2.1.3 Wild Rice

Wild rice is an important resource in terms of its economic and environmental values, as well as having significant cultural value to the native Ojibwe people, which includes the Bands. This section provides baseline information on the importance of wild rice, its habitat requirements, and presence within the NorthMet Project area. Section 4.2.9 discusses the cultural importance of wild rice to the tribes in further detail.

Importance of Wild Rice

The Ojibwe people have a special cultural and spiritual tie to natural wild rice. Their migration story describes how they undertook a westward migration from eastern North America, which tribal prophets had foretold would continue until the Ojibwe people found "the food that grows on water" (Benton-Banai 1988). That food was wild rice, known as manoomin, and it is revered to this day by the Ojibwe as a special gift from the Creator. Natural wild rice remains a mainstay of traditional foods for the Ojibwe community and offers significant nutritional value. The tradition of hand harvesting natural wild rice continues to this day among both tribal and non-tribal cultures. It is estimated that more than 3,000 tribal members participate in wild rice harvesting statewide along with about 1,500 non-tribal individuals (MDNR 2008c).

Wild rice also represents an important food source for both migrating and resident wildlife. Wild rice has been listed as one of the 10 most important sources of food for ducks throughout the United States and Canada. In Minnesota, research conducted at Chippewa National Forest found that natural wild rice was the most important food for mallards during the fall, although many other species of duck also use beds of wild rice. The stems of wild rice provide nesting material for several species and critical brood cover for waterfowl. The entire wild rice plant provides food during the summer for herbivores. In addition, rice worms and other insect larvae feed heavily on natural wild rice. These insects provide a rich source of food for various birds. In the spring, decaying rice straw supports a diverse community of invertebrates and thus provides an important source of food for a variety of wetland wildlife. As a result, many species of wildlife use wild rice lakes and streams for reproduction and foraging areas, including 17 species listed in the MDNR Comprehensive Wildlife Conservation Strategy (MDNR 2006d) as Species of Greatest Conservation Need (SGCN).

In addition to its importance for wildlife, natural wild rice has other ecological values. Emergent aquatic plants like wild rice protect shorelines from erosion, provide habitat for fish, and temporarily sequester nutrients during the growing season, thereby reducing the potential for stream and lake eutrophication and turbidity.

Natural wild rice is an important component of tribal and local economies in Minnesota. In 2007, nearly 0.3 million pounds of unprocessed natural wild rice were purchased from the Leech Lake Band of Ojibwe-licensed harvesters generating more than $400,000 of income for tribal members (MDNR 2008c).

Minnesota was the world's first producer of cultivated wild rice in the 1950s and remains one of the world's leading producers of cultivated wild rice, producing 4 to 6 million pounds annually (MCWRC 2012). Cultivated wild rice, which depends on natural wild rice to an important degree in maintaining genetic diversity, plays an important role Minnesota's economy (MDNR 2015e).

Preferred Habitat and Life Cycle

The historic range of natural wild rice is believed to have encompassed all of Minnesota (Moyle 1945), although it was most common in areas of glacial moraines in central and northern Minnesota. Based on a recent inventory, natural wild rice is still found in 55 counties in Minnesota (MDNR 2008c).

The distribution and abundance of natural wild rice is dependent on its habitat requirements, which include the following (MDNR 2008c):

- Surface water hydrology – some moving water, with rivers, flowages, and lakes with inlets and outlets being optimal areas for growth;
- Seasonal water depths – water levels that are relatively stable or decline gradually during the growing season are preferred, with optimal depths of 0.5 to 3.0 ft of water;
- Substrate – although wild rice may occur in a variety of lake bottoms, the most consistently productive stands are those with soft, organic sediments;
- Water clarity – clear to moderately colored (stained) water is preferred as darkly stained water can limit sunlight penetration and hinder early plant development; and
- Water chemistry – wild rice grows within a wide range of chemical parameters; however, productivity is highest in water with a pH of 6.0 to 8.0 and alkalinity greater than 40 mg/L. Wild rice stands require nitrogen and phosphorus, although excess levels of some nutrients, especially phosphorus, can adversely affect productivity. Wild rice is an annual plant that develops in the spring from a seed that drops off the plant to bottom sediments during the previous fall. The seed requires a dormancy period of 3 to 4 months in 35°F or colder water before germinating in the spring when water temperatures reach 40°F. The plant goes through several distinct growth phases during its lifecycle. During the submerged leaf stage in late May to early June, a cluster of underwater leaves forms. The floating leaf stage typically begins in mid-June as floating leaves develop and lay flat on the water surface. This stage is when wild rice is most susceptible to being uprooted by rapidly rising water levels or waves generated by high winds.

Aerial shoots typically begin to develop by the end of June and grow to a height of 2 to 8 ft above the water surface by August. Wild rice begins to flower in late July and the seeds develop in August and September. The wild rice seeds on the same plant mature across a staggered time period, ensuring that some seeds survive environmental conditions to perpetuate the stand. Some seeds may remain dormant in the bottom sediment for many years to several decades if conditions are not suitable for germination, allowing wild rice populations to survive through time periods with less than optimal conditions and reduced productivity. The time period from germination to dropping of mature seeds typically requires about 110 to 130 days, depending upon environmental conditions. Even under ideal growing conditions, wild rice stands undergo approximately 3- to 5-year cycles in which productivity varies. A typical cycle includes a highly productive year followed by a low productive year, which is followed by a gradual recovery.

Two primary factors that can impact wild rice productivity are changes in hydrology and water quality. Wild rice typically occurs in shallow water and is sensitive to varying water levels, especially during the floating leaf stage in early summer when abruptly rising water levels can uproot the plant. Wild rice will stop growing or become less productive if water becomes too deep (Dore 1969). A recent survey of wild rice harvesters (Norrgard et al. 2007) identified water level as the highest management priority. MDNR wildlife managers have hired trappers to remove beavers from some wild rice lakes to protect wild rice from rising water levels resulting from beaver dam activity.

Regulations Applying to Waters that Contain Wild Rice

Minnesota Rule 7050.0224 identifies a Class 4A water quality standard of 10 mg/L for sulfate concentrations "…applicable to water used for the production of wild rice during periods when the rice may be susceptible to damage by high sulfate levels." The MPCA has developed draft staff recommendation that the 10 mg/L sulfate standard is applicable to portions of the Partridge River and Embarrass River used for the production of wild rice (MPCA 2012a). The MPCA is overseeing a variety of studies relating to sulfate and wild rice, with the goal of informing decisions about state water quality standards. All information provided was considered when the MPCA made their recommendation. Should the application of the standard change, it would be addressed at that time.

Presence of Wild Rice within the NorthMet Project Area

Prior to the NorthMet Project Proposed Action, the existing number, location, extent, and health of wild rice stands within the Partridge River and Embarrass River were unknown. As part of development of the EIS, PolyMet conducted a review of available historic and cultural information, including the report *Natural Wild Rice in Minnesota* (MDNR 2008c), United States Geological Survey (USGS) topographic maps, and a wild rice list provided by the 1854 Treaty Authority. PolyMet also analyzed historic (2004 to 2008) infrared aerial photographs and consulted with persons and groups knowledgeable about wild rice to identify potential wild rice locations along the Partridge River and Embarrass River, including Wyman Creek, a tributary of the Partridge River; Spring Mine Creek, a tributary of the Embarrass River; and downstream on the St. Louis River. They also surveyed Hay Lake and Little Rice Lake, which are not in the Embarrass River or Partridge River watersheds, but were included as potential control sites for future monitoring of wild rice presence and health. Based on this analysis, field surveys were conducted in potential wild rice areas during August and September 2009 using a protocol adapted from the 1854 Treaty Authority. The location and both qualitative and quantitative estimates of density and crop acreage were recorded. Qualitative estimates recorded approximate stand density using a density factor with a scale of 1 (low density) to 5 (high density), similar to a method used by the 1854 Treaty Authority. Quantitative estimates of wild rice density and coverage were determined by sampling representative grids. Sulfate monitoring was also conducted during the wild rice survey (Barr 2011a; Barr 2012a; 2013l). The 2009 survey was followed by additional surveys in 2010, 2011, and 2012.

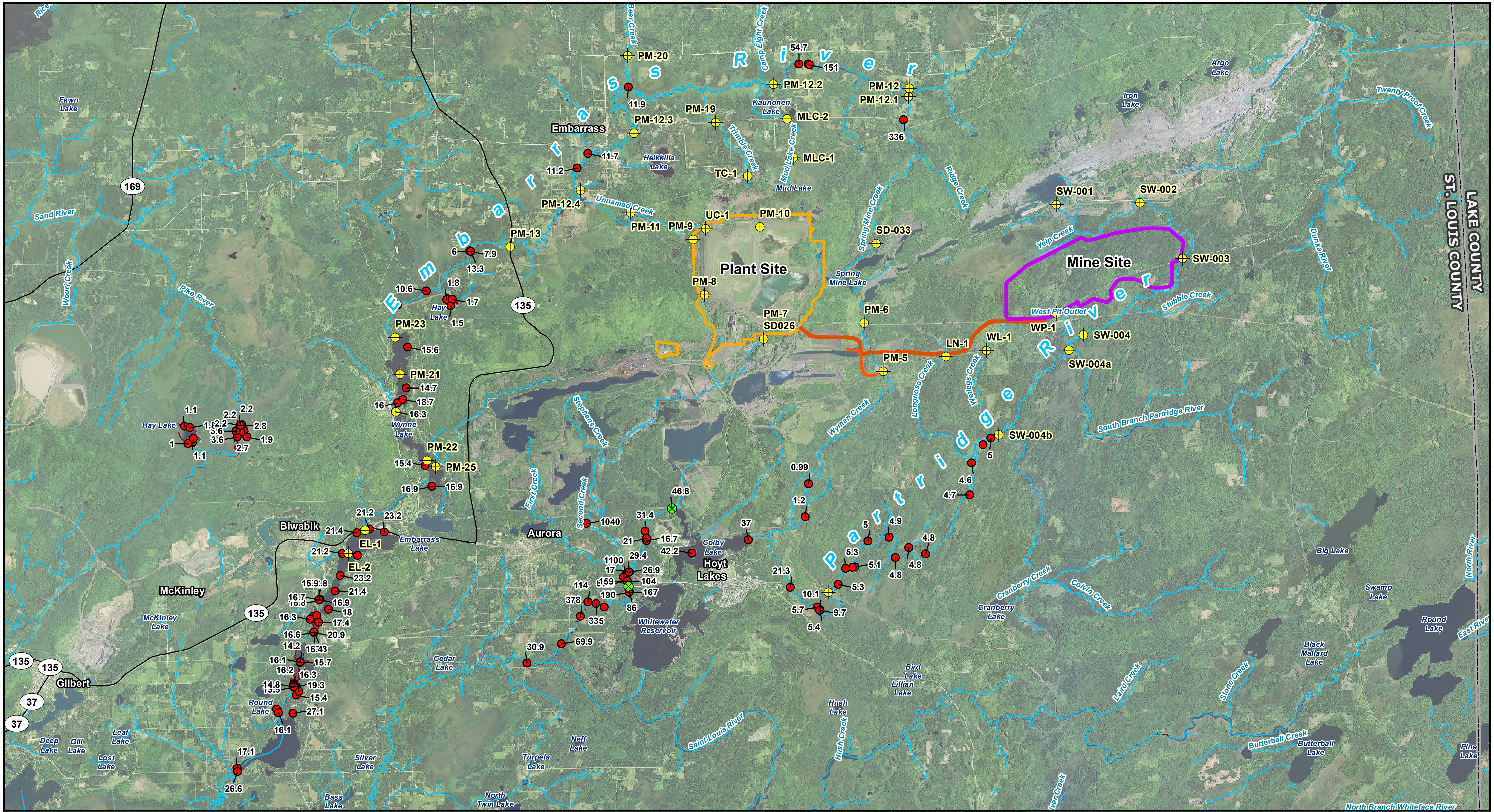
Results of the 2009, 2010, and 2011 sulfate monitoring are shown in Figure 4.2.2-3. Wild rice survey and water quality monitoring results for each waterbody are provided in Table 4.2.2-3 (Barr 2010a; Barr 2011a; Barr 2012a; Barr 2013l; Barr 2013p).

Waterbodies at least partially surveyed during these surveys include the upper Embarrass River and its tributaries (Spring Mine, Trimble, and Unnamed creeks), the Embarrass River chain of lakes (including Sabin, Wynne, Embarrass, Lower Embarrass, Unnamed, Cedar Island, Fourth and Esquagama lakes), the lower Embarrass River, the upper Partridge River, Colby Lake, the lower Partridge River and tributaries to the Partridge River (including Wyman and Second Creeks). The results over the 4 years of surveys indicate some variability in the location and density of observed wild rice and in associated water column sulfate concentrations between survey years. The 2012 survey showed generally fewer and less dense stands of wild rice than were observed in the 2009 to 2011 surveys.

To date within the NorthMet Project area, MPCA has reached a draft staff recommendation regarding waters used for the production of wild rice (MPCA 2012b). These waters include:

- Embarrass Lake;
- the northernmost tip of Wynne Lake (Embarrass River inlet);
- the segment of the Embarrass River from MN Highway 135 bridge to the inlet of Sabin Lake;
- the portion of Upper Partridge River from river mile approximately 22 just upstream of the railroad bridge near Allen Junction to the inlet to Colby Lake;
- the portion of Lower Partridge River from the outlet of Colby Lake to its confluence with the St. Louis River; and
- the portion of Second Creek from First Creek to the confluence with Partridge River.

309 -Page Intentionally Left Blank-



Mine Site

Plant Site

Transportation and Utility Corridor

Stream/River

Surface Water Monitoring Station

Mesabi Nugget Surface Water Monitoring Data - Aug. 19, 2009 (values are for sulfate concentration in mg/L)

2009-2013 Wild Rice Surveys Sulfate Sampling Locations with Sulfate Listed in mg/L

Minnesota Department of Natural Resources

US Army Corps of Engineers St. Paul District

Forest Service U.S. Department of Agriculture

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Figure 4.2.2-3
Sulfate Sampling Locations

NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

311

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Table 4.2.2-3 Wild Rice Survey and Water Quality Monitoring Results

Locations Surveyed	Survey Year	Wild Rice Found?[1]	Density Factor[2] (Scale 1-5)	Sulfate Range[3] (mg/L)
Partridge River Watershed				
Upper Partridge River (above Colby Lake, portions)	09, 10, 11, 12	Yes (isolated)	1–3	5–21 mg/L
Colby Lake	09, 10	No	---	37–42 mg/L
Lower Partridge River (below Colby Lake)	09, 10, 11, 12	Yes	1–5	17–411 mg/L
Wyman Creek	11, 12	No	---	---
Second Creek (portions)	09, 10, 11, 12	Yes (near mouth)	1–4	1,100 mg/L
Embarrass River Watershed				
Upper Embarrass River (Spring Mine Creek to Sabin Lake)	09, 10, 11, 12	Yes (isolated)	1	6–151 mg/L
Sabin - Wynne Lakes	09, 10, 11, 12	Yes (isolated)	1	15–16 mg/L
Chain of Lakes (including Embarrass, Lower Embarrass, Cedar Island, Esquagama, Unnamed, and Fourth)	09, 10, 11, 12	Yes	1–5	14–27 mg/L
Lower Embarrass River (Esquagama Lake to CR 95)	09, 10	No	---	---
Spring Mine Creek (portions)	09, 10, 11, 12	No	---	---
Trimble and Unnamed Creeks (portions)	10, 11, 12	No	---	---

Sources: Barr 2010c; Barr 2011a; 2012a; Barr 2013l; Barr 2013p.

Notes:

[1] 'Yes' indicates that wild rice was observed in at least one of the survey years. Simply finding wild rice in a survey is not the same as being designated a water used for the production of wild rice.

[2] Informal observational scale of relative wild rice density (1 – low density to 5 – high density)

[3] Range of water column sulfate concentration taken at time of wild rice survey. Samples were only taken when and where wild rice was observed. Values rounded to nearest 1 mg/L. Sample sizes were low resulting in relatively large variability within some individual waterbodies.

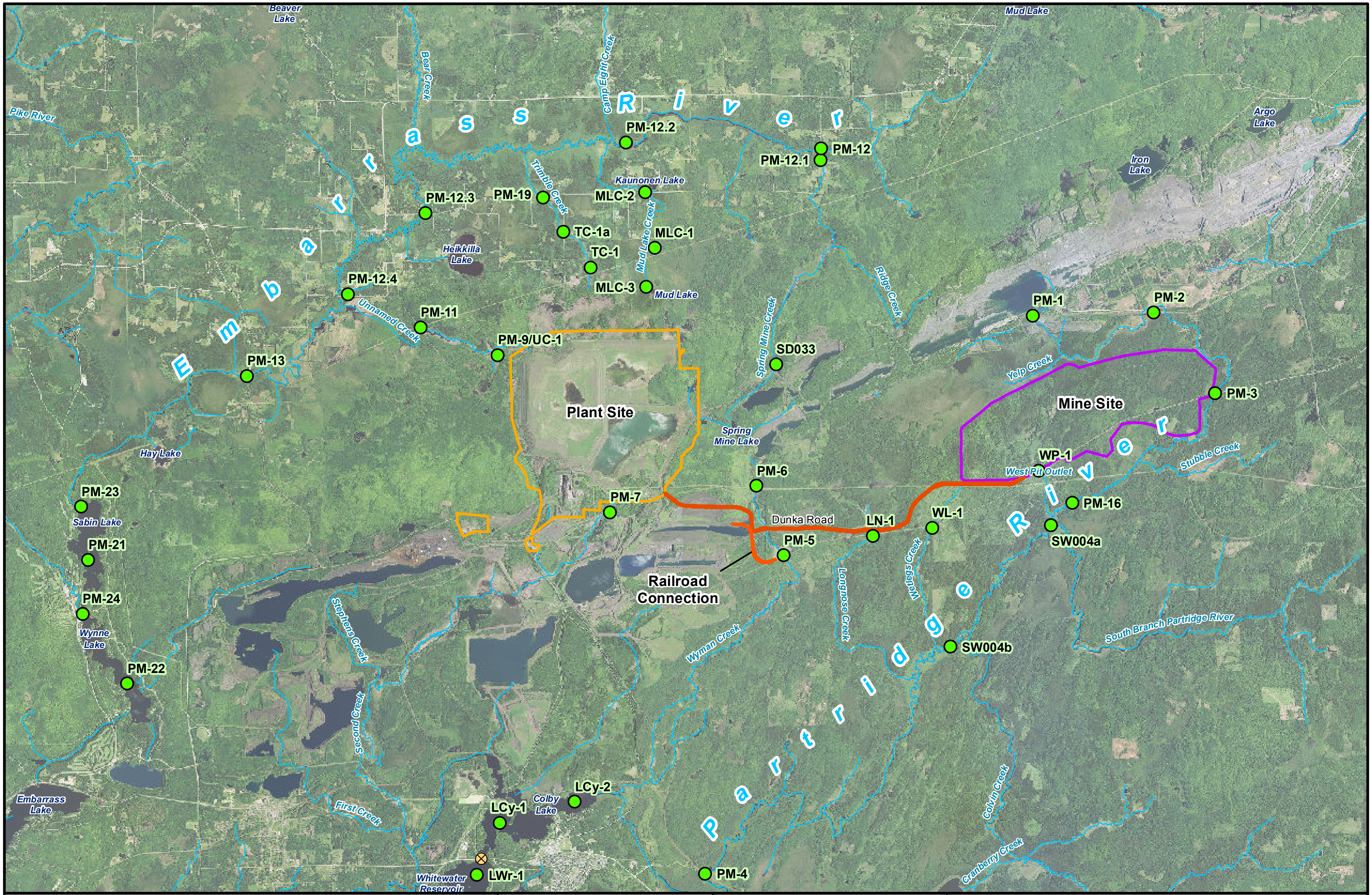
Surveys of the St. Louis River from Brookston to Lake Superior were conducted in 2009 and from the NorthMet Project area to the St. Louis Estuary in 2010. Wild rice was identified on the St. Louis River for a short distance downstream from its confluence with the Partridge River. The most dense stand (density factor of 2) was located just upstream of Highway 100, and a few sparse stands were also located approximately 500 and 1,000 ft further downstream (see Figure 4.2.2-3). Sulfate concentrations in 2010 in the St. Louis River near Highway 100 averaged 17.7 mg/L.

4.2.2.1.4 Mercury

Based on sampling done for the NorthMet Project Proposed Action from 2004 to 2013, total mercury concentrations in the Upper Partridge River average about 3.3 ng/L (Barr 2014m). At monitoring station SW-005, total mercury concentrations range from below the analytical detection limit to a maximum of 18.4 ng/L, with an average concentration of 4.3 ng/L. In Colby

Lake, total mercury concentrations are between 4.6 and 8.7 ng/L, averaging 6.0 ng/L. Total mercury concentrations are similar in the Embarrass River, averaging 5.1 ng/L at monitoring station PM-12 and 4.3 ng/L at monitoring station PM-13 from 2004 to 2013 (see Table 4.2.2-4). Methylmercury concentrations in the Partridge River at SW-005 average 0.41 ng/L (see Table 4.2.2-14) and in the Embarrass River average 0.53 ng/L at PM-12 and 0.38 ng/L at PM-13 over the same period (see Table 4.2.2-30). In addition, mercury monitoring has occurred at other locations in and near the existing LTVSMC Tailings Basin (see Table 4.2.2-4 and Figure 4.2.2-4). Generally, mercury concentrations are consistent with baseline levels, averaging less than 2.0 ng/L. Sample locations in and near the existing LTVSMC Tailings Basin were well below average concentrations in precipitation (approximately 13 ng/L; PolyMet 2015m).

A QA/QC review was conducted to assess the monitoring performance which includes monitoring for mercury. This review was performed in accordance with Barr Engineering Standard Operating Procedure for data validation, which is based on *The National Functional Guidelines for Inorganic and Organic Data Review* (USEPA 2004b and 005b). Both laboratory and field sampling procedures were examined in the review of the data for the respective sampling events. Field sampling procedures were examined utilizing field blank and equipment blank analysis and blind field duplicate data. Laboratory procedures were evaluated by examining recommended holding times and preservation, laboratory blank analyses, laboratory control samples and laboratory control sample duplicates, duplicate analysis, matrix spikes and matrix spike duplicates, and laboratory duplicate data.



Surface Water Monitoring Location
Diversion Works
Stream/River
Mine Site
Plant Site
Transportation and Utility Corridor

US Army Corps of Engineers
St. Paul District

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Figure 4.2.2-4
Additional 2009 Baseline Monitoring Stations for Sulfate and Mercury
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

354 -Page Intentionally Left Blank-

Table 4.2.2-4 Summary of Total Mercury Concentrations in the Partridge River and Embarrass River Watersheds near the Mine Site and Plant Site

		Mercury Concentrations				
Location[1]	**Dates**	**# of Detections**	**Mean[4] (ng/L)**	**Range (ng/L)**	**# Exceeding 1.3 ng/L[2]**	**# Exceeding 13 ng/L[3]**
Partridge River						
SW-001	2004, 2006, 2008	5 of 10	2.3	<1–<5	5	0
SW-002	2004, 2006, 2012, 2013	10 of 15	2.7	<2–<5	12	0
SW-003	2004, 2006–2008, 2012, 2013	19 of 31	2.8	<1–7.8	24	0
SW-004	2004, 2006–2008, 2010, 2012, 2013	23 of 33	3.3	<0.25–8.7	27	0
SW-004a	2010, 2012, 2013	11 of 11	4.1	0.79–12.5	8	0
SW-004b	2010, 2012, 2013	11 of 11	5.4	0.82–18.5	10	1
SW-005	2004, 2006–2008, 2010, 2012, 2013	22 of 33	4.3	<0.25–18.4	28	1
Creeks, Partridge River Watershed						
LN-1	2011–2013	13 of 13	3.5	1.2–9.2	12	0
WP-1	2011–2013	6 of 6	13.9	5.1–28.1	6	3
WL-1	2011–2013	12 of 12	5.0	2.1–9.8	12	0
PM-5	2004, 2011–2013	22 of 27	1.2	<0.25–3.4	9	0
PM-6	2004, 2013	4 of 5	3.5	<0.25–7.9	3	0
Lakes (Surface), Partridge River Watershed						
Colby Lake	2008, 2013	9 of 9	6.0	4.6–8.7	9	0
LTVSMC Tailings Basin Surface Water Seepage						
PM-9	2001–2006	12 of 65	1.8	0.7–4.1	6	0
PM-10	2001–2007	14 of 66	1.4	0.6–2.3	7	0
SD004	2002–2009	23 of 23	1.4	<0.25–4.5	6	0
SD005	2001–2004	2 of 18	1.6	1.2–2	1	0
PM-8	2001–2006	13 of 17	1.7	0.5–4.6	7	0
WS013	2001–2005	7 of 29	2.1	0.9–6.3	2	0
Cell 1E	2002–2003	3 of 25	0.2	<0.1–1	0	0
Cell 2E	2001–2003	3 of 20	0.35	<0.1–3.6	1	0
Cell 2W	2001	0 of 8	<0.1	NA	0	0
Emergency Basin	2001–2005	12 of 41	0.7	<0.1–4.2	10	0
West Seep	2001–2003	1 of 17	0.23	<0.1–<1.25	0	0
Embarrass River						
PM-13	2004, 2006–2008, 2012, 2013	23 of 35	4.3	<1–12.4	29	0
PM-12	2004, 2006–2008, 2012, 2013	28 of 34	5.1	<1–<10	33	0

			Mercury Concentrations			
Location[1]	Dates	# of Detections	Mean[4] (ng/L)	Range (ng/L)	# Exceeding 1.3 ng/L[2]	# Exceeding 13 ng/L[3]
Creeks, Embarrass River Watershed						
PM-11	2004, 2006, 2008, 2011–2013	24 of 30	2.5	<0.25–<10	19	0
PM-19	2011–2013	26 of 26	1.5	0.5–5.1	7	0
PM-20(5)	2009	8 of 8	2.5	1.3–4	7	0
TC-1	2012	1 of 1	1.1	1.1–1.1	0	0
TC-1A	2012, 2013	4 of 4	2.5	0.9–5.1	2	0
MLC-1	2011–2013	7 of 7	2.2	1.1–4	6	0
MLC-2	2011–2013	14 of 14	3.1	0.9–6.5	12	0
MLC-2/MLC-3A	2012	1 of 1	0.99	0.99–0.99	0	0
Lakes (surface), Embarrass River Watershed						
PM-23/Sabin Lake	2009	5 of 5	3.19	1.9–4.8	5	0
PM-21/Sabin Lake	2009	5 of 5	3.26	2.1–5.5	5	0
PM-22/Wynne Lake	2009	5 of 5	3.12	2–5	5	0
PM-24/Wynne Lake	2009	5 of 5	3.56	3.2–4.3	5	0
PM-25	2009	3 of 3	6.47	4.9–8.1	3	0
Wetlands						
Wetland 003	2002–2005	7 of 12	2.2	<1 to 4.4	7	0
Wetland North	2002–2005	8 of 11	3.6	<1 to 6.7	8	0

Sources: Barr 2007h; Barr 2006f; Barr 2009c; Barr 2010c; Barr 2014d.

Notes:
1 See Figures 4.2.2-1, 4.2.2-4, 4.2.2-10, 4.2.2-12, and 4.2.2-13.
2 Minnesota Class 2B Lake Superior standard for mercury.
3 Estimated average total mercury concentration in precipitation in Northern Minnesota, based on annual average mercury concentration from the National Atmospheric Deposition Program for the Fernberg Road Monitoring Site, 2010-2011 (PolyMet 2015m).
4 Where non-detects occur, the mean was calculated using half the detection limit.
5 Dissolved mercury concentrations are presented in the table for PM-20, as only dissolved samples were collected and analyzed for this sample location.

The MDNR has additionally conducted numerous research studies regionally and in the St. Louis River watershed specifically. The river and its tributaries frequently have Hg concentrations that exceed the 1.3 ng/L standard, especially in the weeks following major storm events. The vast majority of the Hg carried in the river is bound to dissolved organic carbon that is derived from wetland areas and riparian soils (summarized in Berndt et al. 2014).

4.2.2.2 Partridge River Watershed

This section describes the baseline hydrology and water quality for the groundwater and surface water within the Partridge River Watershed portion of the NorthMet Project area. This includes all of the Mine Site and the Transportation and Utility Corridor, as well as the former LTVSMC processing plant and a small portion of the Tailings Basin.

4.2.2.2.1 Groundwater Resources

This section describes the geology and hydrogeology of the NorthMet Project area and the groundwater resources at the Mine Site that could be affected by the NorthMet Project Proposed Action. Since the publication of the DEIS, additional groundwater monitoring wells were installed and data collected to better describe the groundwater resources at the Mine Site.

In total, 24 monitoring wells were installed in surficial aquifer and nine in bedrock (see Figure 4.2.2-8). Six or more groundwater samples have been collected for chemical analysis from each of those wells, except one surficial aquifer well that was dry after the first sampling (so it only provided a single sample) and three bedrock wells that were also sampled once only. A statistical analysis indicated that the total number of groundwater quality samples was sufficient to satisfy the USEPA's request that an uncertainty range around the estimate of average concentration for each solute could be identified such that there was a less than 5 percent probability that the actual average would be outside of this range (Barr 2012p).

This section describes available baseline data on the hydraulic properties of the rocks and sediments at the Mine Site, the rationale for assessing its adequacy, and a summary of specific values for Mine Site baseline aquifer characteristics.

Geology of the Mine Site

The shallow materials present at the Mine Site include a relatively thin (0 to approximately 59 ft thick) layer(s) of glacial till and wetland deposits. The till has been described at a regional scale as an unsorted sandy loam mixture with pebbles, cobbles, and boulders (Jennings and Reynolds 2005). Soil borings collected from within the Mine Site are generally consistent with this description, indicating that the till is a heterogeneous and laterally discontinuous zone with a composition ranging from very dense clay to well-sorted sand. In some of the borings, multiple layers of till were encountered, separated by intervals of sand and gravel. However, such sands and gravels apparently do not form laterally extensive bodies (PolyMet 4u2015m).

The NorthMet Deposit itself is below the till in the layered mafic intrusive rocks of the Partridge River intrusion, which are part of the Duluth Complex. The north edge of the Duluth Complex within the Mine Site contacts rock formations comprising the Virginia formation, which hosts large taconite iron ore mines (see Figure 3.2-10).

More than 10 copper-nickel-PGE zones of mineralization have been identified along the northern margin of the Duluth Complex. Those deposits consist of disseminated copper-nickel-iron sulfides, with minor local massive sulfides, hosted in layered heterogeneous troctolitic (plagioclase and olivine with minor pyroxene) rocks that are forming the basal unit of the Duluth Complex. Extensive drilling within the Partridge River intrusion (over 1,100 drill holes) has identified seven layered troctolitic igneous rock units dipping southeast within the NorthMet Deposit (see Figure 3.2-10). Unit 1, which hosts much of the NorthMet economic sulfide mineralization, is the oldest and lower-most layer.

The footwall rocks below the NorthMet Deposit consist of Paleoproterozoic sedimentary rocks. The youngest of these sedimentary rocks is the Virginia Formation, which directly underlies the intrusive Unit 1 across all of the NorthMet Project area (i.e., the Duluth Complex contacts only the Virginia Formation – it does not contact the older sedimentary formations). The Virginia Formation consisting of a thinly bedded sequence of argillite and greywacke outcrops just north of West Pit. During mining operations, it would be exposed along the northern wall of the East Pit.

Underlying the Virginia Formation is the Biwabik Iron Formation, which is the source of taconite iron ore. That formation also hosts an important water resource tapped by residential and community wells in the region. Current drilling and interpolation of geology between drill holes indicates that the mine pits at their final phase of development would retain an approximate 130 to 150 ft separation between their bottoms and the Biwabik Formation (PolyMet 2014q). The oldest of the sedimentary rocks present in the proposed mining area is the Pokegama Quartzite. These sedimentary rocks are underlain by Archean granite of the Giants Range batholith.

Hydrogeology of the Mine Site Surficial Deposits and Bedrock Units

A highly heterogeneous formation of glacial till is thought to have hydraulic conductivities ranging widely, from 0.003 to 3 ft/day. Wetland deposits are on average considerably more permeable than the till.

The Biwabik Iron Formation has a relatively high permeability, whereas the Virginia Formation and Duluth Complex are much less permeable (Siegel and Ericson 1980). PolyMet conducted several aquifer tests to characterize the hydraulic conductivity and specific storage values for the bedrock units underlying the Mine Site (see Table 4.2.2-5). No hydraulic testing of the Biwabik Iron Formation was done within the NorthMet Project area. However, the tests conducted outside the NorthMet Project area (see Table 4.2.2-5) and the ongoing use of the Biwabik Iron Formation as a source of water in the region document that it is characterized by the highest hydraulic conductivity, followed by the Virginia Formation, with the Duluth Complex having conductivity at least one order of magnitude lower.

Hydraulic characteristics of these various geologic units in the Mine Site were determined from the following series of aquifer pumping tests (PolyMet 4u2015m):

- Ten pump tests conducted using borings in the surficial aquifer (including three borings that were turned into permanent monitoring wells; see PolyMet 4u2015m);
- Ten aquifer performance tests conducted using bore holes completed in the Duluth Complex bedrock (PolyMet 2015m);
- Four aquifer pump tests conducted on the Virginia Formation bedrock (conducted using wells P1 through P4, with monitoring in six observation wells, Ob-1, Ob-2, Ob-3, Ob-3a, Ob-4, and Ob-5, plus a water supply well; see PolyMet 2015m);
- One long-term (30-day) pump test conducted using bedrock well P-2, with water levels monitored in wetland piezometers located north of the pumping well (PolyMet 2015m); and
- Specific capacity tests conducted using P-3 and P-4, which are open exclusively in the Virginia Formation (PolyMet 2015m).

A range of specific storage values for the bedrock (i.e., 2.3×10^{-5} to 5.5×10^{-7} ft^{-1}) was determined using the aquifer tests' time-drawdown data collected from the observation wells. The specific capacity tests conducted using two wells indicated that the upper portion of the Virginia Formation is more permeable than its lower portion (Barr 2007a). This is attributed to the higher density of fractures and joints in the bedrock closer to the surface. Overall, groundwater flow within the bedrock is thought to be primarily through fractures and other secondary porosity features as the rocks have low primary hydraulic conductivity. Groundwater in the shallow bedrock is thought to be hydraulically connected with the overlying surficial deposits, resulting in similar flow directions, both in bedrock and surficial deposits (Barr 2007c). Figure 4.2.2-5 shows the depth to bedrock at the Mine Site.

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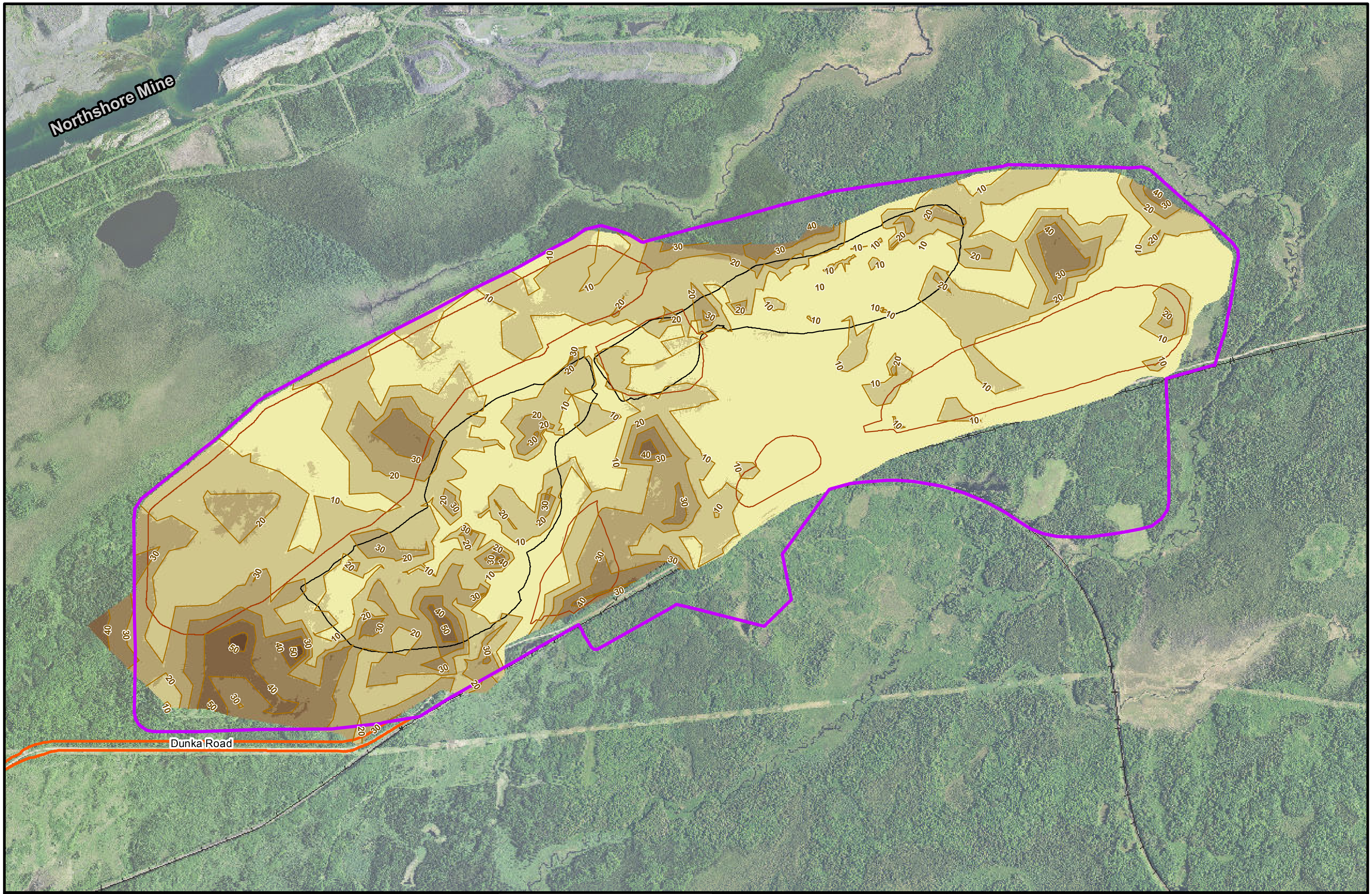

Mine Site
Transportation and Utility Corridor
Proposed Stockpile
Proposed Mine Pit
10-ft Contour
Depth to Bedrock (ft)
0 - 10
10 - 20
20 - 30
30 - 40
40 - 50
50 - 58
Existing Railroad

US Army Corps of Engineers
St. Paul District

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0 750 1,500 3,000 Feet

Figure 4.2.2-5
Mine Site Depth to Bedrock
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

467 -Page Intentionally Left Blank-

Table 4.2.2-5 Bedrock and Surficial Aquifer Hydraulic Conductivity Estimates at the Mine Site

		Hydraulic Conductivity (ft/day)	
Aquifer	**Test Methods**	**Range**	**Geometric Mean**
Surficial	Lab permeability tests on silty sand samples	$4.3x10^{-4}$ to $8.1x10^{-3}$(1)	NA
	Single-well tests	$1.2x10^{-2}$ to $3.1x10^{1}$	NA
Duluth Complex	Single-well tests on exploratory borings (5 tests in southern portion of West Pit; 5 tests close to contact with Virginia Formation)	$2.6x10^{-4}$ – $4.1x10^{-2}$(2)	$2.3x10^{-3}$
Virginia Formation - Upper Portion	4 pumping wells with observation wells	$2.4x10^{-3}$ - 1.0(3)	0.17
Virginia Formation - Lower Portion	Single well pumping tests on 2 wells	NA[4]	0.047
Biwabik Formation	Region-specific capacity pumping tests (not at Mine Site)	0.9(5)	

Sources: [1] Appendix B in RS22, Draft 03, Barr 2008d; [2] RS02, Barr 2006b; [3] RS10, Barr 2006c; [4] RS10A, Barr 2007a; [5] Siegel and Ericson 1980; PolyMet 2015m.

ft/day = feet per day

Concerns have been raised that fractures, including faults and fracture zones, may exist that could permit transmission of groundwater through the bedrock over considerable distances. Such fractures have been identified elsewhere on the Canadian Shield. Foose and Cooper (1978; 1981) appear to have provided the only published work specifically looking at the presence of fracturing and faulting in the Duluth Complex. They identified numerous faults and fractures in their surface mapping of the Harris Lake area (which is about 36 miles for the NorthMet Project area), as is commonly found in the surface exposures of crystalline bedrock. However, they described the most extensive faults as being largely filled with gouge. They also concluded that most of the faults and fractures formed early and at depth, during emplacement of the Duluth Complex, and were not related to post-emplacement deformation, which would have more likely resulted in open fractures that could facilitate groundwater flow.

Evidence of several high-angle faults, consisting of brecciated intervals and fault gouge mineralization, was noted in the exploration cores from the NorthMet Project area (PolyMet 2007b). While correlations between boreholes could only be approximated, the faults appear to be normal and generally trend to the northeast across the site and have downward offset to the southeast, which would be consistent with generation and activation of rift during the Mid-Continent Rift event. There have been no other tectonic events in the Lake Superior region that might have generated more recent fractures and faults or reactivated preexisting ones that would serve as significant zones of groundwater transmission. Numerous lineaments have been mapped over northeastern Minnesota, but these have been associated with glacial deposition and not fracturing in the underlying bedrock (Morey 1981; Heutmaker and Morey 1982). One exploration borehole at the Minnamax prospect encountered groundwater at a depth of 1,390 ft in the Duluth Complex that had artesian flow for a period of 6 days (Barr 1976). However, none of the other 12 exploration borings completed on the prospect encountered similar conditions, indicating little to no hydrogeological interconnection of bedrock fracture or fault zones across the area of that prospect. No similar artesian flows were encountered in any of the exploration boreholes or other boreholes completed within the NorthMet Project area. Increased groundwater flow may occur through shallow bedrock that is more fractured and possibly more weathered than deeper bedrock. However, such flow is likely limited by glacial scouring and removal of the highly weathered and fractured upper zone of bedrock.

Over 14,000 rock quality designation (RQD) measurements for the Duluth Complex were taken using rock cores obtained from hundreds of Mine Site boreholes ("RQD" is a measure of fracture density in a segment of rock drill core, where 100 percent indicates no breaks and 0 percent indicates that all pieces of core within a core run are less than 10 centimeters long). The collected RQD data provide strong evidence that the upper 10 to 15 meters of bedrock tend to be more fractured and have higher hydraulic conductivity than deeper bedrock (Barr 2014b).

The overlying surficial deposits at the Mine Site are poorly sorted and range from very dense clay to well-sorted sand with boulders and cobbles (Barr 2006b; Golder 2007). Hydraulic testing indicates that these deposits may contain layers of relatively low hydraulic conductivity. Testing shallow wells, however, documented a much higher average hydraulic conductivity than underlying bedrock (see Table 4.2.2-5). Shallow borings and test trenches at the Mine Site encountered bedrock at depths ranging from 3.5 to 17 ft below ground surface (bgs).

The site exploration drilling database, drilling logs, and electrical resistivity data were used to develop an estimated depth-to-bedrock isopach map (Golder 2007). The picture presented on that map is consistent with the more limited boring and trenching data. These data indicate that surficial deposits at the Mine Site are less than 20 ft thick over more than 75 percent of the area, and less than 30 ft in thick over 92 percent of the area. The isopach contouring indicates the presence of local depressions in the bedrock surface where surficial deposits may be up to 50 ft thick. However, no major bodies of highly permeable outwash sands and gravel have been reported that might serve as groundwater conduits through the surficial deposits.

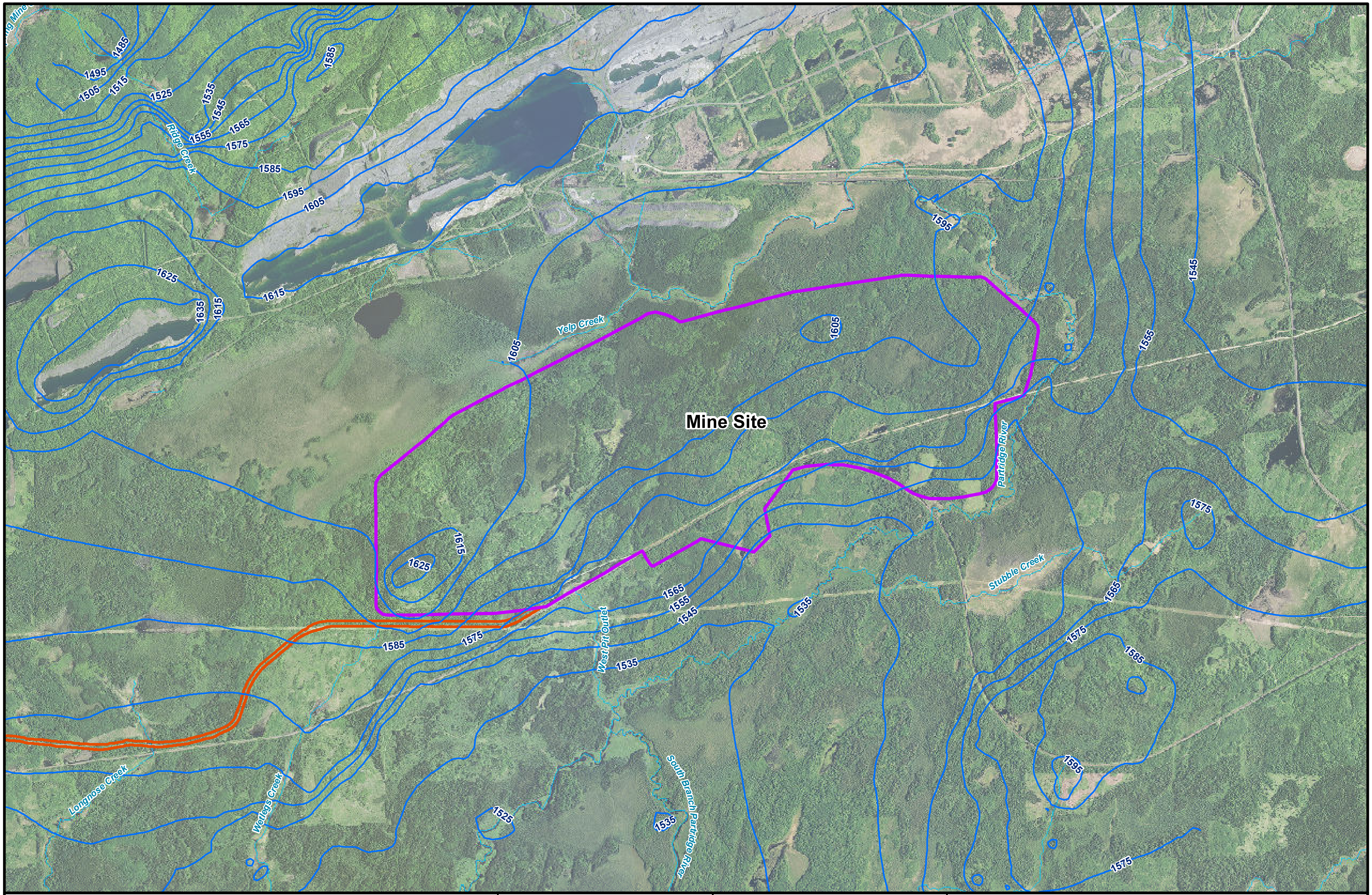
The Mine Site is covered by extensive wetlands, many of which have only minimal hydraulic connection to the underlying groundwater. This interpretation is based on well logs, soil borings, available soil mapping, and the results of wetland characterization field investigations. In particular, a 2010 field survey focused on identifying the fraction of wetlands in the NorthMet Project area that were "ombrotrophic bogs." These bogs form when sphagnum peat accumulation rises above the groundwater table, which reduces inputs of minerals and nutrients from groundwater. Thus, ombrophobic bogs are wetlands almost entirely fed (with water and minerals) from direct precipitation; they have little hydraulic connection to underlying groundwater (Eggers 2011a).

Prior to conducting the analysis of how changes in groundwater and surface water hydrology may potentially affect the wetlands, bog wetlands within and surrounding the Mine Site were reclassified as either ombrotrophic or minerotrophic (i.e., wetlands fed by precipitation, groundwater, streams, and/or springs). This reclassification was carried out consistent with guidelines provided by the USACE (Eggers 2011a; PolyMet 2015b). The field survey (that was conducted along a representative cross section through the NorthMet Project area) recorded those parameters that distinguish the ombrotrophic bogs from the more hydraulically connected wetlands. The survey recorded vegetation species, percent areal cover of Sphagnum mosses (high sphagnum cover is associated with bogs), pH, and specific conductivity (ombrotrophic bogs tend to have lower pH and conductivity than hydraulically connected wetlands). The survey results indicated that approximately 90 percent of the wetlands within the Mine Site are ombrotrophic (PolyMet 2015b). The other wetland communities at the Mine Site include shrub swamps, coniferous swamps, shallow marsh, wet/sedge meadows, open bogs, and hardwood swamps, which may receive some portion of their hydrology from groundwater.

Water table elevations document that groundwater at the Mine Site generally flows south to southeast, toward the Partridge River, which is the major discharge point for the area (see Figure 4.2.2-6). MDNR well records within the NorthMet Project area indicate that water table levels vary seasonally between 3 and 10 ft bgs. At the Mine Site, depth to groundwater is generally less than 5 ft bgs (Barr 2006a). Three nested well pairs at the Mine Site (MW-6S/MW-6D, MW-08S/MW-08D, and MW-10S/MW-10D) allow for evaluation of vertical hydraulic gradients in the surficial deposits. For the nested pairs at MW-6 and MW-8, the vertical hydraulic gradients are small (approximately 0.02 ft/ft) and indicate either upward or downward groundwater flow. At MW-10, the vertical gradient is larger (approximately 0.1 ft/ft) and indicates downward groundwater flow (PolyMet 2015m).

Groundwater elevations measured by PolyMet in Mine Site bedrock boreholes show the hydraulic gradients within bedrock are similar to that of the overlying surficial deposits, indicating hydraulic connection between the surficial deposits and bedrock units (PolyMet 2015m). The Regional Copper-Nickel Study (Siegel and Ericson 1980) concluded that recharge to the bedrock is from direct precipitation where bedrock outcrops at the surface, and from seepage through surficial deposits where the top of bedrock is buried (Siegel and Ericson 1980). This study also reported that the upper 200 to 300 ft of the Duluth Complex formation appeared to be fractured and jointed more extensively than at greater depths, so that the upper portion of the bedrock should have greater hydraulic conductivity. More detailed analyses indicate that the hydraulic connection between surficial deposits and the underlying bedrock, although present, is weak. Water-table monitoring during a 30-day pumping test at bedrock well P-2 showed only a small amount of drawdown in the nearest deep wetland piezometer, and no detectable drawdown at other water table or deep wetland piezometers (PolyMet 2015m; Barr 2007a).

569 -Page Intentionally Left Blank-



Mine Site

Transportation and Utility Corridor

* Water Table Elevation in Surficial Aquifer (Ft AMSL)

Stream/River

* Source: PolyMet 2015j

US Army Corps of Engineers
St. Paul District

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0 0.25 0.5 1 Miles

Figure 4.2.2-6
Estimated Existing Groundwater Contours - Mine Site
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

571 -Page Intentionally Left Blank-

Because of the shallow water table and the generally thin layer of surficial deposits, flowpaths within the surficial deposits are generally thought to be short, with groundwater recharge areas located not far from the discharge areas. The water table is generally a “subdued replica” of the topographic surface, and as a result, groundwater divides generally coincide with surface water drainage divides (PolyMet 2015m, Section 4.3.3.1). Groundwater flow in the surficial aquifer is affected by bedrock outcrops, which cause deviations in the local groundwater flow directions (Siegel and Ericson 1980). However, because the bedrock is hydraulically connected with the overlying surficial deposits, groundwater in the bedrock flows in a similar direction as groundwater in the overlying surficial deposits (PolyMet 2014m, Section 4.3.3.2). Topographic divides are expected to approximate the locations of flow divides in bedrock groundwater.

As recognized in other studies (MDNR 2004; Siegel and Ericson 1980), aquifer testing (see Table 4.2.2-5) showed that the ability of the surficial deposits to transmit water was highly variable and depended upon location and thickness of those deposits. No data were available regarding the storage parameters for the surficial deposits.

Baseline Groundwater Quality

Baseline groundwater quality at the Mine Site is characterized using the data collected by PolyMet (PolyMet 2013i) at the following locations (see Figure 4.2.2-7):

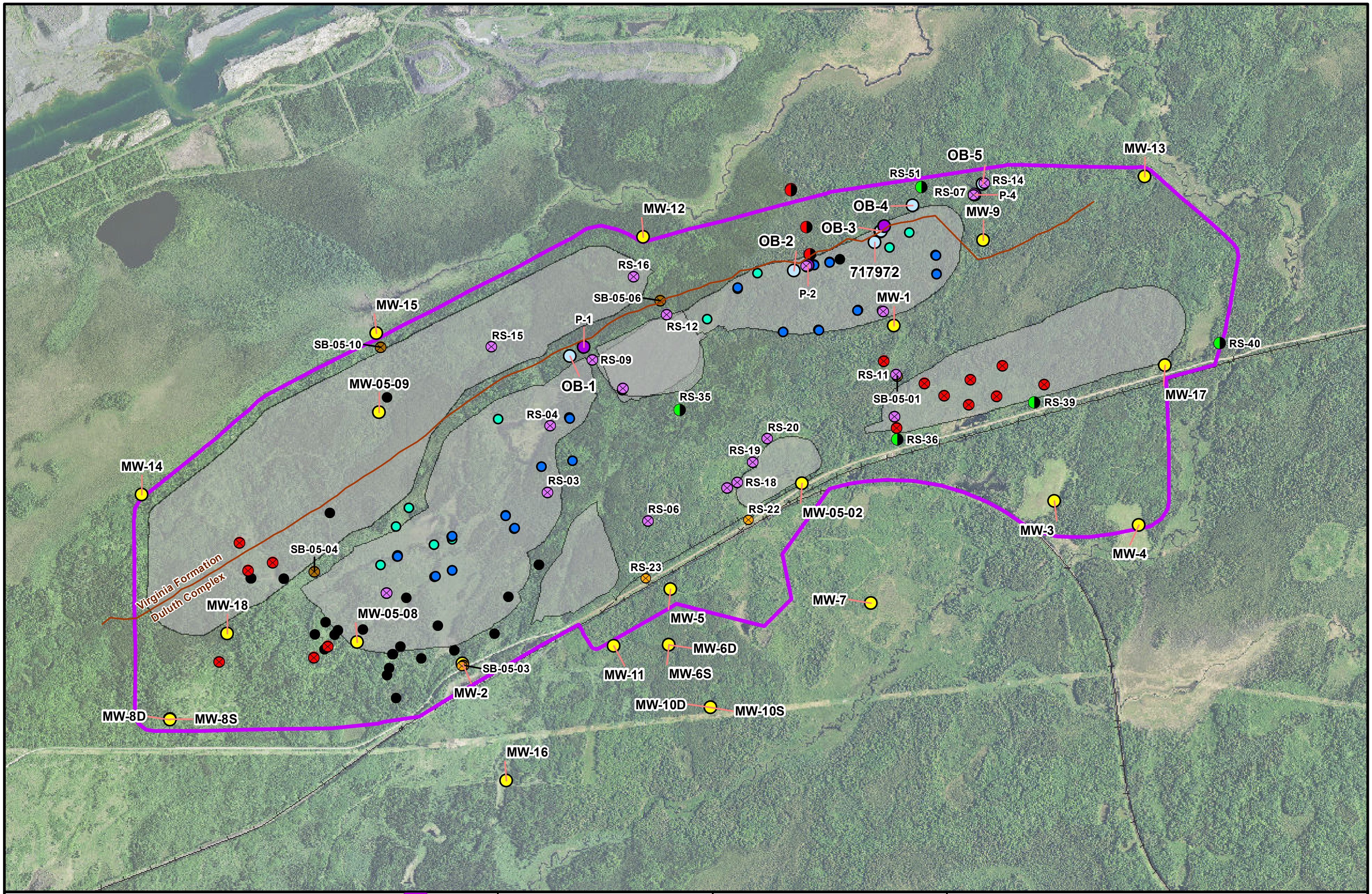
- Three older monitoring wells in the surficial aquifer (MW-05-02, MW-05-08, and MW-05-09), sampled from 2005 through 2013;
- Twenty-one newer wells installed in the surficial aquifer in 2011 and 2012 (MW-1, MW-2, MW-3, MW-4, MW-5, MW-6S, MW6D, MW7, MW-8S, MW-8D, MW-9, MW-10S, MW-10D, MW-11, MW-12, MW-13, MW-14, MW-15, MW-16, MW-17, and MW-18), sampled from 2011 through 2013;
- Five observation wells in the upper 100 ft of the bedrock (ob-1 through ob-5), sampled from 2006 through 2013 (two of those wells are completed in the Duluth Complex and three in the Virginia Formation); and
- Four bedrock wells (P-1, P-2, P-3, and P-4) completed to depths ranging from 485 to 610 ft below grade, which were sampled during aquifer testing in 2005 and 2006.

These samples were subject to standard quality controls (e.g., trip blanks, field blanks, laboratory control and laboratory control duplicates, matrix spike, and matrix spike duplicates, and assessment of holding times) and were acceptable for use in the SDEIS and FEIS (PolyMet 2014u; Section 4.5.2.1.3). A statistical analysis of the samples from these wells through the end of 2013 was used to estimate baseline groundwater quality in the bedrock unit and surficial deposits, which subsequently was used as input into the Mine Site water quality model. Baseline groundwater quality results are summarized in Table 4.2.2-6.

Surficial Deposits

Water samples collected from the 24 wells completed in surficial deposits at the Mine Site indicate that shallow groundwater generally meets evaluation criteria for all solutes except for aluminum (total and dissolved), beryllium (total), iron (total and dissolved), and manganese (total and dissolved) (see Table 4.2.2-6). Overall pH levels tended toward basic (mean of 7.0). The metals exceeding groundwater evaluation criteria (see Section 5.2.2.1) probably reflect natural conditions; there is no record of any historic activities at the Mine Site that could have caused elevated concentrations of these constituents.

These results are generally consistent with the findings presented in the Regional Copper-Nickel Study, which identified concentrations of total cadmium, iron, manganese, and nickel at concentrations above the groundwater evaluation criteria (see Table 4.2.2-6, with data from Siegel and Ericson 1980). Results from the analysis of water samples collected from the existing USGS and USFS wells completed in the surficial deposits indicate that dissolved concentrations in some locations were at or higher than the groundwater evaluation criteria for aluminum, cadmium, cobalt, iron, manganese, and nickel (see Table 4.2.2-6). Siegel and Ericson (1980) noted that higher concentrations of copper, cobalt, nickel, and sulfate are potentially correlated with proximity to the mineralized contact zone between the Duluth Complex and older rocks, as is the case with the NorthMet Project area, and is probably related to the oxidation of sulfide minerals. The pHs measured in the initial groundwater samples from a few wells were near or slightly above 10; but pHs tended to be lower in later samples and decreased to below 10 in all wells, suggesting that cement or other reagents used for well installation and completion may have temporarily increased pH in the vicinity of these wells.



Phase I

- Bedrock Aquifer Testing Location - 2005
- Soil Borings - 2005

Phase II

- Overburden Geochem/Geotech Boring - 2008
- Exploratory Borehole Sump Logging Location - 2010
- Bedrock Groundwater Elevation Measurement - 2006
- Sorption Samplin Location - 2009
- Golder Test Trench - 2006
- Pumping Test Wells - 2005/2006
- Observation Wells - 2005/2006
- Phase III - Wetland Piezometer - 2006
- Rotasonic Borings - 2001/2012
- Surface Monitoring Well
- Mine Site
- Unit Boundary
- Existing Railroad

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N W E S

0 800 1,600 3,200 Feet

Figure 4.2.2-7
Groundwater Sampling at the Mine Site
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

630

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Table 4.2.2-6 Summary of Existing Groundwater Quality Monitoring Data for the NorthMet Mine Site

Parameters	Units	Groundwater Evaluation Criteria	Surficial Aquifer				Surficial Aquifer Northeast MN Baseline	Surficial Aquifer Cu-Ni Study Baseline	Bedrock			
			Detection	Mean[1]	Range	# Exceed	Range	Range	Detection	Mean[1]	Range	# Exceed
General												
Alkalinity	mg/L	--	318 of 320	63.1	<5–263	NA	30–427	--	45 of 48	65.8	<5–115	NA
Ammonia as Nitrogen	mg/L	--	97 of 320	0.25	<0.025–3.5	NA	--	--	9 of 48	0.25	<0.025–0.27	NA
Calcium	mg/L	--	320 of 320	15.3	2.4–38.8	NA	0.2–115	6.0–150	49 of 49	15.9	4.2–32.5	NA
Chloride	mg/L	250	173 of 320	0.71	<0.25–13.2	0	0.3–89	0.1–35	39 of 48	1.1	<0.25–93.1	0
Fluoride	mg/L	2	82 of 320	0.07	<0.05–0.52	0	0.20–1.1	--	27 of 48	0.09	<0.05–1.1	0
Hardness	mg/L	--	320 of 320	66.2	10.3–164	NA	--	--	48 of 48	70.2	15.0–151	NA
Magnesium	mg/L	--	320 of 320	6.8	0.89–18.9	NA	0.1–64.5	1.1–64	48 of 49	7.5	<1–21.6	NA
pH	s.u.	6.5–8.5	318 of 318	7.0	5.0–10.4	**115**	6.0–8.5	5.7–8.0	48 of 48	7.1	6.0–10.4	**15**
Potassium	mg/L	--	320 of 320	1.7	0.27–8.6	NA	0.5–2.9	--	49 of 49	1.7	0.73–3.44	NA
Sodium	mg/L	--	318 of 320	5.4	<1–29.8	NA	1.7–188	--	39 of 49	5.8	<1–43.9	NA
Sulfate	mg/L	250	310 of 320	9.0	<0.5–104	0	<0.3–377	0.7–450	47 of 48	14.1	<0.5–1,200	**1**
TDS	mg/L	500	310 of 311	144	<5–6,080	**1**	28–1,010	--	30 of 30	126	51.0–214	0
Metals - Total												
Aluminum	µg/L	200	27 of 27	**5,751**	31.6–32,300	**22**	<0.1–870	--	38 of 49	989	<10–6,950	**20**
Antimony	µg/L	6	1 of 27	0.54	<0.25–<1.5	0	<0.01–0.09	--	4 of 49	0.63	<0.25–<1.5	0
Arsenic	µg/L	10	14 of 27	1.8	<0.25–5.8	0	<0.01–19	--	22 of 49	2.3	<0.25–24.1	**3**
Barium	µg/L	2,000	318 of 320	33.5	<5–615	0	1.6–191	--	35 of 49	6.7	<5–32.4	0

Parameters	Units	Groundwater Evaluation Criteria	Surficial Aquifer				Surficial Aquifer Northeast MN Baseline	Surficial Aquifer Cu-Ni Study Baseline	Bedrock			
			Detection	Mean[1]	Range	# Exceed	Range	Range	Detection	Mean[1]	Range	# Exceed
Beryllium	µg/L	0.08	25 of 320	**0.13**	<0.1–1.6	BDL[2]	<0.01–0.41	--	3 of 49	**0.11**	<0.1–0.36	**49**
Boron	µg/L	1,000	17 of 320	27.2	<17.5–99.4	0	<13–709	--	10 of 49	53.2	<25–518	0
Cadmium	µg/L	4	6 of 27	0.15	<0.1–0.56	0	<0.02–0.24	--	4 of 49	1.1	<0.1–48.0	**1**
Cobalt	µg/L	--	22 of 27	3.5	<0.1–23.0	NA	0.02–2.6	--	31 of 49	2.5	<0.1–23.3	NA
Copper	µg/L	1,000	27 of 27	21.7	0.80–99.6	0	<5.5–530	--	36 of 49	7.4	<0.25–46.3	0
Iron	µg/L	300	27 of 27	**6,980**	54.3–44,400	**22**	<3.2–20,207	--	47 of 49	**7,161**	<25–44,300	**36**
Lead	µg/L	--	77 of 320	0.80	<0.25–16.7	NA	<0.03–25	--	10 of 49	0.55	<0.25–2.9	NA
Manganese	µg/L	50	26 of 27	**267**	<15–1,770	**22**	0.9–1,462	--	46 of 49	**112**	<5–383	**26**
Mercury	ng/L	2,000	181 of 320	2.7	<0.25–87.6	0	--	--	25 of 51	0.82	<0.25–4.9	0
Methylmercury	ng/L	--	6 of 26	0.091	<0.0125–0.52	NA	--	--	5 of 51	0.040	<0.0125–0.11	NA
Nickel	µg/L	100	25 of 27	10.6	<1–47.0	0	<6.0–20	--	38 of 49	43.5	<0.25–445	**9**
Selenium	µg/L	30	2 of 27	0.61	<0.5–<1	0	<1.0–11	--	1 of 49	1.0	<0.5–<5	0
Silver	µg/L	30	0 of 27	0.23	<0.1–<1	0	<0.01–0.11	--	0 of 49	0.21	<0.1–<0.5	0
Thallium	µg/L	0.6	16 of 320	0.12	<0.0085–<1	**6**	<0.005–0.032	--	0 of 49	0.37	<0.1–<1	**14**
Zinc	µg/L	2,000	13 of 27	15.5	<3–64.5	0	<2.7–1102	--	21 of 49	17.0	<3–125	0
Metals-Dissolved/Filtered												
Aluminum	µg/L	200	134 of 319	63.9	<10–910	**31**	--	0–280	6 of 49	20.2	<10–127	0
Antimony	µg/L	6	0 of 292	0.26	<0.25–<2.5	0	--	--	--	--	--	--
Arsenic	µg/L	10	140 of 307	0.79	<0.25–6.7	0	--	--	7 of 25	0.57	<0.25–2.5	0
Barium	µg/L	2,000	3 of 4	7.3	<5–11.1	0	--	--	11 of 11	1.4	0.58–3.7	0
Boron	µg/L	1,000	0 of 8	25.0	<25–<25	0	--	--	2 of 15	29.8	<25–65.9	0
Cadmium	µg/L	4	4 of 319	0.10	<0.015–<1	0	--	0–8.4	3 of 48	0.12	<0.1–0.92	0
Cobalt	µg/L	--	165 of 293	0.90	<0.1–8.6	NA	--	--	4 of 11	1.0	<0.1–5.0	NA
Copper	µg/L	1,000	252 of 319	2.6	<0.25–49.0	0	--	0.2 to190[(4)]	29 of 49	1.4	<0.25–3.5	0
Iron	µg/L	300	157 of 307	**1,910**	<25–25,600	**92**	--	--	11 of 25	**633**	<25–3,240	**8**

Parameters	Units	Groundwater Evaluation Criteria	Surficial Aquifer				Surficial Aquifer Northeast MN Baseline	Surficial Aquifer Cu-Ni Study Baseline	Bedrock			
			Detection	**Mean[1]**	**Range**	**# Exceed**	**Range**	**Range**	**Detection**	**Mean[1]**	**Range**	**# Exceed**
Lead	µg/L	--	0 of 1	0.25	<0.25–<0.25	NA	--	--	0 of 11	0.25	<0.25–<0.25	NA
Manganese	µg/L	50	304 of 310	**288**	<0.25–3,280	**200**	--	--	28 of 30	**81.3**	<5–218	**12**
Nickel	µg/L	100	229 of 319	2.1	<0.25–20.5	0	--	0.7–120	37 of 49	24.1	<0.25–158	**8**
Selenium	µg/L	30	2 of 319	0.54	<0.1–<5	0	--	--	0 of 48	0.64	<0.5–<1	0
Silver	µg/L	30	0 of 319	0.11	<0.1–<1	0	--	--	0 of 48	0.21	<0.1–<0.5	0
Vanadium	µg/L	50	34 of 292	3.8	<2.5–<25	0	--	--	--	--	--	--
Zinc	µg/L	2,000	60 of 319	4.6	<3–44.4	0	--	0.7–620	19 of 48	14.9	<3–134	0

Sources: Barr 2006b; Barr 2006c; Barr 2007b; MPCA 1999; Siegel and Ericson 1980; Barr 2014d.

Notes:
< = less than indicated reporting limit. Values in bold exceeds evaluation criteria.
[1] Where non-detects occur, the mean was calculated using half the detection limit. Results of field duplicates were averaged.
[2] Below detection limit.
[3] Barr 2014d data (2005-2013) is from the following wells: MW-05-02, MW-05-08, MW-05-09, MW-1, MW-2, MW-3, MW-4, MW-5, MW-6S, MW-6D, MW-7, MW-8S, MW-8D, MW-9, MW-10S, MW-10D, MW-11, MW-12, MW-13, MW-14, MW-15, MW-16, MW-17, and MW-18.
[4] May reflect contamination (as cited in Siegel and Ericson 1980).

Bedrock

Groundwater samples have been collected from nine bedrock (i.e., Duluth Complex and Virginia Formation) monitoring wells (i.e., pumping wells P1 through P4 and observation wells Ob1 through Ob5), one water supply well, and two exploratory boreholes at the Mine Site. The average water quality in the bedrock at the Mine Site was generally found to meet groundwater evaluation criteria except for aluminum, beryllium, iron, manganese, and thallium (see Table 4.2.2-6). The pH of the bedrock water samples from the Duluth Complex tended toward basic (i.e., greater than 7.0 to 9.0), while samples from the Virginia Formation were, with one exception, more acidic (i.e., less than 7.0). Sample pHs were near or slightly above 10 in a few wells; but pHs tended to be lower in later samples, suggesting that cement or other reagents used for well installation and completion may have increased pH in the vicinity of these wells.

Occasional exceedances of water quality standards were detected for arsenic and nickel. Ammonia was detected in nine samples, which is unusual because ammonia is not typically found in bedrock. The presence of ammonia in at least two of these samples is attributed to either collection or laboratory error (Barr 2006a). Nitrite or nitrate (both are the forms of nitrogen to which ammonia converts) was found in four samples. This result is not unprecedented as the MPCA study in northeastern Minnesota reported that nitrate was detected in two of the 20 collected samples (MPCA 1999a).

Groundwater Use

No domestic wells exist between the Mine Site and the Partridge River. However, there are several MDNR water appropriation permits in effect for mine pit dewatering that affect the Mine Site, including the Northshore Mine permit (Permit 1982-2097). The permit authorizes Northshore Mining Company to withdraw up to 36,000 gpm (80 cubic ft per second [cfs]), of which a maximum of 13,000 gpm (29 cfs) can be discharged to the Partridge River, a maximum of 12,000 gpm (27 cfs) can be discharged to Langley Creek, and a maximum of 11,000 gpm (25 cfs) can be discharged to Unnamed Creek.

4.2.2.2.2 Surface Water

This section describes the existing surface water resources for the Mine Site that could be affected by the NorthMet Project Proposed Action. These resources include the Upper Partridge River, the Upper Partridge River tributary streams, Colby Lake, Second Creek, Whitewater Reservoir, and the Lower Partridge River below Colby Lake downstream to its confluence with the St. Louis River. For purposes of this FEIS, the Partridge River upstream of Colby Lake is referred to as the Upper Partridge River, while the segment downstream of Colby Lake is referred to as the Lower Partridge River (see Figure 4.2.2-1). For this FEIS, new XP-SWMM model predictions were made to estimate Partridge River flow parameters without effects of discharge from the Northshore Mine, and additional surface water quality data has been collected at many locations. These new data are summarized to better describe existing conditions as inputs for modeling potential surface water impacts.

Upper Partridge River

This section describes the baseline surface water hydrology and water quality of the mainstem of the Partridge River upstream of Colby Lake.

Upper Partridge River Hydrology

The Partridge River forms just south of the Northshore Mine, although historically its source was further upstream. It flows approximately 32 river miles to its confluence with the St. Louis River, draining a total of approximately 161 square miles, as measured at Aurora, Minnesota, approximately 3 miles from the St. Louis River confluence (see Figure 4.2.2-1). The Upper Partridge River refers to the segment of the Partridge River upstream of Colby Lake. The Upper Partridge River Watershed is primarily a mix of upland forest (39 percent), lowlands and aquatic environments (27 percent), shrubland (22 percent), and cropland/grassland (2 percent), with some development (10 percent). There are several active and inactive mines within the watershed including the active Northshore Mine in the headwaters area, as well as the inactive and former LTVSMC mine. About 5 miles of the Partridge River run around the northern and eastern perimeter of the proposed NorthMet Mine Site. Seeps from the southern portion of the existing LTVSMC Tailings Basin (south side of Cell 1E) naturally flow to Second Creek, a tributary of the Partridge River in the Lower Partridge Watershed (see Figure 4.2.2-1); however, a portion of the seeps is presently being captured and pumped back to the Tailings Basin under the Consent Decree between the MPCA and Cliffs Erie. The Partridge River varies from sluggish marshy reaches, to large open ponds, to boulder rapids.

Flow data is most valuable when there is a long term of record because the data are less likely to be skewed by dry or wet climate in an atypical year or two (Robson 2000). Data from four USGS gaging stations within the Partridge River Watershed (see Figure 4.2.2-1) are available, but the three that reflect flow from the NorthMet Project area have all been impacted by mining operations (see Table 4.2.2-7). The Partridge River above Colby Lake (USGS Station #04015475) is the gaging station that best represents flows from the NorthMet Project area because it is the most upstream station that captures all flow from the proposed Mine Site, with data available for the period from September 1978 through October 1988. The use of these flow data, although about 25 years old, is reasonable as there has not been any substantial land cover or other changes in the watershed over the intervening years that would raise into question the applicability of these data. PolyMet also assessed a similar watershed in the region, the Kawishiwi River, using a flow record from October 1971 to September 2010 to determine if there were long-term trends in flow in this geographic area. No discernable trend in flow was detected, reinforcing that the use of the existing data for Partridge River above Colby Lake is reasonable (PolyMet 2015m). A recently installed flow gage at the Dunka Road is closer to the Mine Site, crossing near its southeast corner (monitoring location SW-003); however, the short period of record is insufficient for use in the FEIS.

The available flow records indicate that streamflow is generally very low from late fall through the winter, rising sharply during spring snowmelt, and receding during the summer, except for occasional heavy storms. This pattern of significantly reduced summer streamflow is characteristic of streams draining extensive bogs (Brooks 1992). Natural flow is very low during the winter because of the relatively thin surficial deposit over the bedrock, and because little groundwater recharge occurs since most precipitation falls as snow and is not available for infiltration or runoff until it melts (Siegel and Ericson 1980). The discharge statistics for the USGS Station above Colby Lake (USGS Station #04015475) are presented in Table 4.2.2-7. The modeled XP-SWMM flows at seven locations (SW-002, SW-003, SW-004, SW-004a, SW-004b, SW-005, and SW-006) on the Partridge River (see Figure 4.2.2-8) are presented in Table 4.2.2-8.

The Northshore Mine is located at the headwaters of the Partridge River (see Figure 4.2.2-8). Discharges from Northshore to the headwaters of the Partridge River have occurred sporadically since 1956, with limited pumping records available prior to 1988, when record keeping became required by the State. These discharges from the Peter Mitchell Pit can have an impact on the flow regime of the Upper Partridge River, particularly in the winter during low-flow conditions (see Section 6.2.2).

Following closure of the Northshore Mine, discharge to the Partridge River Watershed would cease as the Northshore pit is allowed to flood with water. After the Northshore pit lake is flooded, it would discharge towards the Dunka River, effectively removing the Northshore pit watershed from the Partridge River Watershed. Discharge from the Northshore Mine is planned to end in approximately 2070 (PolyMet 2015m).

For the DEIS, an XP-SWMM hydrologic/hydraulic model of the Partridge River was developed to estimate flows upstream of the USGS Station #04015475. The model was calibrated to gage data from 1984 and 1985 and validated against the 1978-1987 observed flow record. These data were considered reliable for making flow estimations because they do not include contributions from Northshore. No correction was made in the DEIS model calibration for Northshore Mine discharge, as dewatering data were not available at the time (PolyMet 2015m).

In an effort to account for the Northshore Mine discharge in this FEIS, different methods were evaluated. The method chosen was to recalculate the scale factors used to calibrate the XP-SWMM model to data from the USGS gage data, using data collected when the Northshore Mine was not discharging water into the Partridge River (October 1986 to September 1988). A more detailed description of the XP-SWMM model calibration can be found in the Mine Site Water Modeling Data Package (PolyMet 2015m).

Table 4.2.2-7 Monthly Statistical Flow Data (cfs) for USGS Gaging Stations in the Partridge River Watershed

Station:	04015475 Partridge River Above Colby Lake[2]			04015500 Second Creek Near Aurora			04016000 Partridge River Near Aurora		
Period of Record:	1978-1988			1955-1980			1942 – 1982		
Drainage Area:	106.0 mi^2			29.0 mi^2			161.0 mi^2		
Contributing Drainage Area:	100.0 mi^2			22.4 mi^2			147.7 mi^2		
Month	**Monthly Average**	**Daily Minimum**	**Daily Maximum**	**Monthly Average**	**Daily Minimum**	**Daily Maximum**	**Monthly Average**	**Daily Minimum**	**Daily Maximum**
October	116[1]	14	775	24	1.2	134	97	3.3	1,140
November	63	13	468	20	4.0	103	71	4.0	308
December	20	4.1	95	12	2.2	35	34	5.7	116
January	7.5	1.4	23	9.2	1.5	30	21	2.3	61
February	6.4	1.0	26	8.9	1.5	28	17	2.3	41
March	16	0.6	209	16	2.0	84	41	3.0	1,560
April	242	4.0	1,960	47	5.0	233	271	6.5	2,580
May	220	11	874	34	1.7	126	333	37	3,190
June	105	5.9	568	29	1.4	95	210	17	2,920
July	104	0.5	866	23	3.1	90	101	11	950
August	55	0.7	480	20	2.6	130	64	5.2	459
September	87	2.0	383	24	1.9	100	81	3.2	438

Source: Statistical data from USGS 2015.

Notes:
[1] All values in cfs unless otherwise noted.
[2] Station data may be influenced by Northshore Mine pit dewatering up to October 1986.

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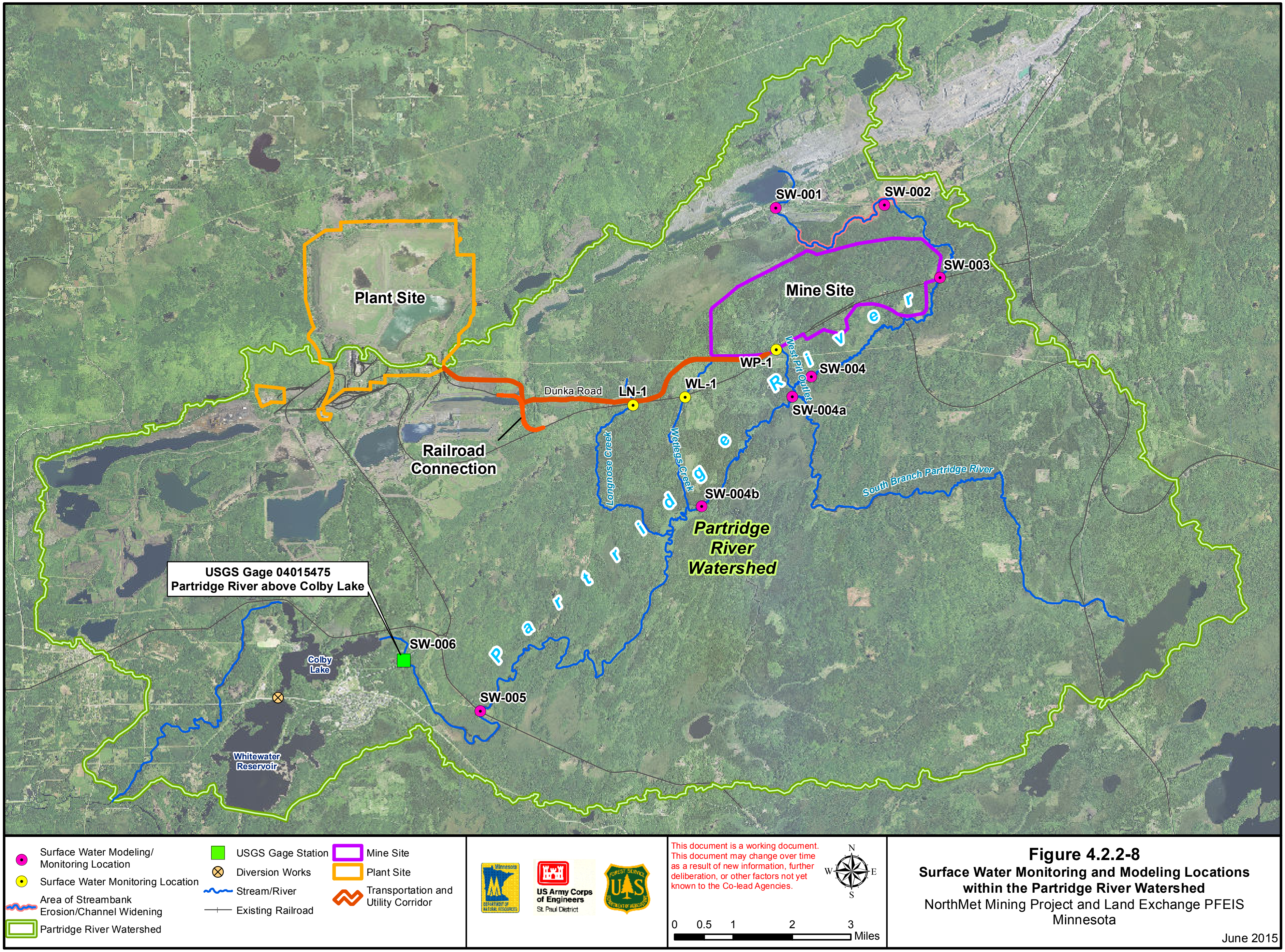

Figure 4.2.2-8
Surface Water Monitoring and Modeling Locations within the Partridge River Watershed
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

756

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Table 4.2.2-8 Modeled Flow Statistics for Various Locations along the Upper Partridge River under Natural Conditions

	Station						
Statistic (Unit)	**SW-002(1)**	**SW-003(1)**	**SW-004(1)**	**SW-004a(1)**	**SW-004b(1)**	**SW-005(1)**	**SW-006(1)**
Drainage Area (acres)[2]	3,838	4,880	9,896	29,887	44,995	58,395	61,386
Annual Daily Mean (cfs)	6.09	7.35	13.97	38.33	57.61	74.77	78.87
October Mean (cfs)	22.76	27.58	52.43	144.03	216.09	278.61	294.02
November Mean (cfs)	4.59	5.80	11.68	31.61	49.19	66.08	68.93
December Mean (cfs)	1.70	2.29	4.43	12.85	19.71	26.61	27.72
January Mean (cfs)	0.57	0.73	1.37	3.95	5.97	7.73	8.11
February Mean (cfs)	1.06	1.27	2.40	6.59	9.88	12.73	13.42
March Mean (cfs)	1.44	1.70	3.10	8.50	12.50	15.16	16.12
April Mean (cfs)	30.58	36.89	71.41	200.60	300.54	390.47	410.56
May Mean (cfs)	7.36	9.05	17.52	49.01	75.47	102.88	108.04
June Mean (cfs)	11.55	13.54	25.56	67.75	101.13	127.93	135.19
July Mean (cfs)	5.97	7.09	13.54	35.56	54.55	75.93	80.42
August Mean (cfs)	3.00	3.57	6.40	16.71	24.79	31.89	33.98
September Mean (cfs)	8.93	10.84	20.14	52.93	79.31	103.64	110.01
10-year[3] High Flow (cfs)	117.79	132.12	214.83	678.28	895.16	1,080.60	1,126.55
Average Annual 1-day Max (cfs)	82.15	93.30	156.05	467.64	630.96	737.26	761.75
Average Annual 3-day Max (cfs)	71.62	82.84	149.39	423.15	593.08	722.50	748.85
Average Annual 7-day Max (cfs)	54.13	63.57	120.31	337.99	490.93	623.57	651.79
Average Annual 30-day Max (cfs)	23.59	28.25	54.01	150.46	223.95	288.80	303.66
Average Annual 90-day Max (cfs)	13.71	16.52	31.66	87.78	131.81	170.99	180.10
10-year[3] Low Flow (cfs)	0.35	0.45	0.72	1.72	2.84	3.58	3.90
Average Annual 1-day Min (cfs)	0.40	0.52	0.85	2.08	3.36	4.32	4.69
Average Annual 3-day Min (cfs)	0.39	0.51	0.84	2.05	3.30	4.28	4.65
Average Annual 7-day Min (cfs)	0.40	0.51	0.86	2.11	3.38	4.32	4.68
Average Annual 30-day Min (cfs)	0.41	0.51	0.92	2.44	3.81	4.91	5.28
Average Annual 90-day Min (cfs)	0.63	0.80	1.46	3.87	5.87	7.61	8.10
Date of Max 1-day Mean[4] (cfs)	168.85	168.85	169.26	168.95	169.16	169.77	169.77
Date of Min 1-day Mean[4] (cfs)	211.94	211.94	195.10	201.64	208.29	203.28	200.39
Number of Zero Flow Days/year	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7-day Minimum/Annual Mean[5]	0.06	0.06	0.05	0.05	0.05	0.05	0.05
No of High Pulses[6]/yr	15.17	13.80	10.54	9.00	8.23	6.51	6.34
Mean Duration of High Pulses (days)	4.97	5.46	7.15	8.42	9.19	11.61	11.93

	Station						
Statistic (Unit)	**SW-002(1)**	**SW-003(1)**	**SW-004(1)**	**SW-004a(1)**	**SW-004b(1)**	**SW-005(1)**	**SW-006(1)**
Total High Pulse Duration/yr (days)	69.23	69.31	69.23	69.61	69.53	69.53	69.53
No of Low Pulses7/yr	3.63	3.57	2.72	2.61	2.72	1.97	1.97
Mean Duration of Low Pulses (days)	19.04	19.15	26.30	27.34	26.37	37.26	37.31
Total Low Pulse Duration/yr (days)	70.89	70.27	73.46	73.38	73.64	75.50	75.59
Avg. Hydrograph Increase (cfs/day)	3.94	4.69	6.93	20.61	28.11	24.65	26.33
Avg. Hydrograph Decrease (cfs/day)	1.49	1.63	2.46	7.06	9.38	10.19	10.23
No of Flow Reversals/yr	54.84	49.75	38.43	38.49	38.80	34.02	38.86

Sources: PolyMet 2015m, Appendix J;

Notes:
[1] Based on existing-conditions XP-SWMM model results adjusted using scale factors listed in Table 4-7 of the Mine Site Water Modeling Data Package (PolyMet 2015m).
[2] Based on existing conditions Partridge River Tributary Areas listed in Table 1-18 of the Mine Site Water Modeling Data Package (PolyMet 2015m).
[3] Annual instantaneous peak with a 10-year recurrence interval.
[4] Mean Julian date of each annual 1-day maximum or minimum flow.
[5] Mean value of the 7-day minimum flow divided by the mean annual flow of that year.
[6] The number of times per year the mean daily flow increases above the 75th-percentile of all recorded/simulated mean daily flows.
[7] The number of times per year the mean daily flow falls below the 25th-percentile of all recorded/simulated mean daily flows.

Upper Partridge River Groundwater Baseflow

Estimating the groundwater contribution to flow in the Upper Partridge River is necessary for modeling future impacts because groundwater and surface water quality are different. The flow contribution from groundwater is referred to as groundwater baseflow and represents a relatively constant source of water to the river.

Both PolyMet and the MDNR evaluated Partridge River groundwater baseflow. The MDNR directly measured low flows at several locations along the Partridge River during the winters of 2008, 2010, and 2011; however, these flow measurements were likely affected by discharges from the Northshore Mine and were not indicative of groundwater baseflows only.

PolyMet used data from USGS gaging station #04015475, from periods when the Northshore Mine was not discharging water (January and February 1985, and October 1986 to September 1988), to determine the average 30-day winter low flow. This 30-day low-flow value was assumed to be the groundwater baseflow at that location and was used in XP-SWMM to estimate groundwater baseflow at several locations in the Upper Partridge River. Estimated low flows in the Upper Partridge River are presented in Table 4.2.2-9.

The only other available gaging data that could be used for estimation of baseflow are from a station installed in 2011 at SW-003 on the Partridge River. However, interpretation of groundwater baseflow at SW-003 is not reliable for use in the GoldSim modeling of groundwater baseflow (discussion of modeling is provided in Section 5.2.2) due to the complicating effects of

Peter Mitchell Pit (Northshore) pumped discharges, seepage from the Northshore West Pond, and complex storage and release mechanisms in the wetlands that receive these flows.

Table 4.2.2-9 Modeled 30-Day Low Flow

Station	XP-SWMM Modeled 30-day Low Flow (cfs)[1]
SW-002	0.4
SW-003	0.5
SW-004	0.9
SW-004a	2.4
SW-004b	3.8
SW-005	4.9
SW-006	5.3

Source: XP-SWMM Data: PolyMet 2015m.

Note:
[1] XP-SWMM model was calibrated to flow-flow conditions when there was no dewatering from Northshore Mine.

Upper Partridge River Stream Geomorphology

A Level I Rosgen Geomorphic Survey (Rosgen 1996) was conducted for the Partridge River from its headwaters to Colby Lake, a distance of about 28 miles (Barr 2005). A Level I Survey is a physical classification of a stream channel to determine its geomorphic characteristics based on the relationship of its physical geometry and hydraulic characteristics. The purpose of a geomorphic survey is to evaluate the stability of a stream under existing conditions, to determine its sensitivity to hydrologic change, and to indicate how restoration may be approached if a portion of the stream becomes unstable. This survey is included in this FEIS because it assesses erosion and/or channel widening caused by changes in flow that may occur from current or future mine water discharge, and is thus helpful in assessing project-specific or cumulative effects. This broad level characterization was performed using 2003 aerial photography, USGS 7.5 minute quadrangles with a 10-ft contour interval, available ground photographs, and two site visits.

The survey results indicated that approximately 54 percent of the Partridge River is a Type C channel, 31 percent is a Type E channel, and 13 percent is a Type B channel. Type C channels are characterized as moderately sinuous (meandering), having a mild slope and a well-developed floodplain, and being fairly shallow relative to their width. Type E channels are similar to Type C, except that they tend to be more sinuous and deeper relative to their width. Type B channels are steeper, straighter, and have less floodplain available than Type C or E channels. Type B channels tend to be less sensitive to impact than Type C or E channels and are dominated by boulder material on the Partridge River.

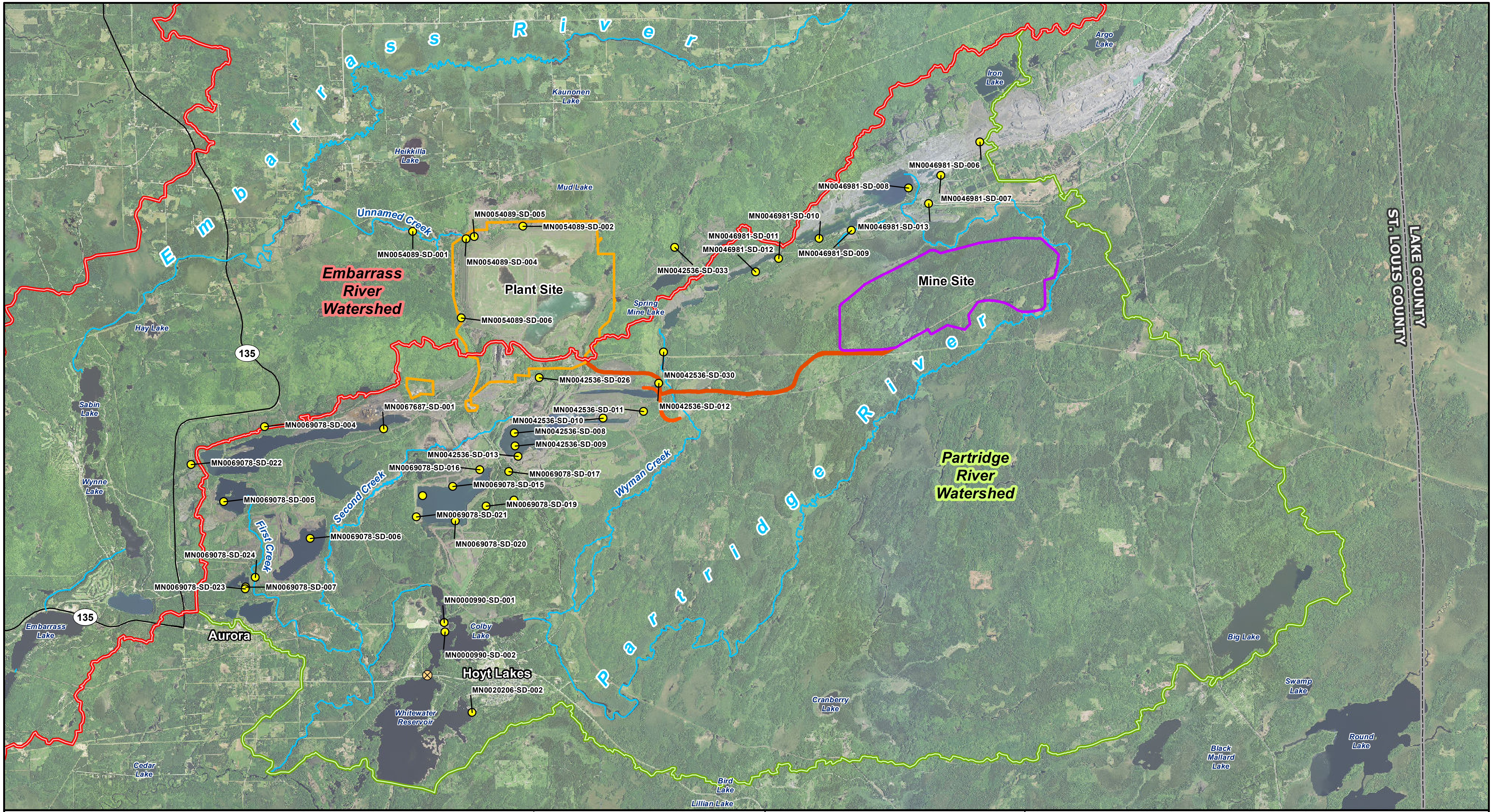
The Rosgen field survey found the Partridge River to be stable, with no evidence of erosion except in its headwaters (see Figure 4.2.2-8). In general, the Partridge River has well vegetated stream banks for nearly its entire length, and a very well-developed floodplain for all but the Type B reaches. There are many beaver dams along the entire length of the Partridge River, particularly at the head of rapids sections, which create wide pools. Because its steep reaches are well-armored and the flatter reaches tend to have well vegetated shorelines, the Partridge River is considered to be a robust stream. The limited erosion and/or channel widening found in the headwaters may be attributable to pit dewatering discharges from the Northshore Mine, which has a maximum permitted discharge rate of 29 cfs, and the historic straightening of the river channel for construction of a railroad (Barr 2005).

Two additional Rosgen surveys were conducted on Unnamed Creek and two stream reaches in the upper Partridge River. A Level I Rosgen Geomorphic Survey (Rosgen 1996) was conducted on Unnamed Creek in November 2011 using survey-grade GPS and ground photographs. The survey results indicated that Unnamed Creek is consistent with Type C and E channels with no evidence of erosion, downcutting, or channel widening at any of the surveyed locations and well-developed floodplains, substantial bank vegetation, and cobbles in the steeper riffle sections. Water levels in Unnamed Creek are likely controlled by beaver dams in the surrounding wetlands as the baseflow to the creek from groundwater is low. Unnamed Creek is likely to withstand moderate changes in hydrology with no degradation as it has well-developed floodplains and substantial bank vegetation (Barr 2013o).

A level II Rosgen Classification was conducted for two stream reaches on the upper Partridge River in July (East Reach) and August 2009 (West Reach). A Level II classification (Rosgen 1996) consists of a survey of the channel profile and cross-sections of the channel and floodplain as well as sampling of the stream bed material. The survey results indicated that both reaches are consistent with Type E channels with no evidence of erosion, downcutting, or channel widening at either of the surveyed reaches; both reaches have well-developed floodplains and vigorous bank vegetation. As with Unnamed Creek, the water levels in both reaches are likely controlled by beaver dams in the surrounding wetlands as the baseflow to the reaches from groundwater is low. These reaches are likely to withstand moderate changes in hydrology with no degradation as they have well-developed floodplains and substantial bank vegetation (Barr 2013q).

Partridge River Surface Water Withdrawals and Discharges

There are several mines, the City of Hoyt Lakes WWTP, and Minnesota Power's Laskin Energy Center (a power plant) that have withdrawn or discharged water in the past, and/or are currently withdrawing or discharging water that affects flows in the Partridge River (see Figure 4.2.2-9). Table 4.2.2-10 summarizes the NPDES/SDS discharges to and surface water withdrawals from the Partridge River and its tributaries. Most of these outfalls do not discharge continuously, and many, although still "active" in terms of permit status, have not discharged for many years (i.e., various mine pit dewatering discharges).



MPCA Water Quality Stations or NPDES Discharge Points
Diversion Works
Embarrass River Watershed
Partridge River Watershed
Stream/River
Mine Site
Plant Site
Transportation and Utility Corridor
Existing Road

US Army Corps of Engineers
St. Paul District

This document is a working document. This document may change over time as a result of new information, further deliberation, or other factors not yet known to the Co-lead Agencies.

N S E W

0 0.5 1 2 3 Miles

Figure 4.2.2-9
Past and Current NPDES Discharges into the Partridge and Embarrass Rivers
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

856

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Table 4.2.2-10 Discharges to and Surface Water Withdrawals from the Partridge River Watershed

NPDES Permit Number	Discharge ID	Outfall Description	Receiving Waters	Authorized Flow (cfs)	
				Avg.	Max.
MN0069078 Mesabi Mining LLC1	MN0069078-SD-001	Pit 2WX, Composite SD-018 to SD-021	Colby Lake	NA	NA
	MN0069078-SD-004	Pit 1 dewatering pipe	Unnamed creek tributary to Wynne Lake	8.4	18.3
	MN0069078-SD-005	Pit 9 dewatering pipe	First Creek	7.8	11.1
	MN0069078-SD-006	Pit 6 dewatering pipe	Second Creek	15.5	22.3
	MN0069078-SD-007	Pit 9S dewatering pipe	First Creek	16.7	22.3
	MN0069078-SD-014	Pit 2WX dewatering pipe	Second Creek (via wetlands)	7.8	11.2
	MN0069078-SD-015	Pit 2WX dewatering pipe	Second Creek (via wetlands)	7.8	11.2
	MN0069078-SD-016	Pit 2WX dewatering pipe	Second Creek (via wetlands)	7.8	11.2
	MN0069078-SD-017	Pit 2WX dewatering pipe	Second Creek (via wetlands)	7.8	11.2
	MN0069078-SD-018	Pit 2WX dewatering pipe	Tributary to Colby Lake	7.8	11.2
	MN0069078-SD-019	Pit 2WX dewatering pipe	Tributary to Colby Lake	7.8	11.2
	MN0069078-SD-020	Pit 2WX dewatering pipe	Tributary to Colby Lake	7.8	11.2
	MN0069078-SD-021	Pit 2WX dewatering pipe	Tributary to Colby Lake	7.8	11.2
	MN0069078-SD-022	Pit 9 dewatering pipe	Unnamed creek tributary to Wynne Lake	7.8	11.2
	MN0069078-SD-023	Pit 9S dewatering pipe	First Creek	16.7	22.3
	MN0069078-SD-024	Pit 6 dewatering pipe	First Creek	--	11.2
MN0042536 Cliffs Erie LLC[2]	MN0042536-SD-008	Pit 2W dewatering pipe	Second Creek	7.8	11.2
	MN0042536-SD-009	Pit 2W dewatering pipe	Second Creek	7.8	22.3
	MN0042536-SD-010	Pits 2/2E/3 dewatering pipe	Wetland to Wyman Creek	7.8	11.2
	MN0042536-SD-011	Pits 2/2E/3 dewatering pipe	Wetland to Wyman Creek	7.8	11.2
	MN0042536-SD-012	Pit 3 overflow channel	Wyman Creek	7.8	11.2
	MN0042536-SD-013	Pit 2W dewatering pipe	Tributary to Colby Lake	11.1	22.3
	MN0042536-SD-026	Cell 1E seepage/stormwater	Second Creek	0.6	1.4
	MN0042536-SD-030	Pit 5S overflow	Wyman Creek	--	--
		Stormwater from Area/Shops	Second Creek	--	--
		Stormwater from Plant Area	Second Creek	--	--

NPDES Permit Number	Discharge ID	Outfall Description	Receiving Waters	Authorized Flow (cfs) Avg.	Max.
MN0067687 Mesabi Nugget Delaware	MN0067687-SD-001	Pit 1 overflow	Second Creek	2.3	9.0
MN0046981 Northshore Mining Co. Northshore Mine	MN0046981-SD-006	185S pit dewatering	Partridge River headwaters	Inactive	50.8
	MN0046981-SD-007	223S pit dewatering	Partridge River headwaters	Inactive	50.8
	MN0046981-SD-008	258S pit dewatering	Partridge River headwaters	Inactive	50.8
	MN0046981-SD-009	280/292S pit dewatering	Partridge River headwaters	11.5	50.8
	MN0046981-SD-010	360S pit dewatering	Partridge River headwaters	0.3	50.8
	MN0046981-SD-011	380S pit dewatering	Partridge River headwaters	Inactive	50.8
	MN0046981-SD-012	430S pit dewatering	Partridge River headwaters	Inactive	50.8
	MN0046981-SD-013	Crusher 2 sanitary outfall	Partridge River headwaters	Inactive	0.07
	MN0046981-SD-016	Crusher 2 area discharge	Partridge River headwaters	0.01	0.14
MN0020206 Hoyt Lakes WWTP	MN0020206-SD-002	Main Facility Discharge	Whitewater Reservoir	0.39	1.1
MN0000990 MN Power Laskin Energy Center	MN0020206-SD-001	Main Discharge	Colby Lake	194	212
	MN0020206-SD-002	Ash Pond Discharge	Colby Lake	0.6	2.2
Water Appropriation Permittee	**Permit Number**	**Intake Description**	**Water Source**	**Flow (cfs) Avg.**	**Max.**
MN Power/Cliffs Erie LLC	1949-0135	Mining process water	Colby Lake	--	26.7[3]
MN Power (Laskin)	1950-0172	Cooling Water	Colby Lake	--	224[4]
Hoyt Lakes	1954-0036	Municipal Water Supply	Colby Lake	0.5	2.3[5]

Sources: MPCA 2014; MDNR 2013e.

Notes:
Most of these outfalls do not discharge continuously, and many, although still "active" in terms of permit status, have not discharged for many years (i.e., various mine pit dewatering discharges). The actual total discharge to the river is far less than the sum of the average flows.

[1] Permit remains active for closure purposes only; no active dewatering occurring. Pit 6 (SD006) filled with water and has groundwater outflow to Second Creek.
[2] Permit remains active for closure purposes only; no active dewatering occurring. Pit 3 (SD012) filled with water and has passive outflow to Wyman Creek averaging 1.1 cfs. Pit 5S (SD030) filled with water and has unmeasured passive outflow to Wyman Creek. Pit 2W filled with water and has outflow to Second Creek averaging approximately 8 cfs.
[3] Historically used for pellet plant makeup water; no present active pumping. Represents instantaneous peak withdrawal, permit also includes a maximum average withdrawal rate of 26.7 cfs for any continuous 60-day period or up to 33.4 cfs with prior written commissioner's approval
[4] Includes a maximum 4.2 cfs consumptive use for evaporative losses.
[5] Represents instantaneous peak withdrawal, permit also includes an annual maximum withdrawal rate of 2.3 cfs.

Although mine discharges have occurred at least periodically in the NorthMet Project area since 1956 when the Northshore Mine began operations, there are few readily available mine pumping records prior to 1988 when the state began requiring water appropriation permit holders to report this information. Pumping records for the Northshore Mine from 1976 to approximately 1986 are available and show an annual average discharge of between 6.8 and 15.1 cfs. Since 1988, the highest reported average monthly discharge from the Northshore Mine to the Partridge River was 34 cfs (Barr 2008f). However, monthly averages obscure the nature of the Northshore Mine discharges to the Partridge River, which are sporadic. They can have a considerable impact on the flow regime of the Upper Partridge River, particularly in the winter during low-flow conditions.

In addition, former LTVSMC Pits 3 and 5S are currently overflowing into Wyman Creek (MPCA 2014d), which flows south into the Partridge River (RS74A Barr 2008a). Average monthly outflow from Pit 3 (SD012), as reported to the MPCA for permit compliance during 2009 through 2011, was about 0.7 cfs. Average winter outflow was 0.1 cfs. There are no discharge records for outflow from Pit 5S (SD-030) because the outflow is dispersed through a wide area of broken rock. The number and volume of these combined discharges, when compared to average and especially low flow in the Partridge River, indicate that the Northshore Mine and former LTVSMC pit discharges have the potential to significantly affect flows. Lack of historical information regarding actual dates of discharge complicates interpreting the flow record.

Upper Partridge River Water Quality

Recent water quality data (collected by PolyMet in 2004, 2006, 2007, 2008, 2010, 2011, 2012, and 2013) and historic water quality data (back to 1956) are available for various constituents in various locations along the Partridge River, which are summarized in Table 4.2.2-11. Most of these water quality data represent grab samples and the frequency of sampling does not allow a detailed assessment of water quality trends, seasonal effects, or relationship to flow. Nevertheless, collectively, the data can be used to generally characterize water quality in the watershed and draw some comparisons with surface water quality standards.

Table 4.2.2-11 Surface Water Quality Data in the Partridge River Watershed (see Figure 4.2.2-1)

Sample Location	Sampling Period
SW-001	2004, 2006, 2008
SW-002	1974–1976, 1978, 2001-2002, 2004, 2006, 2012–2013
SW-003	1974-1978, 2001-2004, 2006–2008, 2010, 2012–2013
SW-004	2004, 2006–2008, 2010–2013
SW-004a	2010, 2012–2013
SW-004b	2010, 2012–2013
SW-005	1976–1977, 2004, 2006–2008, 2010–2013
Colby Lake	1976–1977, 1988, 2001–2003, 2008, 2010
Whitewater Reservoir	1972, 1985, 2001, 2010

Sample Location	Sampling Period
USGS gage #04016000/CN122	1956–1966, 1976–1977, 1979
USGS gage #04015475	1979
Tributaries	
West Pit Outlet Creek, WP-1	2011–2013
S. Branch, USGS gage #04015455	1973–1976
Colvin Creek, CN124	1973–1976
Wetlegs Creek, WL-1	2011–2013
Longnose Creek, LN-1	2011–2013
Wyman Creek, PM-5 / PM-6	2004 (PM-5, PM-6), 2011–2013 (PM-5), 2013 (PM-6)
Second Creek, PM-7, PM-17, PM-18	2004, 2006–2007

Sources: Barr 2007h; Barr 2008f; Barr 2007i; Siegel and Ericson 1980; Barr 2009c; Barr 2014d.

In general, ambient water quality is similar across the watershed, although a few parameters (e.g., aluminum and copper) appear to reflect a slightly increasing trend downstream (see Table 4.2.2-12). Comparing 1970s data from the Regional Copper-Nickel Study with recent (post-2000) PolyMet data collected at three monitoring stations common to both data sets (SW-002, SW-003, and SW-005) shows that some parameters appear to have decreased in concentration (e.g., sulfate at SW-003 and SW-005), but the water sampled at these stations in the 2000s is generally similar to the quality measured in the 1970s. Although a few individual samples exceeded surface water quality evaluation criteria, overall instream water quality meets state water quality standards. The only consistent exceedance of water quality standards was dissolved oxygen near the headwaters of the Partridge River (SW-002, Figure 4.2.2-3). Sufficient information is not available to interpret this exceedance, but the dissolved oxygen exceedances are localized and are not found at other upstream or downstream locations. The Upper Partridge River is not listed as an impaired waterbody on the 303(d) list. At SW-005, mean sulfate concentrations exceed the 10 mg/L wild rice standard that is applicable in this location.

There are limited water quality data available from the mainstem of the Partridge River that predate the operation of the Northshore Mine beginning in 1956 that can be used to characterize relatively “undisturbed” conditions. There are six samples that were collected during the Regional Copper-Nickel Study in 1976 and 1979 along the South Branch of the Partridge River at USGS Gaging Station #04015455 (see Figure 4.2.2-1). These samples were unaffected by mining and most potential significant sources of contamination, thus they can provide some insights on “undisturbed condition” water quality in the Partridge River for several key parameters (see Table 4.2.2-13). As these few samples indicate, water quality generally met evaluation criteria for the parameters monitored, except aluminum. In addition, mercury cannot be assessed due to the high detection limit (500 ng/L) used in the 1970s samples.

Table 4.2.2-12 Comparison of Historic and Recent Mean Water Quality Data for Selected Parameters at Common Monitoring Stations along the Partridge River

							SW-002		**SW-003**		**SW-005**	
			Detection		**Range**		**Mean**					
General Parameters	**Units**	**Evaluation Criteria(10)**	**1970s**	**2000s(9)**	**1970s**	**2000s(9)**	**1970s**	**2000s(9)**	**1970s**	**2000s(9)**	**1970s**	**2000s(9)**
Dissolved Oxygen	mg/L	>5.0	41 of 41	97 of 98	3.3–11.6	<0.05–13.9	6.7	7.6	9.1	9.4	8.0	7.9
Hardness	mg/L	500	94 of 94	122 of 122	16–204	16.9–228	115	141	117	98.5	85	71.2
pH	s.u.	6.5-8.5	186 of 186	119 of 119	6.2–8.7	6.0–8.5	7.0	7.1	7.3	7.4	7.2	7.4
Sulfate	mg/L	--(7)	93 of 93	117 of 122	3.0–76	<0.5–83.1	20.1	30.8	18.9	15.1	**18.9**	**10.1**
Metals – Total												
Aluminum	µg/L	125	27 of 30	86 of 101	0.50–205	<10–1,550	43.6	31.3	76	51.8	123	**129(5)**
Arsenic	µg/L	53	15 of 30	39 of 74	0.50–5.0	<0.25–3.0	3.8	0.48	3.2	0.90	0.8	1.0
Cobalt	µg/L	5	3 of 55	40 of 112	0.50–2.0	<0.1–<12.5	0.6	0.30	0.5	0.33	0.6(1)	1.2
Copper	µg/L	9.3(2)	67 of 68	94 of 118	0.25–8.0	<0.25–3.0	1.3	0.76	1.3	1.0	2.4	1.6
Iron	µg/L	--	78 of 78	80 of 80	400–7,200	1.3–30,700	1,085	3,125(3)	1,365	1,570(4)	1,528	2,264(6)
Lead	µg/L	3.2(2)	44 of 68	21 of 92	0.10–10.0	<0.15–12.3	0.6	0.29	0.8	0.27	0.7	0.41(8)
Manganese	µg/L	--	69 of 70	86 of 86	0.03–1,400	15.5–1,100	112	254	153	135	160	138
Nickel	µg/L	52(2)	19 of 64	73 of 118	0.50–9.0	<0.25–4.9	1.4	0.71	1.5	1.1	1.0(1)	1.7
Zinc	µg/L	120(2)	34 of 66	26 of 118	0.50–18.0	<0–82.9	5.6	5.5	4.4	8.7	2.0	10.5

Sources: Barr 2007h for 1970s data; Barr 2014d for 2000s data.

Notes:
1 Based on fewer than five samples.
2 Water quality standard for this metal is hardness-dependent. Listed value assumes a hardness concentration of 100 mg/L.
3 Excludes single outlier value of 1.27 µg/L from values included in Barr 2014d.
4 Excludes single outlier value of 1.45 µg/L from values included in Barr 2014d.
5 Excludes single outlier value of 1,550 µg/L from values included in Barr 2014d.
6 Excludes single outlier value of 2.03 µg/L from values included in Barr 2014d.
7 Sulfate standard of 10 mg/L applies to designated "waters supporting the production of wild rice" (SW-005)
8 Excludes single outlier value of 12.3 µg/L from values included in Barr 2014d.
9 For non-detects, means were calculated at half the detection limit.
10 Section 5.2.2 includes a detailed discussion of evaluation criteria.

Table 4.2.2-13 Baseline Water Quality from the South Branch of the Partridge River[1]

Constituent	Units	Surface Water Standard	# of Samples	S. Branch Partridge R. Mean Concentration	S. Branch Partridge R. Range of Concentrations
General Parameters					
Chloride	mg/L	--	5	1.4	<0.1–3.2
Fluoride	mg/L	--	5	0.2	0.1–0.3
Hardness	mg/L	500	1	37	37
pH	s.u.	6.5–9.0	5	7.0	6.8–7.3
Sulfate	mg/L	--	5	5.2	1.4–8.9
Metals					
Aluminum	µg/L	125	2	150	100–200
Arsenic	µg/L	53	2	<1.0	<1.0
Iron	µg/L	--	5	856	320–1,400
Manganese	µg/L	--	2	40	30–50
Mercury	ng/L	1.3	2	<500	<500

Source: MPCA 2013a.

Note:
[1] Based on water quality monitoring data from 1976 and 1979.

PolyMet averaged available ambient water quality data from 2004 to 2013 to document existing conditions against which to evaluate impacts from the NorthMet Project Proposed Action at several locations, as shown in Figure 4.2.2-7, along the Partridge River (see Table 4.2.2-14). Average existing water quality concentrations were below evaluation criteria for most parameters listed in Table 4.2.2-14. At SW-005, where the standard applies, the wild rice sulfate standard is exceeded. The aluminum evaluation criterion is exceeded at SW-004, SW-004b, and SW-005; the thallium evaluation criterion is exceeded at SW-001; and the mercury evaluation criterion is exceeded at all sites.

Table 4.2.2-14 Average Existing Water Quality Concentrations in the Partridge River

Parameter	Units	Evaluation Criteria[7]			SW-001	SW-002	SW-003	SW-004	SW-004a	SW-004b	SW-005
			Detection	Range				Mean			
General											
Alkalinity	mg/L		143 of 144	<0–853	94.6	101	83.2	97.3	76.6	59.8	56.5
Calcium	mg/L	--	230 of 230	3.9–45.9	24.6	29.8	22.9	21.1	21.8	16.9	15.3
Chloride	mg/L	230	224 of 224	0.7–55.2	1.6	25.7	10.3	9.2	9.3	5.7	5.7
Fluoride	mg/L	--	59 of 97	<0.05–<2.5	0.14	0.11	0.09	0.10	0.11	0.10	0.30
Hardness	mg/L	500	230 of 230	16.9–228	97.0	141	98.5	92.1	97.8	78.9	71.2
Magnesium	mg/L	--	230 of 230	2.7–29.1	10.4	16.7	10.3	9.7	10.6	8.9	8.1
pH	s.u.	6.5–8.5	218 of 218	5.6–8.73	8.3	7.1	7.4	7.4	7.2	7.2	7.4
Potassium	mg/L	--	84 of 85	<1.25–5.2	2.7	3.0	2.4	2.2	2.5	1.7	1.4
Sodium	mg/L	--	95 of 95	1.2–40.4	4.8	14.5	6.5	6.7	10.2	6.7	4.4
Sulfate	mg/L	10[1]	223 of 230	<0.5–83.1	21.8	30.8	15.1	13.9	15.9	11.3	**10.1**
TDS	mg/L	700	222 of 222	56–395	119	235	161	155	171	153	143
Metals											
Aluminum	µg/L	125	170 of 196	<5–4600	18.0	31.3	51.8	**193**	119	**127**	**129[4]**
Antimony	µg/L	31	0 of 104	<0.25–<1.5	1.5	0.53	0.53	0.53	0.25	0.25	0.53
Arsenic	µg/L	53	96 of 154	<0.25–11.7	6.5	0.48	0.90	1.1	0.95	0.96	1.0
Barium	µg/L	--	44 of 70	<5–36	5.0	17.3	11.3	9.6	12.0	8.9	8.7
Beryllium	µg/L	--	0 of 70	<0.1–<0.1	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Boron	µg/L	500	79 of 95	<17.5–435	96.0	148	94.8	93.0	116	75.9	51.4
Cadmium	µg/L	2.5[2]	6 of 80	<0.01–<0.1	0.10	0.10	0.10	0.09	0.08	0.07	0.09
Cobalt	µg/L	5.0	94 of 212	<0.1–<12.5	0.45	0.30	0.33	0.57	0.42	0.43	1.16
Copper	µg/L	9.3[2]	186 of 222	<0.25–9.1	1.6	0.8	1.0	1.5	1.5	1.5	1.6
Iron	µg/L	--	161 of 163	<15–30700	30.0[5]	3,125[7]	1,570[8]	2,653[9]	2,031	2,402	2,264[10]
Lead	µg/L	3.2[2]	38 of 183	<0.015–12.3	0.30	0.29	0.27	0.32	0.22	0.26	0.41[11]
Manganese	µg/L	--	171 of 173	<5–6480	7.9	254	135	339	170	148	138

Parameter	Units	Evaluation Criteria(7)	Detection	Range	SW-001	SW-002	SW-003	SW-004	SW-004a	SW-004b	SW-005
			Detection	Range				Mean			
Mercury	ng/L	1.3	101 of 144	<0.25–18.5	**2.3**	**2.7**	**2.8**	**3.3**	**4.1**	**5.4**	**4.3**
Methylmercury	ng/L	--	39 of 42	<0.028–560	0.05	--	0.27	0.39	0.6(3)	0.51	0.41
Nickel	µg/L	52(2)	152 of 42	<0.000028–0.56	1.4	0.71	1.1	1.5	1.2	1.6	1.7
Selenium	µg/L	5.0	13 of 173	<0.1–<5	1.7	0.90	0.90	0.73	0.44	0.64	0.77
Silver	µg/L	1.0(2)	0 of 95	<0.1–<0.5	0.29	0.21	0.21	0.20	0.10	0.10	0.20
Thallium	µg/L	0.56	75 of 179	<0.0002–<1	**0.60**	0.19	0.19	0.16	0.01	0.01	0.15
Vanadium	µg/L	--	0 of 36	<1.5–<1.5	--	1.5	1.5	1.5	1.5	1.5	1.5
Zinc	µg/L	120(2)	48 of 222	<0–82.9	8.9	5.5	8.7	10.3	4.6	4.2	10.5

Source: Barr 2014d.

Notes:

Values in bold indicates an exceedance of surface water quality standard, based on the average value of all samples. Means calculated using non-detects at half the detection limit.

1 MPCA has listed the Partridge River downstream from river mile approximately 22 just upstream of the railroad bridge near Allen Junction as Wild Rice water, so the 10 mg/L sulfate standard is only applicable to that portion of the Upper Partridge River (SW-005).

2 Water quality standard for this metal is hardness-dependent. Listed value assumes a hardness concentration of 100 mg/L.

3 Excludes single outlier value of 0.56 µg/L from values included in Barr 2014d.

4 Excludes single outlier value of 1,550 µg/L from values included in Barr 2014d.

5 Excludes single outlier value of 0.06 µg/L from values included in Barr 2014d.

6 Section 5.2.2 includes a detailed discussion of evaluation criteria.

7 Excludes single outlier value of 1.27 µg/L from values included in Barr 2014d.

8 Excludes single outlier value of 1.45 µg/L from values included in Barr 2014d.

9 Excludes single outlier value of 1.41 µg/L from values included in Barr 2014d.

10 Excludes single outlier value of 2.03 µg/L from values included in Barr 2014d.

11 Excludes single outlier value of 12.3 µg/L from values included in Barr 2014d.

Upper Partridge River Tributary Streams

The NorthMet Project Proposed Action could affect four small streams that are tributaries to the Partridge River, including the following (see Figure 4.2.2-1):

- Wetlegs Creek – which would be crossed by the Transportation and Utility Corridor that links the Mine Site with the Plant Site.
- Longnose Creek – which would also be crossed by the Transportation and Utility Corridor that links the Mine Site with the Plant Site.
- Wyman Creek – which would also be crossed by the Transportation and Utility Corridor that links the Mine Site with the Plant Site.
- West Pit Outlet Creek – which would receive discharge from the WWTF after closure.

No baseline flow data collection or hydrologic modeling was conducted for Wetlegs, Longnose, and Wyman creeks as the NorthMet Project Proposed Action is not expected to affect the hydrology of these streams. PolyMet used the calibrated XP-SWMM model to estimate selected flow volumes for West Pit Outlet Creek. The XP-SWMM model estimates an average annual flow of 1.2 cfs at the approximate location of the WWTF discharge under existing conditions.

In terms of surface water quality, Wetlegs Creek, Longnose Creek, and the West Pit Outlet Creek drain relatively undisturbed watersheds; whereas Wyman Creek drains an area previously mined by LTVSMC, including Area 3 and Area 5S Pits. Water quality data for various constituents from the two locations on Wyman Creek was collected in 2004, 2011, and 2012 at PM-5, and again in 2013 at both locations. Data collection from Wetlegs Creek, Longnose Creek, and the West Pit Outlet Creek was initiated in spring 2011, with monthly sampling through the end of 2013 (PolyMet 2015m). Water quality data for the four streams are summarized in Table 4.2.2-15. These constituents are generally within the range documented for the main branch of the Partridge River. Parameters with mean concentrations higher than recorded for the Partridge River include iron for Longnose Creek, Wetlegs Creek, and the West Pit Outlet Creek; copper and nickel for Wetlegs Creek and the West Pit Outlet Creek; and manganese and vanadium for all four streams. As with the Partridge River, background concentrations of mercury exceed the 1.3 ng/L standard. Collectively, these data can be used to characterize existing background water quality for these streams.

1003 **Table 4.2.2-15 Mean Water Quality Data for Longnose Creek, Wetlegs Creek, Wyman Creek, and West Pit Outlet Creek**

					Longnose Creek(1) LN-1	West Pit Outlet Creek(7) WP-1	Wetlegs Creek(2) WL-1		Wyman Creek(3) PM-5	Wyman Creek(3) PM-6
Parameter	**Units**	**Detection**	**Range**	**Evaluation Criteria(6) (Longnose, West Pit Outlet and Wetlegs)**		**Mean**		**Evaluation Criteria(6) (Wyman)**	**Mean**	
General										
Alkalinity	mg/L	61 of 64	<5–200	--	44.3	21.3	39.8	--	157	100
Calcium	mg/L	101 of 101	2.2–51.1	--	11.1	5.7	10.4	--	35.1	23.2
Chloride	mg/L	66 of 101	<0.25–9.9	230	0.63	0.56	1.0	100	1.7	1.0
Fluoride	mg/L	8 of 23	<0.05–0.19	--	0.050	0.050	0.050	(2.0)(5)	0.091	0.13
Hardness	mg/L	98 of 98	11.8–258	500	48.7	28.8	49.5	250	199	107
Magnesium	mg/L	101 of 101	1.5–36.1	--	4.8	3.3	5.5	--	27.7	14.6
pH	s.u.	99 of 99	5.0–8.3	6.5-8.5	6.8	**5.7**	6.7	6.5–8.5	7.3	7.6
Potassium	mg/L	65 of 67	<0.125–7.0	--	0.63	0.50	0.78	--	5.1	2.1
Sodium	mg/L	52 of 67	<1–17.5	--	1.6	1.3	1.3	--	13.6	6.2
Sulfate	mg/L	74 of 101	<0.5–96.2	--	0.91	2.6	3.9	(250)(5)	67.1	28.1
TDS	mg/L	101 of 101	60.0–352	700	119	152	127	500	270	199
Metals - Total										
Aluminum	µg/L	77 of 95	<10–1,310	125	64.6	**421**	**170**	87	51.8	**102**
Antimony	µg/L	2 of 75	<0.25–<1.5	31	0.25	0.25	0.24	6	0.43	1.5
Arsenic	µg/L	84 of 101	<0.25–6.0	53	1.2	1.9	1.2	2	1.4	0.94
Barium	µg/L	26 of 43	<5–30.6	--	10.4	10.3	10.5	2,000	10.9	10.6
Beryllium	µg/L	0 of 43	<0.1–<0.1	--	0.10	0.10	0.10	4.0	0.10	0.10
Boron	µg/L	12 of 43	<17.5–72.8	500	25.0	25.0	25.0	500	49.5	23.3
Cadmium	µg/L	3 of 43	<0.015–<0.1	2.5(4)	0.070	0.083	0.072	2.5	0.079	0.10
Cobalt	µg/L	60 of 95	<0.1–8.3	5	0.61	1.7	3.7	2.8	0.48	0.50

					Longnose Creek[1] LN-1	West Pit Outlet Creek[7] WP-1	Wetlegs Creek[2] WL-1		Wyman Creek[3] PM-5	Wyman Creek[3] PM-6
Parameter	**Units**	**Detection**	**Range**	**Evaluation Criteria[6] (Longnose, West Pit Outlet and Wetlegs)**		**Mean**		**Evaluation Criteria[6] (Wyman)**	**Mean**	
Copper	µg/L	67 of 95	<0.075–50.9	9.3[4]	0.45	3.6	5.5	9.3[4]	0.68	2.0
Iron	µg/L	101 of 101	237–35,000	--	4,019	7,050	6,372	(300)[5]	1,437	1,872
Lead	µg/L	21 of 81	<0.01–3.1	3.2[4]	0.24	1.0	0.37	3.2[4]	0.26	0.50
Manganese	µg/L	98 of 98	15.2–4,920	--	708	358	678	(50)[5]	1058	428
Mercury	ng/L	58 of 64	<0.25–28.1	1.3	**3.5**	**13.9**	**5.0**	1.3	1.2	**3.5**
Nickel	µg/L	50 of 95	<0.25–22.4	52[4]	0.62	6.9	5.3	52[4]	0.57	2.5
Selenium	µg/L	2 of 81	<0.1–<1	5.0	0.43	0.48	0.44	5.0	0.52	1.0
Silver	µg/L	0 of 43	<0.1–<0.5	1.0[4]	0.10	0.10	0.10	0.12	**0.20**	**0.50**
Thallium	µg/L	29 of 90	<0.0002–<1	0.56	0.0079	0.013	0.010	0.28	0.15	**1.0**
Vanadium	µg/L	1 of 33	<1.5–9.3	--	3.1	4.3	2.8	--	3.0	--
Zinc	µg/L	15 of 92	<3–134	120[4]	3.0	6.9	10.5	120[4]	3.6	5.0

Source: Barr 2014d.

Notes:
Values in bold indicate an exceedance of surface water quality standard.
1 Based on nine samples collected in 2011, seven samples collected in 2012, and eight samples collected in 2013; Source: Large Table 10, Barr 2014d.
2 Based on eight samples collected in 2011, seven samples collected in 2012, and eight samples collected in 2013; Source: Large Table 10, Barr 2014d.
3 Wyman Creek PM-5 based on four samples collected in 2004, eight samples collected in 2011, nine samples collected in 2012, and 12 samples collected in 2013; PM-6 based on four samples collected in 2004 and one sample collected in 2013.
4 Water quality standard for this metal is hardness-dependent. Listed value assumes a hardness concentration of 100 mg/L.
5 Values in parentheses indicate Secondary Maximum Contaminant Levels (sMCLs).
6 See Section 5.2.2 for a detailed discussion of the evaluation criteria. West Pit Outlet Stream averages based on four samples collected in 2011, four samples collected in 2012, and seven samples collected in 2013.

Colby Lake and Whitewater Reservoir

This section describes the baseline surface water hydrology and water quality of Colby Lake and Whitewater Reservoir.

Colby Lake and Whitewater Reservoir Hydrology

Colby Lake is located approximately 8 miles southwest from the Mine Site and about 4 miles south of the Plant Site on the Partridge River. It is located approximately 17 river miles downstream from SW-004a (PolyMet 2015m, Appendix C). It has a surface area of approximately 539 acres and a maximum depth of approximately 30 ft (see Figure 4.2.2-1). The outlet control of Colby Lake is at an elevation of approximately 1,439 ft amsl. The outflow from the lake stops when water levels drop below this level.

Around 1955, in order to ensure a reliable source of water, Erie Mining Company (precursor to LTVSMC) constructed Whitewater Reservoir and the Diversion Works, which connects Colby Lake and Whitewater Reservoir. This diversion works separates the two waterbodies and allows water to be exchanged between the two. Formerly known as Partridge Lake, this impoundment increased the surface area and depth of the original lake and subjected it to greater annual water level fluctuations. Whitewater Reservoir has a surface area of approximately 1,210 acres and a maximum depth of approximately 73 ft. Water losses due to seepage through the northwest and south dikes can be 15 cfs or more and drain to the Partridge River downstream of Colby Lake (MDNR 2004). The City of Hoyt Lakes WWTP discharges an annual average of 0.39 cfs of treated wastewater effluent into Whitewater Reservoir (see Table 4.2.2-10 and Figure 4.2.2-10).

The Diversion Works contain three 8-ft gates that can be opened to allow the release of water from Colby Lake to Whitewater Reservoir during high flows in the Partridge River. The Diversion Works also contain three high-volume pumps to move water from Whitewater Reservoir back to Colby Lake during low water levels. During operation of the former LTVSMC processing plant, water would typically flow through the Diversion Works gates from Colby Lake to Whitewater Reservoir during the spring runoff and then be pumped back into Colby Lake when needed. Historically, this system was not used as much as expected. When water levels in Colby Lake fall below 1,439.0 ft amsl due to low inflows, the MDNR water appropriation permit (1949-0135) limits withdrawals of water from Colby Lake to the rate that water can be pumped from Whitewater Reservoir to replace the water withdrawn.

After closure of the LTVSMC mine and processing plant in 2001, Minnesota Power purchased the Diversion Works and most of LTVSMC's riparian land around Whitewater Reservoir. This land currently is leased as lake-front property. The water appropriation permit is currently jointly held by Minnesota Power and Cliffs Erie. An agreement has been reached whereby PolyMet would replace Cliffs Erie as the co-permittee. This would enable PolyMet to withdraw water from Colby Lake for use as process makeup water, subject to MDNR approval at the time of permitting.

In the 5-year period after LTVSMC stopped its water withdrawals (January 2001 to December 2006) under relatively natural flows (i.e., discharges from the Northshore Mine were only occurring sporadically; see Table 4-5 in Section 4.4.1.2.1 of the Mine Site Water Modeling Data Package (PolyMet 2015m)), water levels in Colby Lake were higher with less fluctuation than when LTVSMC was withdrawing water for its mining operations (see Table 4.2.2-16). Over the same period, Whitewater Reservoir also experienced smaller fluctuations and higher average water levels (see Table 4.2.2-17).

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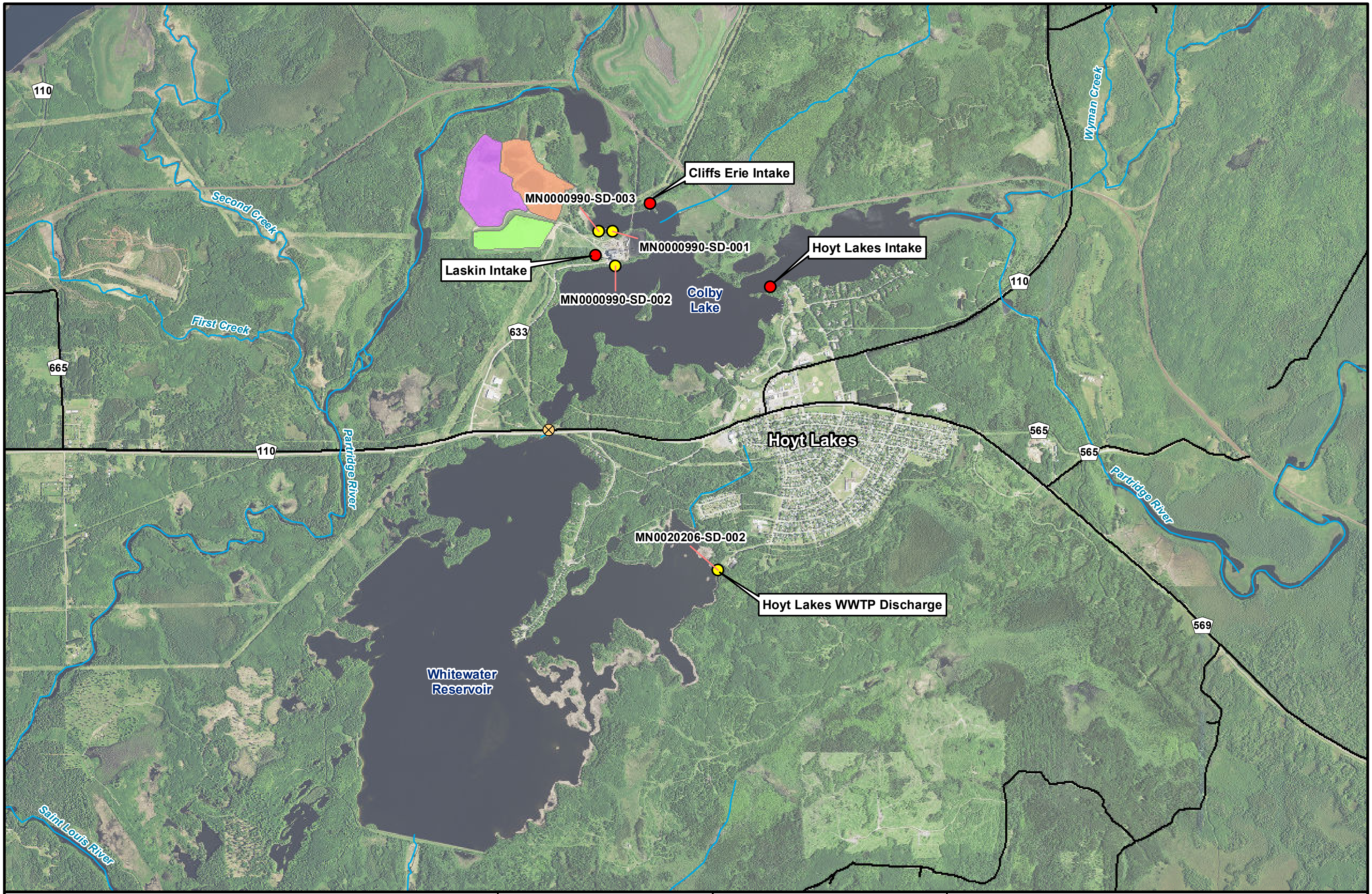

Water Withdrawals from Colby Lake
MPCA Water Quality Station 2006/Discharges to Surface Waters NPDES Discharges
Stream/River
Existing Road
Diversion Works
Ash Pond Cell E
Ash Pond Cells A and B
Ash Pond Cells C and D

US Army Corps of Engineers St. Paul District

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Figure 4.2.2-10
NPDES Discharges - Colby Lake and Whitewater Reservoir Area
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

1062 -Page Intentionally Left Blank-

Table 4.2.2-16 Comparison of Colby Lake Elevations over Time

Time Period	Represent	Source	Max Annual Fluctuation[1]	% Time below elevation 1,439.0
1937–1954	Pre-mining	Actual measurements	4.6 ft	5.0
1955–1992	During mining[2] (with LTVSMC withdrawals)	Actual measurements	4.1 ft	24.1
1978–1988	During mining[2] (with LTVSMC withdrawals)	Actual predictions	2.7 ft	17
2001–2006	During mining[2] (without LTVSMC withdrawals)	Actual measurements	3.7 ft	7.5
2007–2013	During mining[2] (without LTVSMC withdrawals)	Actual measurements	3.6 ft	0

Source: MDNR 2015c.

Notes:
[1] Maximum annual fluctuation is the maximum difference between annual maximum and minimum water elevations for any single year during the indicated time period.
[2] Includes effects of Northshore Mining operations from 1955 to present.
[3] Data for 2013 are incomplete.

Table 4.2.2-17 Comparison of Whitewater Reservoir Elevations over Time

Time Period	Represent	Source	Max Annual Fluctuation[1]	Average Water Elevation
1937–1954[(3)]	Pre-mining	Actual measurements	2.0 ft	Not Applicable
1955–1980	During mining[2] (with LTVSMC withdrawals)	Actual measurements	14.3 ft	1,437.7 ft
2002–2008	During mining (without LTVSMC withdrawals)	Actual measurements	4.5 ft	1,438.0 ft
2009–2013[4]	During mining (without LTVSMC withdrawals)	Actual measurements	4.2 ft	1,438.1 ft

Source: Actual measurements taken from MDNR 2015d No data was available between 1980 and 2001.

Notes:
[1] Maximum annual fluctuation is the maximum difference between annual maximum and minimum water elevations for any single year during the indicated time period.
[2] Includes effects of Northshore Mining operations from 1955 to present.
[3] Pre-1955 data is for Partridge Lake. Construction of Whitewater Reservoir, which raised the elevation of Partridge Lake, was not completed until 1955.
[4] Data for 2013 are incomplete.

Colby Lake is currently used as a potable water source for the City of Hoyt Lakes, which is permitted to withdraw a maximum annual average of 0.5 cfs with an instantaneous peak rate of 2.3 cfs. Colby Lake is also used as a cooling water source for Minnesota Power's Laskin Energy Center coal-fired power plant. The power plant discharges the once-through, non-contact cooling water (MN0000990 SD-001) to the downstream portion of the lake, but there is up to a 4.2 cfs evaporative loss of water from the cooling tower (see Table 4.2.2-10).

Colby Lake Water Quality

Water quality in Colby Lake is affected by inflow from the Upper Partridge River Watershed, (including Northshore Mine discharges), inflow from other tributaries draining directly to Colby Lake such as Wyman Creek (including Pits 3 and 5S overflow via Wyman Creek, as well as two permitted discharges from Minnesota Power's Laskin Energy Center (i.e., cooling water discharge and a clarified ash pond discharge), pumping from Whitewater Reservoir during low flows, and stormwater runoff from the City of Hoyt Lakes.

Water quality data are available for Colby Lake from various sources from 1976 to 2013 (PolyMet 2015m). The most recent monitoring data (November 2008, April through September 2010, and June through December 2013) showed elevated concentrations of aluminum, iron, mercury, and manganese (see Table 4.2.2-18). Two exceedances of arsenic and a single exceedance of thallium were observed, although average concentrations of both parameters met surface water quality standards. Colby Lake is on the Minnesota 303(d) TMDL List because of mercury concentrations in fish tissue, but is not included in Minnesota's regional mercury TMDL because the mercury concentrations in the fish are considered too high to be returned to Minnesota's mercury water quality standard using solely the state-wide TMDL approach. Similar to other lakes in Minnesota, the main source of mercury is atmospheric deposition. A TMDL study of Colby Lake is needed to determine what additional actions are required to reduce the mercury concentration in fish, but has not yet been performed.

Sulfate concentrations in Colby Lake from the most recent monitoring data (from 2008, 2010, and 2013) range from 6.6 to 60.7 mg/L with a mean of 27.2 mg/L. This is higher than the concentrations in the Partridge River at SW-005 (mean sulfate concentration of 10.1 mg/L for data from the early-2000s, see Table 4.2.2-12). In addition to what is provided by inflow from the Partridge River, it is interpreted that there are significant other sources of sulfate loading to Colby Lake.

Table 4.2.2-18 Summary of Colby Lake Water Quality Data

			C-N Study (1976–1977)		MPCA Data (1976–2007)			Minnesota Power Data (2002–2003)			Barr Data (2008, 2010, 2013)			
Parameter	**Units**	**Surface Water Evaluation Criteria**	**# Samples**	**Range**	**# Samples**	**Mean**	**Range**	**Detection**	**Mean**	**Range**	**Detection**	**Mean**	**Range**	**# Exceed**
General														
Calcium	mg/L	--	4	11to 21	14	57.1	21–104	--	--	--	31 of 31	18.4	9.0–29.1	NA
Chloride	mg/L	230	5	6.3–9.4	17	6.1	1.8–9.3	--	--	--	19 of 19	3.6	2.0–5.3	0
Fluoride	mg/L	(2.0)[2]	5	0.1–0.7	10	0.3	0.1–0.4	--	--	--	3 of 5	0.09	<0.05–0.14	0
Hardness	mg/L	500	5	41–83	14	91.2	40–150	--	--	--	31 of 31	81.4	44.4–119	0
Magnesium	mg/L	--	5	3.2–7.3	14	34.1	19–51	12 of 12	11.0	4.4–17.5	31 of 31	8.6	5.3–11.4	NA
pH	s.u.	6.5-8.5	17	6.5–7.8	109	7.1	6.3–8.8	--	--	--	26 of 26	7.6	7.0–8.2	0
Potassium	mg/L	--	4	1.3–1.5	10	1.7	1.4–2.2	--	--	--	9 of 9	1.1	0.84–1.5	NA
Sodium	mg/L	--	4	3.6–4.3	10	6.3	4.7–8.0	--	--	--	9 of 9	4.2	2.9–6.7	NA
Sulfate	mg/L	(250)[2]	15	8.7–140	14	52.9	8.7–140	--	--	--	31 of 31	27.2	6.6–60.7	0
Metals														
Aluminum	µg/L	125	5	180–470	10	307	180–610	12 of 12	171	61–264	31 of 31	113	42.8–243	**9**
Antimony	µg/L	5.5	--	--	--	--	--	0 of 3	3	<3	0 of 9	0.25	<0.25	0
Arsenic	µg/L	2.0	3	0.4–2.1	4	1.4	<0.5–2.1	1 of 3	1.4	<2.0–2.3	26 of 31	0.99	<0.25–2.1	**2**
Barium	µg/L	2,000	--	--	--	--	--	2 of 3	15.7	<10.0–29.1	7 of 9	7.5	<5–11.3	0
Beryllium	µg/L	4	--	--	--	--	--	0 of 3	0.2	<0.2	0 of 9	0.10	<0.1	0
Boron	µg/L	500	--	--	--	--	--	3 of 3	79	54–100	6 of 9	52.1	<25–96.3	0
Cadmium[1]	µg/L	2.5	10	0.02–0.2	15	0.05	0.02–0.20	0 of 3	0.2	<0.2	0 of 9	0.10	<0.1	0
Cobalt	µg/L	2.8	9	<0.3–0.5	6	0.4	<0.3–1.4	2 of 12	0.7	<1.0–1.9	14 of 19	0.31	<0.1–0.67	0
Copper[1]	µg/L	8.0	12	1.6–7.3	15	4.9	1.6–8.0	8 of 12	8.3	<5.0–14.5	19 of 19	3.7	1.6–6	0
Iron	µg/L	(300)[2]	15	190–2,300	15	836	190–2,500	3 of 3	2,103	650–3,030	31 of 31	1,596	451–4,900	**31**
Lead[1]	µg/L	3.2	12	0.2–1.7	14	0.5	0.2–0.9	0 of 3	1.0	<1.0	7 of 19	0.51	<0.25–<1	0
Manganese	µg/L	(50)[2]	5	50–90	14	282	63–	3 of 3	123	30–280	31 of 31	106	25.2–390	**23**

			C-N Study (1976–1977)		MPCA Data (1976–2007)			Minnesota Power Data (2002–2003)			Barr Data (2008, 2010, 2013)			
Parameter	**Units**	**Surface Water Evaluation Criteria**	**# Samples**	**Range**	**# Samples**	**Mean**	**Range**	**Detection**	**Mean**	**Range**	**Detection**	**Mean**	**Range**	**# Exceed**
							2,100							
Mercury	ng/L	1.3	10	80–400	9	190	<1000–360	--	--	--	9 of 9	6.0	4.6–8.7	**9**
Nickel[1]	µg/L	52	10	0.1–6.0	13	2.7	<1–9.0	1 of 3	3.4	<5.0–5.3	18 of 19	2.2	<1–3.1	0
Selenium	µg/L	5.0	--	--	2	<0.8	<0.8	0 of 12	2.0	<2.0	0 of 19	0.66	<0.5–<2	0
Silver[1]	µg/L	1.0	--	--	--	--	--	0 of 2	1.0	<1.0	0 of 9	0.10	<0.1	0
Thallium	µg/L	0.28	--	--	--	--	--	0 of 3	2.0	<2.0	24 of 31	0.06	<0.0025–0.46	**1**
Vanadium	µg/L	--	--	--	--	--	--	--	--	--	0 of 9	0.94	<0.5–<1.5	NA
Zinc[1]	µg/L	120	12	1–35.3	15	6.9	1.0–50	2 of 3	17.5	<10.0–36.1	2 of 19	4.8	<3–15.8	0

Sources: Barr 2009c; Barr 2014d; Siegel and Ericson 1980.

Notes:
[1] Water quality standard for this metal is hardness-dependent. Listed value assumes a hardness concentration of 100 mg/L, which approximates the hardness concentration in Colby Lake.
[2] Values in parentheses indicate sMCLs.

Whitewater Reservoir Water Quality

As a result of the Minnesota Statewide Mercury TMDL study, which was approved by the USEPA on April 3, 2008, Whitewater Reservoir was placed on the 2012 inventory of all impaired waters because of mercury concentrations in fish tissue. However, the mercury fish tissue levels are low enough that compliance with applicable standards would be achieved under the statewide TMDL. Therefore, it is not included on the final 2012 TMDL List, and does not need its own TMDL.

The City of Hoyt Lakes WWTP discharges an annual average of 0.39 cfs of treated secondary effluent into Whitewater Reservoir (Barr 2008f; Figure 4.2.2-10). The WWTP discharge most likely affects the water quality of Whitewater Reservoir by the addition of nutrients such as phosphorus and nitrogen.

Limited water quality data are available for Whitewater Reservoir (see Table 4.2.2-19). Based on the most recent data collected by PolyMet in 2010, Whitewater Reservoir has significantly lower concentrations of aluminum, iron, and manganese than Colby Lake. It appears that all constituents meet applicable water quality standards, but sampling for a full suite of metals has not been done.

Table 4.2.2-19 Summary of Whitewater Reservoir 2010 Water Quality Data

Parameter	Units	Surface Water Evaluation Criteria[1]	PolyMet Data 2010			
			Detection	**Mean**	**Range**	**# Exceed**
General						
Calcium	mg/L	--	12 of 12	20.8	20.1–21.2	--
Hardness	mg/L	500	12 of 12	90.2	85.7–92.8	0
Magnesium	mg/L	--	12 of 12	9.3	8.6–9.7	--
pH	s.u.	6.5-8.5	12 of 12	7.74	7.29–7.81	0
Sulfate	mg/L	(250)	12 of 12	34.3	32.9–35.3	0
Metals						
Aluminum	µg/L	50–200	2 of 12	<25	<25–25.4	0
Arsenic	µg/L	2.0	7 of 12	<0.5	<0.5–0.62	0
Iron	µg/L	(300)	5 of 12	<60	<50–76.5	0
Manganese	µg/L	(50)	12 of 12	10.8	6.9–14.6	0
Thallium	µg/L	0.28	5 of 12	<0.02	<0.002–0.049	0

Source: PolyMet 2015m.

Note:
[1] Values in parentheses indicate sMCLs.

Lower Partridge River

This section describes the baseline surface water hydrology and water quality of the Lower Partridge River downstream of Colby Lake.

Lower Partridge River Hydrology

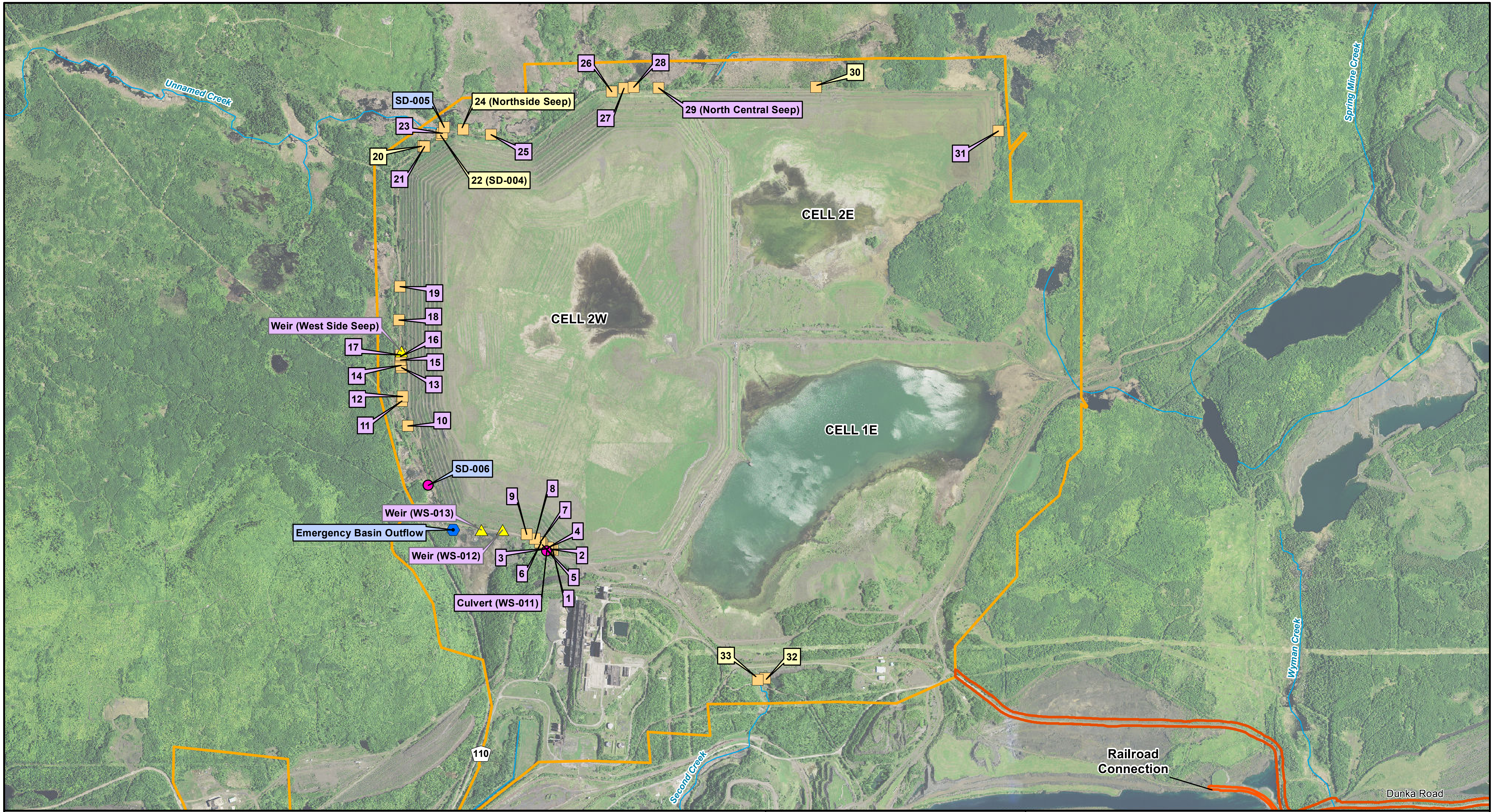
Downstream of Colby Lake, the Partridge River flows approximately four more miles before reaching its confluence with the St. Louis River. Second Creek (also known as Knox Creek) is a tributary of the Partridge River in this segment and until recently was receiving an annual average of 1.2 cfs of surface seepage from the existing LTVSMC Tailings Basin (see Figure 4.2.2-11 for locations of Seeps 32 and 33) (Barr 2008a). A portion of this seepage is now being pumped back into the Tailings Basin, as required by the May 2010 Consent Decree between Cliffs Erie and MPCA. Second Creek is currently receiving seepage from Pit 6. Dewatering flows from Pit 1, as part of the Mesabi Nugget Project (see Table 4.2.2-10, Mesabi Nugget, SD-001) is discharged to Second Creek (see Figure 4.2.2-12) at a rate up to 9 cfs seasonally (September 1 to March 30) as per their reissued permit. Cliffs Erie is discharging Pit 2/2W water to Second Creek at a rate up to 9.4 cfs.

Lower Partridge River Water Quality

Water quality conditions in the Lower Partridge River, from the outlet of Colby Lake to its confluence with the St. Louis River, result from a mix of Colby Lake outflow, Second Creek inflow and local runoff. Colby Lake and Second Creek (First Creek is a tributary to Second Creek) water quality is affected by local runoff from the former LTVSMC processing plant operations.

Periodic dewatering discharges from Pit 9 (see Figure 4.2.2-2) previously drained to First Creek, but this pit has been abandoned long enough for static water levels to develop. Seepage from Pit 6 currently flows to Second Creek. This seepage has very high sulfate concentrations (greater than 1,000 mg/L). This input of sulfate raises the sulfate concentration in the mainstem of the Partridge River from an average of about 27.2 mg/L as it flows from Colby Lake (see Table 4.2.2-18) to over 160 mg/L downstream of the confluence of Second Creek (Barr 2011a). A summary of existing water quality at several locations follows.

Water quality monitoring as part of the MPCA-issued NPDES Permit MN0042536 (SD026), as shown in Figure 4.2.2-11, shows that Seeps 32 and 33 were generally consistent with surface water standards (Barr 2011h). Table 4.2.2-20 summarizes the surface water quality monitoring data for Station SD-026 from 2011 to 2013. Surface water quality data from 2011 onwards are representative of existing conditions at the site, as they post-date the installation of the containment system in 2010 that limits flow to Second Creek on the southern side of the Tailings Basin (PolyMet 2015m). The MPCA will evaluate information relative to water quality standards during the NPDES/SDS permitting process as part of its analysis to determine which pollutants in the discharge would have a reasonable potential to cause or contribute to violation of a water quality standard.



Historical Seeps

- Seeps
- Weirs
- Culvert
- Emergency Basin Outflow

- Plant Site
- Transportation and Utility Corridor
- Stream/River

- Seep: Active Seep
- Seep: Flow Not Measurable or No Flow
- Seep: Surface Discharge

Minnesota Department of Natural Resources

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St. Paul District

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Figure 4.2.2-11
Seeps and Associated Flow Structures at Existing LTVSMC Tailings Basin
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

1176 -Page Intentionally Left Blank-

Proposed Mine Site Boundary
Monitoring Location
Stream/River

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St. Paul District

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Figure 4.2.2-12
Northshore Hydrology
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

1178

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Table 4.2.2-20 Summary of Surface Water Quality Monitoring Data for Station SD026 (2011–2013)

Constituent	Units	Surface Water Evaluation Criteria	SD026 Surface Discharge (Seeps 32 and 33)		
General Parameters			**Detection**	**Mean**	**Range**
Calcium	mg/L	--	46 of 46	71.1	58.8–88.3
Chloride	mg/L	230	44 of 44	11.3	6–21.5
Fluoride	mg/L	--	12 of 12	1.1	0.58–1.8
Hardness	mg/L	500	46 of 46	407	210–631
pH	s.u.	6.5–8.5	46 of 46	7.6	7.1–8.3
Sulfate	mg/L	--	44 of 44	178	114–251
TDS	mg/L		44 of 44	637	395–790
Metals – Total					
Aluminum	µg/L	125	42 of 46	14.3	<4–28.9
Antimony	µg/L	5.5	43 of 46	0.10	<0.1–0.1
Arsenic	µg/L	2.0	43 of 46	0.46	<0.1–1
Barium	µg/L	2,000	46 of 46	31.2	16.4–43.3
Beryllium	µg/L	4.0	43 of 46	0.04	<0.04–0.04
Boron	µg/L	500	46 of 46	163	117–236
Cadmium	µg/L	2.5	43 of 46	0.04	<0.04–0.04
Cobalt	µg/L	2.8	42 of 46	0.37	<0.04–0.93
Copper[1]	µg/L	9.3	45 of 46	1.05	<0.14–1.7
Iron	µg/L	--	46 of 46	1,294	325–1,810
Lead[1]	µg/L	3.2	38 of 46	0.10	<0.1–0.10
Manganese	µg/L	--	46 of 46	919	172–2,190
Mercury	ng/L	1.3	39 of 46	0.35	<0.036–0.8
Molybdenum	µg/L		45 of 46	13.4	<2–25
Nickel[1]	µg/L	52	39 of 46	0.31	<0.1–1.58
Selenium	µg/L	5.0	39 of 46	0.20	<0.2–0.2
Thallium	µg/L	0.28	40 of 46	0.01	<0.0004–0.04
Zinc[1]	µg/L	120	43 of 46	6.45	<1.2–13.8

Source: NTS 2009; PolyMet 2015m.

Notes:
< = less than indicated reporting limit.
Water quality data for SD026 collected for PolyMet were supplemented by data from the MPCA website collected as part of the NPDES reporting requirements. Where samples were duplicated due to the inclusion of PolyMet data in the MPCA database, the duplicates were removed and the PolyMet data was used in the event of any inconsistencies.
[1] Water quality standard for this metal is hardness-dependent. Listed value assumes a hardness concentration of 100 mg/L, which approximates the hardness concentration in Colby Lake.

Limited Lower Partridge River water quality data have also been collected at CR110 (see Figure 4.2.2-1, location 4016000). Table 4.2.2-21 summarizes water quality data from 2008 and 2009 for this location. In general, the concentration of hardness and associated solutes such as calcium, magnesium, and potassium, average two to four times higher in the Lower Partridge River than in the Upper Partridge River at location SW-005. A similar relationship also exists for selected metals such as boron, copper, and nickel, where average concentrations for Lower Partridge River are at least two times those at SW-005. Zinc appears to be an exception, where Lower Partridge River values appear to average about a third of those at SW-005.

Concentrations of sulfate are of special concern because the MPCA staff has recommended that this entire reach of the river from the outlet of Colby Lake to its confluence with the St. Louis River be considered as water used for the production of wild rice (MPCA 2012b). Based on the 2008-2009 data, sulfate concentration in the Lower Partridge River averages about 164 mg/L.

Table 4.2.2-21 Summary of Surface Water Quality Monitoring Data for Station CR110

Constituent	Units	Surface Water Evaluation Criteria	CR110[2]		
General Parameters			**Detection**	**Mean**	**Range**
Calcium	mg/L	--	10 of 10	28.6	13.6–43.7
Chloride	mg/L	230	10 of 10	5.0	2.7–7.7
Fluoride	mg/L	--	10 of 10	0.20	0.11–0.59
Hardness	mg/L	500	10 of 10	291	82.5–546
pH	s.u.	6.5–8.5	12 of 12	7.6	7.3–7.9
Sulfate	mg/L	--	10 of 10	164	43.0–302
TDS	mg/L	500	10 of 10	375	137–650
Metals – Total					
Aluminum	µg/L	125	10 of 10	105	29.3–171
Antimony	µg/L	5.5	7 of 8	0.14	<0.5–0.50
Arsenic	µg/L	2.0	7 of 10	1.3	<2.0
Barium	µg/L	2,000	10 of 10	15.7	8.1–33.0
Beryllium	µg/L	4.0	1 of 8	0.18	<0.20
Boron	µg/L	500	8 of 8	101	59.4–150
Cadmium[1]	µg/L	2.5	1 of 8	0.18	<0.20
Cobalt	µg/L	2.8	8 of 8	0.46	0.28–0.73
Copper[1]	µg/L	9.3	8 of 8	3.4	1.9–4.8
Iron	µg/L	--	10 of 10	942	529–1,640
Lead[1]	µg/L	3.2	6 of 8	0.34	<0.05–0.60
Manganese	µg/L	--	10 of 10	53.4	11.8–106
Mercury	ng/L	1.3	10 of 10	4.4	0.5–7.6
Molybdenum	µg/L	--	10 of 10	1.6	0.73–2.8
Nickel[1]	µg/L	52	8 of 8	3.6	2.7–4.6
Selenium	µg/L	5.0	7 of 8	0.63	0.33–1.0
Thallium	µg/L	0.28	0 of 8	0.40	<0.4
Zinc[1]	µg/L	120	8 of 8	3.5	1.0–6.5

Source: Barr and HC Itasca 2009.

Notes:
1 Water quality standard for this metal is hardness-dependent. Listed value assumes a hardness concentration of 100 mg/L, which approximates the hardness concentration in Colby Lake.
2 Station CR110 is noted as location MNSW12 in the source file.

4.2.2.3 Embarrass River Watershed

This section describes the baseline hydrology and water quality for the groundwater and surface water within the Embarrass River Watershed portion of the NorthMet Project area. Most of the Tailings Basin and the Emergency Basin is located within the Embarrass River Watershed.

4.2.2.3.1 Groundwater Resources

Geology and Hydrogeology

Bedrock at the Plant Site and Tailings Basin is Precambrian crystalline and metamorphic rock. The uppermost bedrock unit that encompasses most of the area represents Giants Range batholith. However, there are two elevated exposures of bedrock (abutting the southeastern corner of Cell 1E at the Tailings Basin) that consist of schist of sedimentary and volcanic origin. Considering the results of hydraulic testing of bedrock boreholes along the perimeter of the Tailings Basin, bedrock is interpreted to have a significantly lower hydraulic conductivity than the overlying surficial deposits (Barr 2014b). This interpretation is supported by analogy to the bedrock of the Mine Site (Duluth Complex), where hydraulic testing has shown bedrock to have a significantly lower hydraulic conductivity than the surficial deposits. The Giants Range granite is mechanically similar to the Duluth Complex, which is documented to have decreasing hydraulic conductivity with depth. Assuming relatively similar stress, weathering, and erosional histories, it is likely that the Giants Range granite also exhibits decreasing hydraulic conductivity with depth.

Jennings and Reynolds (2005) mapped the surficial deposits around and beneath the Tailings Basin as Rainy Lobe Till, which serves as a shallow, unconfined aquifer. This is generally a boulder-rich till with high clay content. However, data from 12 monitoring wells installed north and west of the Tailings Basin indicate the dominating presence in this area of sands with varying amounts of silt and gravel. In a separate geotechnical study of the LTVSMC tailings, several soil borings into the surficial deposits identified the presence of layers of clay and sand, plus cobbles and boulders that prevented recovery of an intact sample (Pint and Dehler 2008).

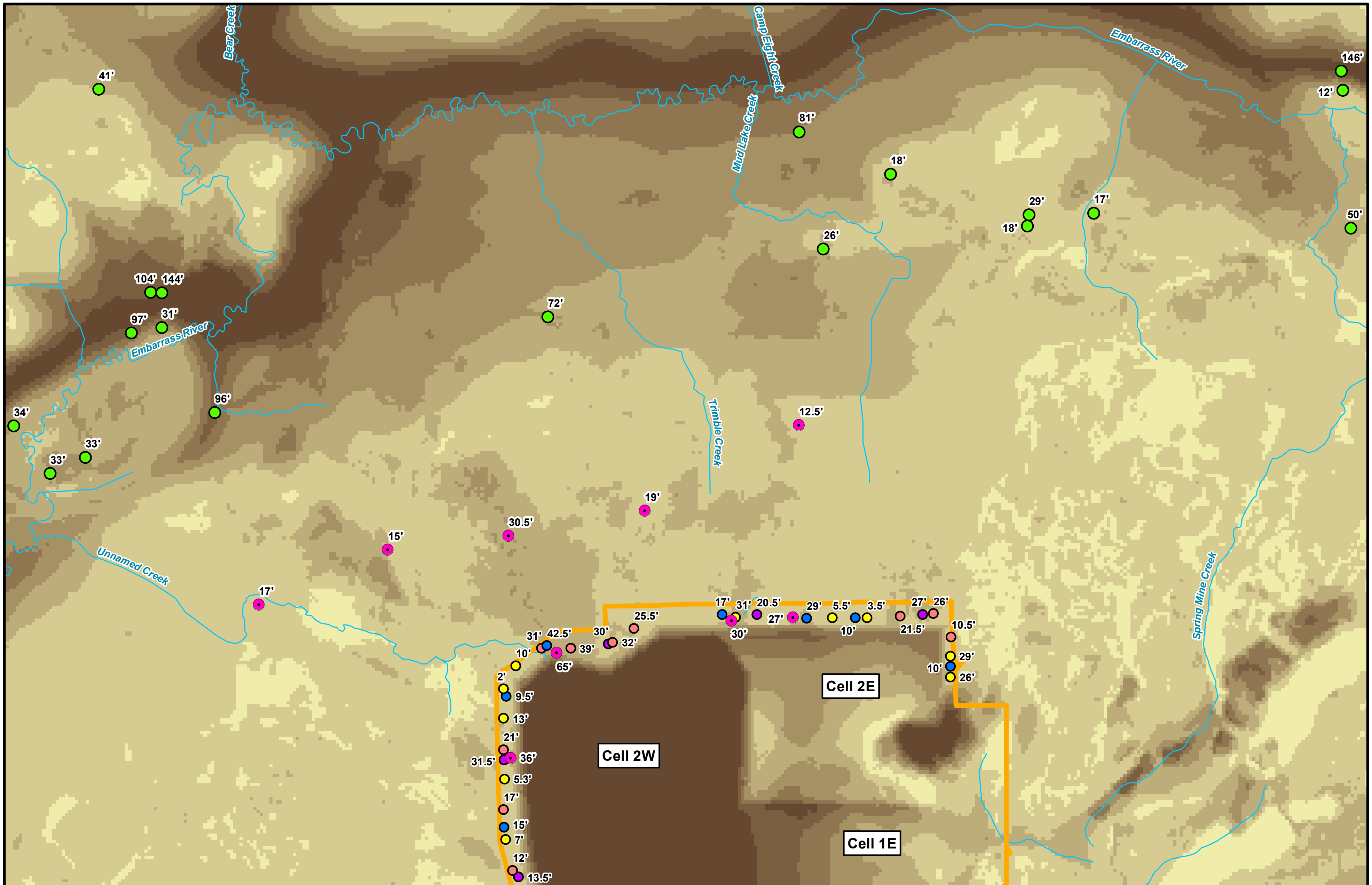
The thickness of unconsolidated deposits (depth to bedrock) along the western, northwestern, and northern sides of the Tailings Basin toe ranges from 3.5 to 42.5 ft as reported in site boring logs (Barr 2014b). The average thickness of unconsolidated deposits along these toes is 19.5 ft. No substantial surficial deposits are present along the southern and much of the eastern sides of the Tailings Basin where the basin abuts against bedrock outcrops. However, an accumulation of surficial deposits is present adjacent to the East Embankment on the eastern side of the Tailings Basin. The area farther northwest of the Tailings Basin is believed to be one of the few areas in the region with significant quantities of outwash (sand and gravel) ranging in thickness from 0 ft to greater than 150 ft (Olcott and Siegel 1979) (see Figure 4.2.2-13).

The surficial till is often overlain by wetland/peat deposits. Peat deposits were encountered in some borings, ranging in thickness from less than a foot to several feet, but they are relatively few and discontinuous. Most of the area between the Tailings Basin and the Embarrass River is covered by extensive wetlands and minor surface water features. Unlike the ombrotrophic bogs at the Mine Site, where sphagnum peat has elevated the bog and reduced connection between the surface water and water table, and which describe approximately 50 percent of the wetlands across the Mine Site (Eggers 2011a), these wetlands between the Tailings Basin and Embarrass River are assumed to represent surficial expressions of the water table (Barr 2012a) and reflect, at least in part, the increase in groundwater and surface water level and flow from LTVSMC tailings seepage.

Regionally, groundwater flows primarily northward toward the Embarrass River, although groundwater in some portions of the Tailings Basin flows to the south to form the headwaters of

Second Creek, a tributary of the Partridge River (see Figure 4.2.2-6). Water level data collected from monitoring wells north of the Tailings Basin show an average gradient of 0.0039 ft/ft. Recent hydrologic investigations indicate that the total groundwater flow through the aquifer downgradient of the Tailings Basin and toward the west, northwest, and north, is approximately 194 gpm (see Table 5.2.2-39). Recharge to the surficial aquifer in the areas west, northwest and north of the Tailings Basin is estimated to be about 0.75 in/yr (PolyMet 2015j). In the area around the Tailings Basin, groundwater flows radially away from it to the west, northwest, and north. There is currently east-to-west groundwater flow towards and under the Tailings Basin from surficial deposits along the embankment on the eastern side of the Tailings Basin.

The existing LTVSMC Tailings Basin consists of three cells. Cell 2W is the largest (1,450 acres) and highest (average fill height of 200 ft) and has been closed and re-vegetated. Cell 1E is located east of Cell 2W and covers approximately 980 acres with an average fill height of 60 ft. Cell 2E, which is located east of Cell 2W and north of Cell 1E, covers approximately 620 acres, and has an average fill height of 60 ft, although it is at a lower elevation than Cell 1E.



Residential Well from County Well Index (with depth to bedrock)
Groundwater Well - Existing
Rotasonic Location
Rotasonic Location with a Piezometer
Boring Location with Packer
Boring Location
Plant Site
Stream/River

Depth to Bedrock

0' -25'
25' - 50'
50' -75'
75' -100'
100' -125'
> 125'

Minnesota Department of Natural Resources
US Army Corps of Engineers St. Paul District
Forest Service U.S. Department of Agriculture

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N W E S

0 1,000 2,000 4,000 Feet

Figure 4.2.2-13
Depth to Bedrock at Tailings Basin Area
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Minnesota

June 2015

1270 -Page Intentionally Left Blank-

During the LTVSMC operations, the LTVSMC Tailings Basin was built up over time and a groundwater mound formed beneath the basin due to seepage from tailings ponds located within the various cells. Surface seeps initially occurred on the southern, western, and northern sides of the Tailings Basin; however, most surface seeps have dried out since January 2001, when LTVSMC terminated depositing tailings in the basin, so that only a few surface seeps (e.g., seeps 32 and 33, which drain to the south of the existing LTVSMC Tailings Basin and toward Second Creek) remain active (see Figure 4.2.2-11).

The east side of the Tailings Basin is bounded by low-permeability bedrock uplands, except for surficial deposits adjacent to the East Embankment. Groundwater flow to the east and south of the Tailings Basin is minimal. Most groundwater flows from beneath the Tailings Basin into the surrounding surficial deposits to the west, northwest, and north towards the Embarrass River. Recent seepage from the existing LTVSMC Tailings Basin towards the Embarrass River was estimated to be approximately 2,590 gpm (PolyMet 2015j; see Table 5.2.2-38). This seepage rate exceeds the capacity of the surficial aquifer to transmit groundwater, resulting in upwelling to the surface of an estimated 2,381 gpm of tailing water (see Table 5.2.2-39). This upwelling and historic surface seepage from the LTVSMC tailings created or expanded wetlands immediately downgradient of the existing LTVSMC Tailings Basin, and inundated these same wetlands (see Section 4.2.3). These hydrologic effects on wetlands diminish to the north.

Groundwater elevations across the surficial aquifer north of the existing LTVSMC Tailings Basin were determined from several years of water-level measurements in 15 wells (see Figure 4.2.2-14). These include eight wells that are adjacent to (or within) the existing LTVSMC Tailings Basin (GW-001 through GW-008), which were installed as part of the NPDES permit and monitored as far back as 2001. Seven other wells located farther from the existing LTVSMC Tailings Basin (GW-009 through GW-015) were installed in 2009 and 2010 by PolyMet to support hydraulic characterization of the NorthMet Project Proposed Action (PolyMet 2015j). The water table within the Tailings Basin showed a systematic decrease following cessation of the LTVSMC operations in 2001 as the tailings drained, with water levels stabilizing since 2007. Following the cessation of the LTVSMC mine operations, the remaining surface water within Cell 2W was either drained into Cell 1E or infiltrated into the underlying tailings, such that no pond remains. Cells 1E and 2E still impound water, but at lower levels than during the active LTVSMC operations. Water levels measured in the Pond and the piezometer located within the cells indicate that these cells may have been approaching steady-state conditions prior to the seep pump-backs that are part of the Cliffs Erie Consent Decree.

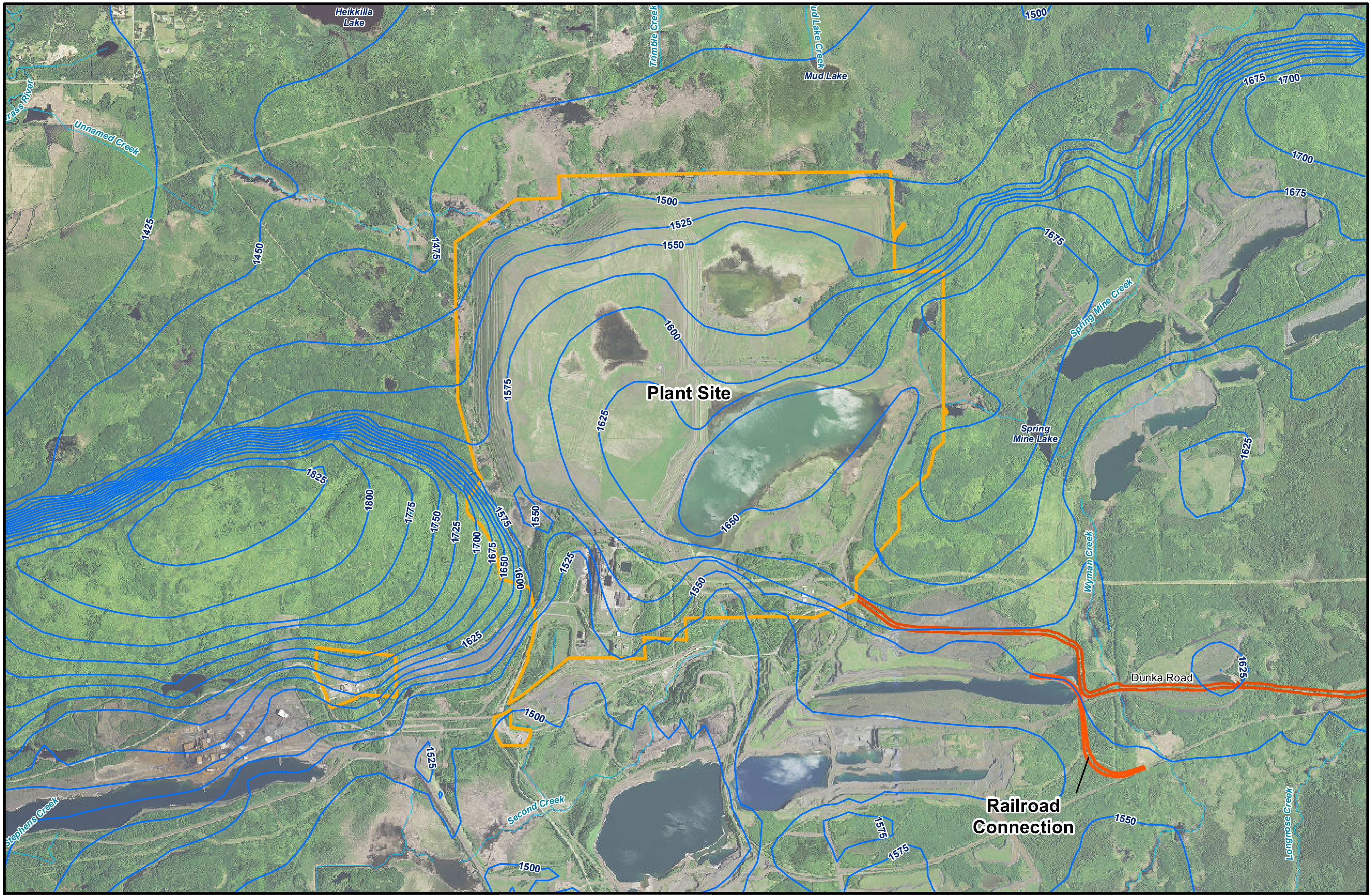
Although water levels were monitored starting in 2001, assessment of the existing conditions and the project effects for this FEIS primarily rely on water-level data collected for 2007 through July 2013 (PolyMet 2015j). Monitoring data shows that the water table slopes to the west, northwest, and north, producing flow from the LTVSMC tailings toward the Embarrass River (see Figure 4.2.2-9 and Figure 4.2.2-15). The fluctuations at individual wells since 2007 have been small. The maximum range in the wells adjacent to the tailings has been 3.8 ft (both GW-005 and GW-008 had this range), and in the farther downgradient wells, the range in water levels at individual wells ranged from 0.33 to 4.67 ft (well GW-011; Figure 4.2.2-7).

Baseline groundwater elevations, depths to bedrock, and surface water drainage locations have been used to identify three flowpaths (West, Northwest, and North) that represent the most direct paths between Tailings Basin facilities and evaluation locations (i.e., property boundaries and surface waters of the state) (PolyMet 2015j). Groundwater flow at the East Embankment is toward the west (under the Tailing Basin), while flow to the east is negligible because of the presence of bedrock outcrops. Groundwater flow toward the south is also negligible because surficial deposits are present there only as thin and laterally discontinuous bodies; tailings water at the South Toe seeps out to ground surface and a portion of that is pumped back to the Tailings Basin.

Figure 4.2.2-14
Monitoring Locations Near Existing Tailings Basin
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

1323 -Page Intentionally Left Blank-



Plant Site

Transportation and Utility Corridor

* Water Table Elevation in Surficial Aquifer (Ft AMSL)

Stream/River

* Source: PolyMet 2015j

US Army Corps of Engineers St. Paul District

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0 0.25 0.5 1 Miles

Figure 4.2.2-15

Estimated Existing Groundwater Contours in Surficial Deposits and Bedrock Outcrops - Plant Site

NorthMet Mining Project and Land Exchange PFEIS

Minnesota

June 2015

1325 -Page Intentionally Left Blank-

Hydraulic characteristics of the surficial deposits and shallow bedrock in the Tailings Basin area are derived from the following sources:

- Eight single-well pumping tests conducted in monitoring wells in the surficial deposits (Barr 2009e).
- Multiple slug tests performed in standpipe piezometers located in the surficial deposits of Cell 2W (Pint and Dehler 2008).
- Slug tests performed in 10 standpipe piezometers installed in surficial deposits, typically right above bedrock, around the perimeter of Tailings Basin, as well as in four accessible wells that were installed in 2008 (PolyMet 2015l, Attachment F).
- Packer tests performed in five of the 12 bedrock borings completed along the northern, northwestern, and western perimeters of the Tailings Basin. In total, 10 tests were performed at one to three depth intervals of each tested boring. Drilling of those bedrock borings produced rock cores and RQD data (PolyMet 2015l, Attachment F).

Estimated hydraulic properties of the native units found near the Tailings Basin vary by several orders of magnitude (Barr 2008c). Estimated hydraulic conductivities range from approximately 0.0002 ft/day for the Giants Range bedrock to approximately 70 ft/day for the glacial till (Barr 2009f). Single well pumping tests conducted in eight of the monitoring wells located within the glacial till found an average permeability of 14 ft/day within a range of 0.4 to 65 ft/day (Barr 2009e), while slug tests performed in standpipe piezometers located in the glacial till downgradient of Cell 2W found an average permeability of only 1.5 ft/day within a range of 0.25 to 2.1 ft/day (Pint and Dehler 2008). The hydraulic conductivity of the LTVSMC tailings ranges from approximately 0.003 ft/day for the slimes to approximately 7 ft/day for the coarse tailings.

Slug tests performed in standpipe piezometers completed in glacial till in different parts of the Plant Site showed hydraulic conductivity ranging from 0.15 to 130 ft/day, with geometric mean of 4.41 ft/day. Those values for glacial till are considered to be the best representation of in situ conditions in glacial till (PolyMet 2015l, Attachment F).

Geometric mean of hydraulic conductivity values obtained from the packer tests performed in the bedrock borings is 0.14 ft/day. This value is judged to be the best estimate characterizing the top 20 ft of bedrock around the Plant Site; it is similar to a geometric mean of hydraulic conductivity values quoted in the Iron Range literature for the Giants Range Granite (Barr 2014b).

It was observed that a density of fractures often decreases with an increasing core depth, indicating hydraulic conductivity decreasing with depth.

Groundwater Quality

Characterization of groundwater quality at the Plant Site is based on the analyses of water collected from the following wells installed in surficial deposits:

- Eight groundwater monitoring wells (i.e., wells GW-001 through GW-008) monitored since at least 1999 (see Figure 4.2.2-14). GW-002 is considered a baseline well for the Tailings Basin, as it is located distant from the Tailings Basin groundwater flowpaths. Wells GW-003, GW-004, and GW-005 located within Cell 2W were intended to monitor the high sulfide Virginia Formation hornfels waste rock that was placed in this cell in 1993. The remaining wells—GW-001, GW-006, GW-007, and GW-008—are located at or very near the toe of the Tailings Basin embankment.

- Seven additional wells installed and monitored since 2009:
  - one at the toe of the Tailings Basin (GW-012);
  - three downgradient of the Tailings Basin (GW-009, GW-010, and GW-011);
  - Three new downgradient wells installed in July 2010, after issuance of the 2009 DEIS (GW-013, GW-014, and GW-015) (PolyMet 2015j); and
- Twenty-nine residential wells identified to be present downgradient of the Tailings Basin at distances ranging between 1.6 and 3.8 miles north of the Plant Site. These wells are completed in unconsolidated deposits and in bedrock. Fifteen of those wells were sampled (see Figure 4.2.2-16).

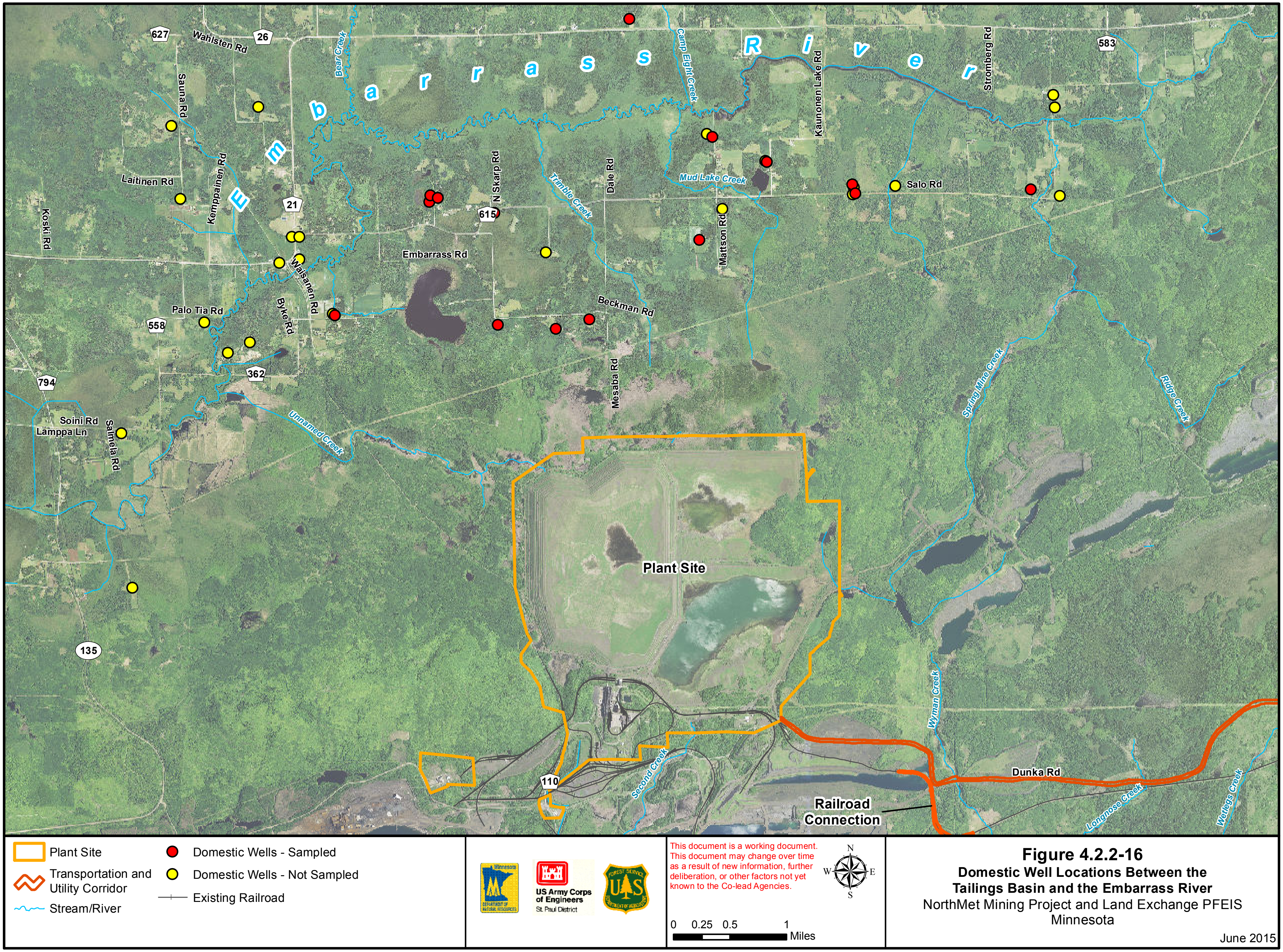

Figure 4.2.2-16
Domestic Well Locations Between the Tailings Basin and the Embarrass River
NorthMet Mining Project and Land Exchange PFEIS
Minnesota
June 2015

1380 -Page Intentionally Left Blank-

The discussion of groundwater quality in the Plant Site area groups the available wells into three categories:

- Natural background wells (GW-002, GW-011, GW-013, and GW-015). These best approximate groundwater quality unaffected by the LTVSMC tailings. Low chloride concentrations measured in those wells indicate that groundwater around those wells have not been affected appreciably by Tailings Basin seepage. Table 4.2.2-22 presents solute concentrations measured in the background wells. It also shows the concentrations reported in the studies of regional background water quality conducted by the MPCA and the USGS (MPCA 1999; Siegel and Ericson 1980);
- Tailings Basin toe wells (GW-001, GW-006, GW-007, GW-008, and GW-012). These wells are located at the toe of the Tailings Basin. Analytical results from some of these wells have been used (in conjunction with a few surface seeps) to estimate the composition of LTVSMC Tailings Basin seepage. Table 4.2.2-23 presents the range for solute concentrations measured in these wells and the remaining Cell 2E Pond.
- Downgradient wells. This group consists of two types of wells:
  - Tailings Basin downgradient wells (GW-009, GW-010, GW-014, and GW-016). These wells are located downgradient of and to the north and northwest of the Tailings Basin, beyond its toe. Table 4.2.2-24 presents ranges for solute concentrations in these wells.
  - Residential wells. Figure 4.2.2-16 shows the locations of the 29 residential wells identified to be present between the Tailings Basin and Embarrass River, and it also shows the 15 that were sampled. Table 4.2.2-24 presents ranges for solute concentrations in these sampled wells.

Natural Background Wells

In the period since release of the 2009 DEIS, an updated review of available groundwater quality data allowed a conclusion that natural water quality in the Tailings Basin area was reflected by wells GW-002, GW-011, GW-013, and GW-015. These four wells were selected as unaffected natural background baseline wells primarily because of their low chloride concentrations (ranging from below detection up to 4.8 mg/L), which are consistent with regional values for background chloride concentrations, and clearly distinct from chloride concentrations in discharge from the existing LTVSMC tailings (approximately 30 mg/L; PolyMet 2015j). Also, concentrations of ammonia (as nitrogen), calcium, fluoride, magnesium, sodium, potassium, sulfate, as well as TDS (total dissolved solids) and hardness are lower in these wells than in the Tailings Basin toe wells and downgradient wells discussed below.

Baseline concentrations of some constituents in groundwater of the Tailings Basin area exceed the groundwater evaluation criteria (see Table 4.2.2-22). For example, at well GW-002, groundwater within the surficial aquifer has elevated concentrations (i.e., at or higher than the groundwater evaluation criteria) of aluminum, iron, and manganese. The manganese levels were within the range of baseline concentrations found by MPCA in northeastern Minnesota (MPCA 1999a) and in the Regional Copper-Nickel Study (Siegel and Ericson 1980), but the aluminum and iron values were above the range of concentrations found in these two studies. In addition, beryllium did not meet the groundwater criterion. However, interpretation of the beryllium concentrations is complicated because the detection limits exceeded the evaluation criteria.

Beryllium was detected in some groundwater samples at concentrations above the evaluation criteria.

Aluminum, iron, and manganese concentrations are heavily influenced by natural processes, particularly chemically reducing conditions and the presence of dissolved organic acids, both of which can arise in aquifer zones enriched in natural organic matter. Further, the analyses of "total" groundwater concentrations included an unknown amount of fine particulates that were then digested in sample preparation and contributed to the reported concentrations. Reported total concentrations could thus be influenced by the high values for elements common in clays and other fine particulates, including aluminum, iron, and manganese. Consequently, the dissolved concentrations are generally considered more representative of groundwater quality than total concentrations. Very few dissolved concentrations measured in the collected samples are exceeding the criteria. All other parameters met the groundwater evaluation criteria.

Table 4.2.2-22 Summary of Natural Background Groundwater Quality Monitoring Data for the Tailings Basin Area and Two Larger Regional Areas

Parameters	Units	Groundwater Evaluation Criteria	Baseline Quality in Surficial Aquifer (GW-002, GW-011, GW-013, and GW-015)				Northeast MN Baseline	Copper-Nickel Study Baseline
General			**Detection**	**Mean[1]**	**Range**	**# Exceed**	**Range**	**Range**
Alkalinity	mg/L	--	49 of 50	51.2	<10–133	NA	--	--
Ammonia as Nitrogen	mg/L	--	10 of 50	0.07	<0.025–0.49	NA	--	--
Calcium	mg/L	--	50 of 50	14.8	3.1–41.4	NA	--	--
Carbon, total organic	mg/L	--	48 of 50	2.8	<0.5–7.4	NA	--	--
Chloride	mg/L	250	30 of 50	0.80	<0.25–4.8	0	--	0.4–35
Fluoride	mg/L	2	14 of 50	0.10	<0.05–0.56	0	0.2–0.57	--
Hardness	mg/L	--	50 of 50	64.6	13.3–236	NA	--	--
Magnesium	mg/L	--	50 of 50	6.7	1.3–32.2	NA	--	--
pH	s.u.[3]	6.5–8.5	50 of 50	7.0	5.5–8.3	**13**	6.0–8.4	5.7–8.0
Potassium	mg/L	--	50 of 50	1.4	0.25–6.1	NA	--	--
Sodium	mg/L	--	44 of 50	3.4	<1–9.8	NA	--	--
Sulfate	mg/L	250	50 of 50	7.5	2.6–38.6	0	<0.3–14.2	1.8–450
TDS	mg/L	--	49 of 50	51.2	<10–133	NA	--	--
Metals – Total								
Aluminum	µg/L	200	49 of 50	4,772	<10–63,500	34	<0.1–30	0–200
Antimony	µg/L	6	0 of 50	0.25	<0.25	0	<0.01–0.04	--
Arsenic	µg/L	10	24 of 50	1.3	<0.25–18.0	1	<0.1–9.1	--
Barium	µg/L	2,000	50 of 50	102	10.9–703	0	1.6–191	--
Beryllium	µg/L	0.08	6 of 50	**0.20**	<0.1–2.7	BDL[2]	<0.01–0.41	--
Boron	µg/L	1,000	0 of 50	29.0	<25–<100	0	<13–41	--
Cadmium	µg/L	4	9 of 50	0.18	<0.1–1.7	0	<0.02–0.2	0–8.4
Chromium	µg/L	100	36 of 50	14.4	<0.5–258	**1**	0.09–4.7	0–5.5
Cobalt	µg/L	--	40 of 50	4.2	<0.1–87.1	NA	0.05–0.63	0.3–28.0
Copper	µg/L	1,000	49 of 50	15.8	<0.25–300	0	<5.5–22	0.6–190
Iron	µg/L	300	50 of 50	**5,862**	53.4–82,600	**34**	7–7,816	0–3,100
Lead	µg/L	--	29 of 50	2.6	<0.25–56.2	NA	<0.03–2.0	0.1–6.4
Manganese	µg/L	50	50 of 50	**271**	1.0–2,140	**30**	0.9–1,248	10–7,190

Parameters	Units	Groundwater Evaluation Criteria	Baseline Quality in Surficial Aquifer (GW-002, GW-011, GW-013, and GW-015)				Northeast MN Baseline	Copper-Nickel Study Baseline
General			Detection	Mean[1]	Range	# Exceed	Range	Range
Mercury	ng/L	2,000	44 of 48	4.1	<0.25–43.1	0	--	--
Methylmercury	ng/L	--	5 of 45	0.041	<0.015–0.10	NA	--	--
Molybdenum	µg/L	--	34 of 50	1.7	<0.1–17.1	NA	<4.2–12	--
Nickel	µg/L	100	46 of 50	15.7	<0.25–316	**1**	<6.0–16	--
Selenium	µg/L	30	1 of 50	0.55	<0.1–1.6	0	<1.0–4.7	--
Silver	µg/L	30	1 of 50	0.11	<0.1–0.46	0	<0.01–0.05	--
Thallium	µg/L	0.6	4 of 50	0.14	<0.0085–0.81	**1**	<0.005–0.01	--
Zinc	µg/L	2,000	25 of 50	19.9	<3–366	0	<2.7–138	3.9–170
Dissolved/Filtered Metals								
Aluminum	µg/L	200	29 of 50	48.5	<10–352	**1**	--	--
Antimony		6	0 of 1	0.25	<0.25	0	--	--
Arsenic	µg/L	10	9 of 44	0.46	<0.25–1.1	0	--	--
Barium		2,000	30 of 31	60.3	<5–236	0	--	--
Beryllium		0.08	0 of 1	1.0	<1–<1	BDL[2]		
Boron	µg/L	1,000	0 of 31	27.4	<25–<100	0	--	--
Cadmium	µg/L	4	4 of 50	0.13	<0.015–1.3	0	--	--
Chromium	µg/L	100	22 of 50	0.90	<0.5–2.4	0	--	--
Cobalt		--	1 of 31	0.14	<0.1–1.3	NA	--	--
Copper	µg/L	1,000	41 of 50	2.0	<0.25–6.5	0	--	--
Iron		300	19 of 43	60.3	<25–288	0	--	--
Lead		--	0 of 31	0.25	<0.25–<0.3	NA	--	--
Manganese	µg/L	50	43 of 45	**152**	<5–744	**12**	--	--
Molybdenum		--	28 of 50	1.4	<0.1–16.6	NA		
Nickel	µg/L	100	43 of 50	1.5	<0.25–5.6	0	--	--
Selenium	µg/L	30	0 of 50	0.49	<0.1–<0.5	0	--	--
Silver	µg/L	30	0 of 50	0.10	<0.1	0	--	--
Thallium		0.6	0 of 1	0.20	<0.2	0	--	--
Zinc	µg/L	2,000	16 of 50	5.4	<3–17.8	0	--	--

Sources: Barr 2014d; NTS 2009; MPCA 1999a; Siegel and Ericson 1980.

Notes:
Groundwater evaluation criteria: The maximum allowed concentrations (or for some less toxic substances, the maximum recommended concentrations) of various constituents in groundwater. The specific thresholds are either the USEPA primary Maximum Contaminant Levels (MCLs), the MDH Health Risk Limits (HRLs), or the USEPA sMCLs (sMCLs are used to set thresholds for aluminum, iron, and manganese). These thresholds are considered when determining whether alternatives considered in this FEIS are expected to have a significant environmental effect.
Bold (e.g., **0.014**) indicates exceeds evaluation criteria.

1 Where non-detects occur, the mean was calculated using half the detection limit.
2 Below detection limit. Detection limit is greater than water quality standard.
3 pH: s.u. stands for Standard Unit.

Tailings Basin Toe Wells

Ponds remain within Cells 1E and 2E of the existing LTVSMC Tailings Basin. No pond is present in Cell 2W. Table 4.2.2-23 summarizes the results of surface water quality monitoring of the Cell 2E pond (mean values for data collected from 2001 to 2004) and groundwater quality monitoring at monitoring wells located along the northern, northwestern, and western toes of the Tailings Basin (GW-001, GW-006, GW-007, GW-008, and GW012). The existing LTVSMC Tailings Basin is a disposal facility and is not a natural surface waterbody or a point of compliance pursuant to Cliffs Erie's NPDES/SDS permit. Therefore, comparison of these data with surface or groundwater evaluation criteria is not appropriate; however, these criteria are listed for informational purposes.

Table 4.2.2-23 Existing Pond Water and Groundwater Quality at the Toe of the Tailings Basin

Parameters	Units	Pond Water Quality (Cell 2E)	Groundwater Evaluation Criteria	Toe of Tailings Basin (GW-001, GW-006, GW-007, GW-008, GW-012, Surficial Aquifer)		
General		**Mean**		**Detection**	**Mean[1]**	**Range**
Alkalinity	mg/L	--	--	83 of 83	421	17.6–852
Calcium	mg/L	30	--	83 of 83	84.0	4.3–211
Chloride	mg/L	23	250	82 of 82	18.2	0.56–30.4
Fluoride	mg/L	5.2	2	64 of 82	0.90	<0.05–2.6
Hardness	mg/L	--	--	80 of 80	591	19.0–1,360
Magnesium	mg/L	--	--	83 of 83	95.0	2.0–262
pH	s.u.	8.4	6.5–8.5	91 of 91	7.3	4.1–8.7
Potassium	mg/L	--	--	83 of 83	5.9	0.58–16.0
Sodium	mg/L	--	--	82 of 83	55.5	<1–131
Sulfate	mg/L	109	250	82 of 82	234	4.1–659
TDS	mg/L	381	500	63 of 63	**799**	85–1,610
Metals – Total						
Aluminum	µg/L	--	200	57 of 83	**1,522**	<10–29,000
Antimony	µg/L	--	6	0 of 80	0.25	<0.25
Arsenic	µg/L	5	10	38 of 80	1.8	<0.25–7.1
Barium	µg/L	--	2,000	82 of 83	133	<5–452
Beryllium	µg/L	--	0.08	4 of 80	**0.19**	<0.1–1.0
Boron	µg/L	278	1,000	66 of 83	319	<25–554
Cadmium	µg/L	--	4	10 of 80	0.17	<0.1–2.0
Chromium	µg/L	--	100	33 of 80	4.3	<0.5–68.2
Cobalt	µg/L	1	--	72 of 80	1.9	<0.1–17.9
Copper	µg/L	2	1,000	79 of 80	7.8	<0.35–205
Iron	µg/L	--	300	69 of 83	**4,709**	<25–31,000
Lead	µg/L	--	--	18 of 80	0.87	<0.25–8.5
Manganese	µg/L	100	50	83 of 83	**1,299**	10.0–4,130
Mercury	ng/L	1.4	2,000	55 of 72	4.9	<0.25–153
Methylmercury	ng/L	--	--	9 of 71	0.048	<0.015–0.28
Molybdenum	µg/L	113	--	74 of 80	20.1	<0.1–47.0
Nickel	µg/L	2.1	100	70 of 80	7.3	<0.25–90.6
Selenium	µg/L	--	30	3 of 80	0.58	<0.5–<5
Silver	µg/L	--	30	2 of 80	0.10	<0.1–0.23
Thallium	µg/L	--	0.6	5 of 80	0.14	<0.0085–0.53

Parameters	Units	Pond Water Quality (Cell 2E)	Groundwater Evaluation Criteria	Toe of Tailings Basin (GW-001, GW-006, GW-007, GW-008, GW-012, Surficial Aquifer)		
General		**Mean**		**Detection**	**Mean**[1]	**Range**
Zinc	µg/L	--	2,000	17 of 80	9.3	<3–94.9
Metals – Dissolved/Filtered						
Aluminum	µg/L	--	200	15 of 80	14.2	<5–93.2
Antimony	µg/L	--	6	0 of 4	0.25	<0.25
Arsenic	µg/L	--	10	26 of 63	1.0	<0.25–6.5
Barium	µg/L	--	2,000	42 of 42	115	1.2–277
Beryllium	µg/L		0.08	0 of 4	1.0	<1
Boron	µg/L	--	1,000	37 of 47	308	<25–531
Cadmium	µg/L	--	4	4 of 80	0.12	<0.1–1.1
Chromium	µg/L	--	100	15 of 80	0.72	<0.5–2.9
Cobalt	µg/L	--	--	32 of 42	0.89	<0.1–3.5
Copper	µg/L	--	1,000	74 of 80	2.0	<0.25–11.0
Iron	µg/L	--	300	34 of 62	**2,265**	<25–11,000
Lead	µg/L	--	--	0 of 42	0.25	<0.25–<0.3
Manganese	µg/L	--	50	64 of 64	**1,158**	5.4–3,710
Molybdenum	µg/L		--	76 of 80	20.0	<0.1–45.0
Nickel	µg/L	--	100	63 of 80	3.3	<0.25–12.2
Selenium	µg/L	--	30	0 of 80	0.50	<0.5
Silver	µg/L	--	30	0 of 80	0.10	<0.1
Thallium	µg/L	--	0.6	0 of 4	0.20	<0.2
Zinc	µg/L	--	2,000	27 of 80	6.9	<3–50.8

Sources: Barr 2014d; Barr 2006f.

Notes:
Bold (e.g., **0.014**) indicates exceeds evaluation criteria.
[1] Where non-detects occur, the mean was calculated using half the detection limit.

Comparing the existing Cell 2E pond water quality with water quality at the toe of the Tailings Basin helps define the effect passage through the existing LTVSMC tailings has on seepage water quality. Such comparison shows that passage through the LTVSMC tailings apparently reduces the average concentrations of arsenic, fluoride, and molybdenum, although it is difficult to determine to what extent these reductions are simply attributable to the effects of dilution. The concentrations of several other parameters, such as calcium, manganese, nickel, and TDS, increase as they seep from the tailings pond to the toe of the Tailings Basin.

The limited amount of pond water quality data generally show fluoride concentrations that are elevated relative to the groundwater evaluation criteria. This could be attributable to the historic use of wet scrubbers for emission control at the former LTVSMC furnaces. These scrubbers removed highly soluble hydrogen fluoride gas (Jiang n.d.) resulting in elevated fluoride concentrations in the scrubber water, which was disposed of in the Tailings Basin.

Groundwater quality monitoring at several wells completed in the surficial aquifer at or near the toe of the Tailings Basin found the pH tending neutral or toward slightly basic (mean of 7.3), and elevated concentrations of several parameters (see Table 4.2.2-23). As with the baseline wells, these wells exhibited elevated aluminum, iron, and manganese concentrations, but also exhibited elevated sulfate, fluoride, molybdenum, and TDS concentrations that are higher than in the baseline wells (see Table 4.2.2-22). Considering these results, NTS (2009) concluded that groundwater has been impacted by the Tailings Basin. NTS noted, however, that there does not appear to be an overall trend, either increasing or decreasing, in the concentration of the monitored constituents.

Tailings Basin Downgradient Wells and Residential Wells

PolyMet conducted between 2 and 15 rounds of groundwater sampling during the 2009 through 2013 period at three monitoring wells (GW-009, GW-010, and GW-014) located approximately 1 mile north of the Tailings Basin (see Figure 4.2.2-14), and a single round of sampling at 15 residential wells located between 1.6 miles and 3.8 miles north of the Tailings Basin (see Figure 4.2.2-16). Water quality in the three affected downgradient monitoring wells and the 15 residential wells is summarized in Tables 4.2.2-24 and 4.2.2-25, respectively (Barr 2014d). As with the baseline wells, the three downgradient monitoring wells also exhibited elevated aluminum and iron concentrations that are higher than those found at the toe of the Tailings Basin.

Samples collected from the residential wells (located farther from the Tailings Basin) showed manganese concentrations that exceeded the groundwater evaluation criteria (i.e., sMCL). High manganese concentrations can naturally occur at some locations under a range of conditions. The measured concentrations are within the range found in the Regional Copper-Nickel Study. One well had aluminum concentrations slightly above the evaluation criterion and four wells had pH concentrations below the minimum of the criterion's range (pH below 6.5), but again, these values are within the neutral range found in the Regional Copper-Nickel Study.

The samples from the residential wells (Barr 2009d) and the downgradient wells sampled for the NorthMet Project Proposed Action (compared in Table 4.2.2-24) include analyses for total (unfiltered) and dissolved (filtered) concentrations for manganese and aluminum, so the maximum reported concentrations of these constituents probably includes the effect of sediment included in the samples. Residential wells have had more time and pumping to flush out sediment and, therefore, samples from them would be expected to have little if any sediment and lower unfiltered analytical results than samples from a monitoring well at the same location.

Comparisons of the groundwater quality data between different groups of wells indicate a general pattern of decreasing concentrations of ammonia, calcium, chloride, fluoride, magnesium, sodium, potassium, sulfate, hardness, pH, and TDS from the Tailings Basin wells (the highest), to downgradient wells, to residential and natural background wells (the lowest). Concentrations of those general parameters are similar between the residential and background wells.

Concentrations of metals (both total and dissolved) do not show any clear pattern of increasing or decreasing concentrations between the well groups. Two exceptions are boron and molybdenum showing, again, a trend of decreasing concentrations from the Tailings Basin wells to downgradient wells, to residential and background wells.

The MPCA conducted a desktop review of the residential well and monitoring well results (which, in part, included the consideration of chemical tracers). This review concluded that it is not clear whether elevated concentrations in some of the residential wells were caused by the Tailings Basin or reflect natural or localized background concentrations. However, the results for residential wells are similar to the results for natural background wells. That similarity suggests that the residential wells may not be impacted by the Tailings Basin.

Table 4.2.2-24 Summary of Existing Groundwater Quality Monitoring Data Downgradient from the Existing LTVSMC Tailings Basin

Parameters	Units	Groundwater Evaluation Criteria	Downgradient Wells (GW-009, GW-010, GW-014, GW-016) Surficial Aquifer			
General			**Detection**	**Mean[1]**	**Range**	**# Exceed**
Alkalinity	mg/L	--	42 of 42	286	32.9–507	NA
Ammonia as Nitrogen	mg/L	--	24 of 42	0.12	<0.025–0.36	NA
Calcium	mg/L	--	42 of 42	65.8	6.9–252	NA
Carbon, total organic	mg/L	--	42 of 42	13.5	5.4–25.5	NA
Chloride	mg/L	250	42 of 42	12.2	1.4–20.4	0
Fluoride	mg/L	2	35 of 42	0.22	<0.05–0.86	0
Hardness	mg/L	--	42 of 42	326	32.3–1,220	NA
Magnesium	mg/L	--	42 of 42	39.3	3.7–144	NA
pH	s.u.	6.5–8.5	43 of 43	7.1	6.6–7.8	**0**
Potassium	mg/L	--	42 of 42	3.9	0.99–17.2	NA
Sodium	mg/L	--	42 of 42	47.7	3.7–79.4	NA
Sulfate	mg/L	250	42 of 42	62.7	1.6–235	0
TDS	mg/L	500	38 of 38	422	97–653	**11**
Metals – Total						
Aluminum	µg/L	200	37 of 42	**11,356**	<10–134,000	**28**
Antimony	µg/L	6	3 of 42	0.37	<0.25–<2.5	0
Arsenic	µg/L	10	34 of 42	3.0	<0.25–26.6	**1**
Barium	µg/L	2,000	42 of 42	621	15.1–1930	0
Beryllium	µg/L	0.08	10 of 42	**0.45**	<0.1–5.43	BDL[2]
Boron	µg/L	1,000	36 of 42	139	<25–278	0
Cadmium	µg/L	4	10 of 42	0.35	<0.1–4.57	**1**
Chromium	µg/L	100	34 of 42	54.8	<0.5–1,000	**5**
Cobalt	µg/L	--	42 of 42	13.7	1.1–215	NA
Copper	µg/L	1,000	42 of 42	37.0	1.2–545	0
Iron	µg/L	300	42 of 42	**24,834**	729–228,000	**42**
Lead	µg/L	--	22 of 42	5.5	<0.25–78.4	NA
Manganese	µg/L	50	42 of 42	**2,044**	217–6,720	**42**
Mercury	ng/L	2,000	41 of 41	12.7	0.81–102	0
Methylmercury	ng/L	--	16 of 39	0.09	<0.015–0.51	NA
Molybdenum	µg/L	--	42 of 42	12.5	0.22–130	NA
Nickel	µg/L	100	39 of 42	39.1	<0.25–620	**3**
Selenium	µg/L	30	4 of 42	0.8	<0.5–6.49	0
Silver	µg/L	30	4 of 42	0.16	<0.1–1.05	0
Thallium	µg/L	0.6	7 of 42	0.19	<0.0085–1.15	**3**
Zinc	µg/L	2,000	19 of 42	42.8	<3–610	0
Metals – Dissolved/Filtered						
Aluminum	µg/L	200	16 of 42	29.1	<10–232	**1**
Antimony	µg/L	6	0 of 0	--	--	NA
Arsenic	µg/L	10	25 of 38	1.6	<0.25–6.2	0
Barium	µg/L	2,000	22 of 22	515	9.1–1,920	0
Beryllium	µg/L	0.08	0 of 0	--	--	NA
Boron	µg/L	1,000	23 of 26	143	<25–267	0
Cadmium	µg/L	4	3 of 42	0.12	<0.1–1.1	0
Chromium	µg/L	100	16 of 42	1.0	<0.5–2.86	0

Parameters	Units	Groundwater Evaluation Criteria	Downgradient Wells (GW-009, GW-010, GW-014, GW-016) Surficial Aquifer			
Cobalt	µg/L	--	22 of 22	2.4	0.58–5.4	NA
Copper	µg/L	1,000	42 of 42	2.9	0.52–20.7	0
Iron	µg/L	300	35 of 36	**7,132**	<25–14,800	**33**
Lead	µg/L	--	0 of 22	0.25	<0.25–<0.25	NA
Manganese	µg/L	50	38 of 38	1,624	17.3–3,910	37
Molybdenum	µg/L	--	42 of 42	9.2	0.24–59	NA
Nickel	µg/L	100	40 of 42	3.3	<0.25–11.2	0
Selenium	µg/L	30	1 of 42	0.5	<0.5–<0.5	0
Silver	µg/L	30	0 of 42	0.1	<0.1–<0.1	0
Thallium	µg/L	0.6	0 of 0	--	--	NA
Zinc	µg/L	2,000	15 of 42	6.3	<3–37.2	0

Source: Barr 2014d; Barr 2009d.

Notes:
Bold (e.g., **0.014**) indicates exceeds evaluation criteria.
[1] Where non-detects occur, the mean was calculated using half the detection limit.
[2] Below detection limit. Detection limit is greater than water quality standard.

Table 4.2.2-25 Summary of Groundwater Quality of Residential Wells Downgradient from the Existing LTVSMC Tailings Basin

Parameters	Units	Groundwater Evaluation Criteria	Downgradient Residential Wells Bedrock and Surficial Aquifers			
General			**Detection**	**Mean[1]**	**Range**	**# Exceed**
Alkalinity	mg/L	--	--	--	--	NA
Ammonia as Nitrogen	mg/L	--	--	--	--	NA
Calcium	mg/L	--	15 of 15	25	11.7–51.4	NA
Carbon, total organic	mg/L	--	--	--	--	NA
Chloride	mg/L	250	14 of 15	4.2	<0.5–12.5	0
Fluoride	mg/L	2	11 of 15	0.2	<0.1–0.6	0
Hardness	mg/L	--	--	--	--	NA
Magnesium	mg/L	--	--	--	--	NA
pH	s.u.	6.5–8.5	15 of 15	6.9	5.7–7.9	**4**
Potassium	mg/L	--	--	--	--	NA
Sodium	mg/L	--	--	--	--	NA
Sulfate	mg/L	250	11 of 15	6.1	<1–20.9	0
TDS	mg/L	500	15 of 15	125	83–243	0
Metals – Total						
Aluminum	µg/L	200	2 of 15	30.2	<25–83	**1**
Antimony	µg/L	6	0 of 15	<0.5	<0.5	0
Arsenic	µg/L	10	3 of 15	2.8	<2–7.5	0
Barium	µg/L	2,000	--	--	--	--
Beryllium	µg/L	0.08	--	--	--	--
Boron	µg/L	1,000	3 of 15	79	<50–459	0
Cadmium	µg/L	4	--	--	--	--
Chromium	µg/L	100	--	--	--	--
Cobalt	µg/L	--	--	--	--	--
Copper	µg/L	1,000	13 of 14	38	<0.7–155	0
Iron	µg/L	300	--	--	--	--

Parameters	Units	Groundwater Evaluation Criteria	Downgradient Residential Wells Bedrock and Surficial Aquifers			
Lead	µg/L	--	--	--	--	--
Manganese	µg/L	50	15 of 15	**579**	0.66–4,710	**7**
Mercury	ng/L	2,000	--	--	--	--
Methylmercury	ng/L	--	--	--	--	--
Molybdenum	µg/L	--	12 of 15	0.6	0.2–2.8	--
Nickel	µg/L	100	14 of 15	1.9	<0.6–5.5	0
Selenium	µg/L	30	--	--	--	--
Silver	µg/L	30	--	--	--	--
Thallium	µg/L	0.6	--	--	--	--
Zinc	µg/L	2,000	--	--	--	--
Metals – Dissolved/Filtered						
Aluminum	µg/L	200	2 of 15	28	<25–71	1
Arsenic	µg/L	10	3 of 15	2.7	<2–7.5	0
Barium	µg/L	2,000	--	--	--	--
Boron	µg/L	1,000	3 of 15	80	<50–461	0
Cadmium	µg/L	4	--	--	--	--
Chromium	µg/L	100	--	--	--	--
Cobalt	µg/L	--	--	--	--	--
Copper	µg/L	1,000	14 of 15	19.3	<0.7–64.5	0
Iron	µg/L	300	--	--	--	--
Lead	µg/L	--	--	--	--	--
Manganese	µg/L	50	15 of 15	579	0.63–4,850	7
Molybdenum	µg/L	--	--	--	--	--
Nickel	µg/L	100	12 of 15	1.6	<0.6–5	0
Selenium	µg/L	30	--	--	--	--
Silver	µg/L	30	--	--	--	--
Zinc	µg/L	2,000	--	--	--	--

Source: Barr 2009d.

Notes:
Bold (e.g., **0.014**) indicates exceeds evaluation criteria.
[1] Where non-detects occur, the mean was calculated using half the detection limit.

Legacy Groundwater Quality Issues

In 2002, Cliffs Erie commissioned a Phase I ESA of the former LTVSMC property and improvements (NTS 2002). This study identified 62 potential AOCs. Designation as an AOC does not necessarily mean that contamination occurred in the past or is currently present, but simply that these are areas requiring further investigation. The AOCs are discussed further in Section 4.2.1.

In May 2009, Cliffs Erie conducted a detailed assessment of both surface and groundwater quality at the existing LTVSMC Tailings Basin that included testing for VOCs, SVOCs, PCBs, and other parameters to determine if there was any organic contamination that could be transported off-site via stormwater runoff or groundwater seepage. The laboratory analyses showed no evidence of organic contamination leaving the site (Cliffs Erie 2009). The investigations conducted to date and the results of laboratory analyses (which includes sampling at seven monitoring wells, 14 surface discharges, 12 internal waste streams, and six downstream surface water monitoring stations, and visual observation and limited field analyses at 33 seeps at or near the existing LTVSMC Tailings Basin) indicate that these pollutants have not migrated off site.

As noted above, groundwater quality monitoring at several wells completed in the surficial deposits at or near the toe of the Tailings Basin found elevated aluminum, iron, and manganese concentrations, similar to the baseline wells (see Table 4.2.2-23), but also exhibited elevated sulfate, fluoride, molybdenum, and TDS concentrations relative to the baseline wells (see Table 4.2.2-22). Considering these results, NTS (2009) concluded that groundwater had been impacted by the Tailings Basin. NTS noted, however, that there did not appear to be an overall trend, either increasing or decreasing, in the concentration of the monitored constituents.

Baseline Groundwater Quality in the Bedrock

No bedrock groundwater samples have been collected from the Plant Site/Tailings Basin area. Although some of the residential wells are drilled into bedrock, the well completion records indicate that these wells were not constructed as monitoring wells to separate the bedrock groundwater from the surficial aquifer. Siegel and Ericson (1980) report that iron and manganese concentrations of up to 500 µg/L are common in the Giants Range batholith.

Groundwater Use

There are 29 known residential wells between the Tailings Basin and the Embarrass River, with the closest located approximately 1.6 miles from the toe of Cell 2E. Characteristics of the wells are presented in Table 4.2.2-25. Table 4.2.2-26 and Figure 4.2.2-16 shows the locations of all the identified wells and which of those wells were sampled. Analytical results for groundwater samples collected from these 15 residential wells are summarized in Table 4.2.2-25.

Table 4.2.2-26 Existing Domestic Wells Located Between the NorthMet Project Proposed Action Tailings Area and the Embarrass River

Unique Well No.	Direction From Site	Surface Elev. (ft)	Depth (ft)	Depth Cased (ft)	GWL (ft bgs)	Casing Diameter (in)	Aquifer
476480	NW	1,445	63	63	8	6	Alluvium
584595	N	1,468	30	30	8.3	6	Alluvium
144818	N	1,467	45	28	--	6	Bedrock
668955	N	1,459	50	50	15.3	6	Alluvium
658445	N	1,436	83	81	-2	6	Bedrock
693384	W	1,423	325	20	22	6	Bedrock
151880	NW	1,433	103	96	--	6	Multiple
189325	NW	1,430	97	97	7	6	Alluvium
519773	NW	1,417	42	42	5	6	Alluvium
169958	NW	1,443	223	33	23	6	Bedrock
411142	NW	1,445	229	34	35	6	Bedrock
409338	NW	1,429	43	43	25	6	Alluvium
563293	N	1,459	325	18	--	6	Bedrock
555048	NNE	1,459	45	29	0	6	Bedrock
620123	NNE	1,461	65	18	8.2	6	Bedrock
555023	NNE	1,459	100	19	--	6	Bedrock
716183	NNE	--	325	29	20.5	6	Bedrock
174550	NE	1,445	60	50	8	7	Bedrock
447031	N	1,451	86	86	15	6	Alluvium

Unique Well No.	Direction From Site	Surface Elev. (ft)	Depth (ft)	Depth Cased (ft)	GWL (ft bgs)	Casing Diameter (in)	Aquifer
701452	N	--	125	40	8	6	Unknown
735554	N	--	205	31	14	6	Bedrock
576439	NNW	1,447	80	80	7.7	6	Alluvium
187853	NNW	1,465	90	90	--	6	Alluvium
529149	NNW	1,468	42	42	22	6	Alluvium
620143	NNW	1,469	61	61	34.4	6	Alluvium
409060	NNW	--	100	60	40	6	Unknown
741400	NNW	--	41	41	21	6	Unknown
477836	NNW	1,450	81	80.5	17	6	Alluvium
762811	NW	1,450	85	72	19	6	Bedrock

Sources: MDH 2015; Barr 2009d; Barr 2015a.

Note:
GWL = groundwater level

4.2.2.3.2 Surface Water Resources

This section describes the existing surface water resources in the Embarrass River Watershed that could be affected by the NorthMet Project Proposed Action. These resources include the Embarrass River, several small streams draining the Tailings Basin that are tributaries of the Embarrass River (i.e., Mud Lake Creek, Trimble Creek, and Unnamed Creek—see Figure 4.2.2-4), and the Embarrass River chain of lakes. Note that Mud Lake Creek is an unofficial name given the Unnamed Creek that flows north from the northeast corner of the Tailings Basin. It was given this name because of Mud Lake near the headwaters of the stream, and to distinguish it from the other Unnamed Creek that flows northwest from the northwest corner of the Tailing Basin. It is referred to as Mud Lake Creek throughout the FEIS.

Since publication of the DEIS, additional surface water quality data has been collected at many locations within the Embarrass River Watershed. These new data have been summarized below to better describe existing conditions. The surface water hydrology of the Embarrass River and its tributaries was not evaluated using the XP-SWMM model. Rather, it was estimated using a spreadsheet model that extrapolates flows from a USGS gaging station on a catchment area basis.

<u>Embarrass River</u>

This section describes the baseline surface water hydrology and water quality of the mainstem of the Upper Embarrass River, several streams that receive drainage from the Tailings Basin and are tributaries of the Embarrass River, and the Lower Embarrass River as it flows through an area referred to as the chain of lakes.

Embarrass River Hydrology

The Embarrass River originates just south of the City of Babbitt and flows southwest approximately 23 miles to its confluence with the St. Louis River, draining 171 square miles as measured at McKinley, near the confluence with the St. Louis River. The Embarrass River Watershed is dominated by upland forests (44 percent), lowland forest and aquatic environments (23 percent), crop/grassland (8 percent), and scrub/shrub (21 percent), with little development

(4 percent). Most of the Tailings Basin seepage drains to the Embarrass River via three tributary streams.

There were two USGS gaging stations located within the Embarrass River Watershed (#04017000 located about three miles northwest of the Tailings Basin and #04018000 located about 7 miles southwest of the Tailings Basin). Table 4.2.2-27 provides flow data for the nearest gaging station at the Embarrass River Watershed (Station #04017000; see Figure 4.2.2-17 for location).

Table 4.2.2-27 Monthly Statistical Flow Data for USGS Embarrass Gaging Stations

Station:	04017000 Embarrass River at Embarrass		
Period of Record:	1942–1964		
Drainage Area:	88.3 mi^2		
Month	**Monthly Average (cfs)**	**Daily Minimum (cfs)**	**Daily Maximum (cfs)**
October	46	2.6	453
November	33	4.9	166
December	14	3.4	50
January	6.7	0.90	22
February	5.0	0.90	14
March	22	1.4	774
April	190	2.6	1,490
May	194	21	1,720
June	114	5.2	1,090
July	63	3.6	790
August	31	1.8	284
September	50	2.2	789

Source: Siegel and Ericson 2008.

Flow characteristics for different reaches of the Embarrass River and selected tributaries were estimated by extrapolating flows from USGS gaging station 04017000 (located just downstream of PM-12.3) on a catchment area basis. A summary of the flow results for different stations on Embarrass River, Mud Lake Creek, Trimble Creek, and Unnamed Creek is provided in Table 4.2.2-28. Flow contributed by the Tailings Basin seepage is separated from the flows derived using the unit-area basis in the table to provide greater clarity of water origins. Tailings Basin flows presented in the last column of Table 5.2.2-14 can be added to the annual flow characteristics presented in the table to determine the appropriate flow volume.

Table 4.2.2-28 Plant Site Surface Water Flows for Existing Conditions Based on Embarrass River Stream Gaging Results Applied to Contributing Watersheds and Additional Flow Tailings Basin Seepage and Flowpath Discharge

Stream	Embarrass River or Tributary Surface Water Station	Existing Watershed Area Excluding Tailings Basin Footprint (mi^2)	Estimated Groundwater Baseflow (cfs)	Annual 7-Day Minimum Flow with 10-year Return Period[1] (cfs)	Annual 1-Day Minimum Flow[1,2] (cfs)	Annual Daily Mean Flow[1,2] (cfs)	Annual 1-day Maximum Flow[1,2] (cfs)	Annual 1-day Maximum Flow with 10-year Return Period[1] (cfs)	Additional Flow to Station from Tailings Basin Seepage (cfs)
Embarrass River	PM-12	19.0	0.86	0.4	0.74	13.8	145	259	0.00
	PM-12.2	34.2	1.55	0.7	1.34	24.9	261	467	0.00
	PM-12.3	83.0	3.76	1.79	3.24	60.5	633	1,135	4.41
	PM-12.4	94.4	4.27	2.07	3.69	68.8	720	1,290	4.43
	PM-13[3]	107	4.83	2.33	4.17	77.8	814	1,457	5.77[4]
Mud Lake Creek	MLC-3	1.40	0.06	0.07	0.05	1.02	10.7	19.2	0.83
	MLC-2	3.57	0.16	0.07	0.14	2.60	27.2	49.1	0.93
Trimble Creek	TC-1	2.18	0.10	0.04	0.09	1.59	16.6	29.6	3.36
	PM-19	3.94	0.18	0.12	0.15	2.87	30.1	53.5	3.48
Unnamed Creek	UC-1a	2.29	0.10	0.09	0.09	1.67	17.5	30.9	1.11
	PM-11	3.37	0.15	0.09	0.13	2.46	25.7	45.9	1.11

Source: Barr 2015i.

Notes:
1 Based on USGS record applied to watershed area, flow from the tailings basin (last column) is in addition to the flow values presented.
2 Long-term average.
3 PM-13 values differ from those in Table 4-5 of the Plant Site Water Modeling Data Package (PolyMet 2015j), which were based on the historical drainage area of 88.3 mi^2.
4 5.77 cfs (2,590 gpm) is the estimated total seepage from the Tailings Basin.

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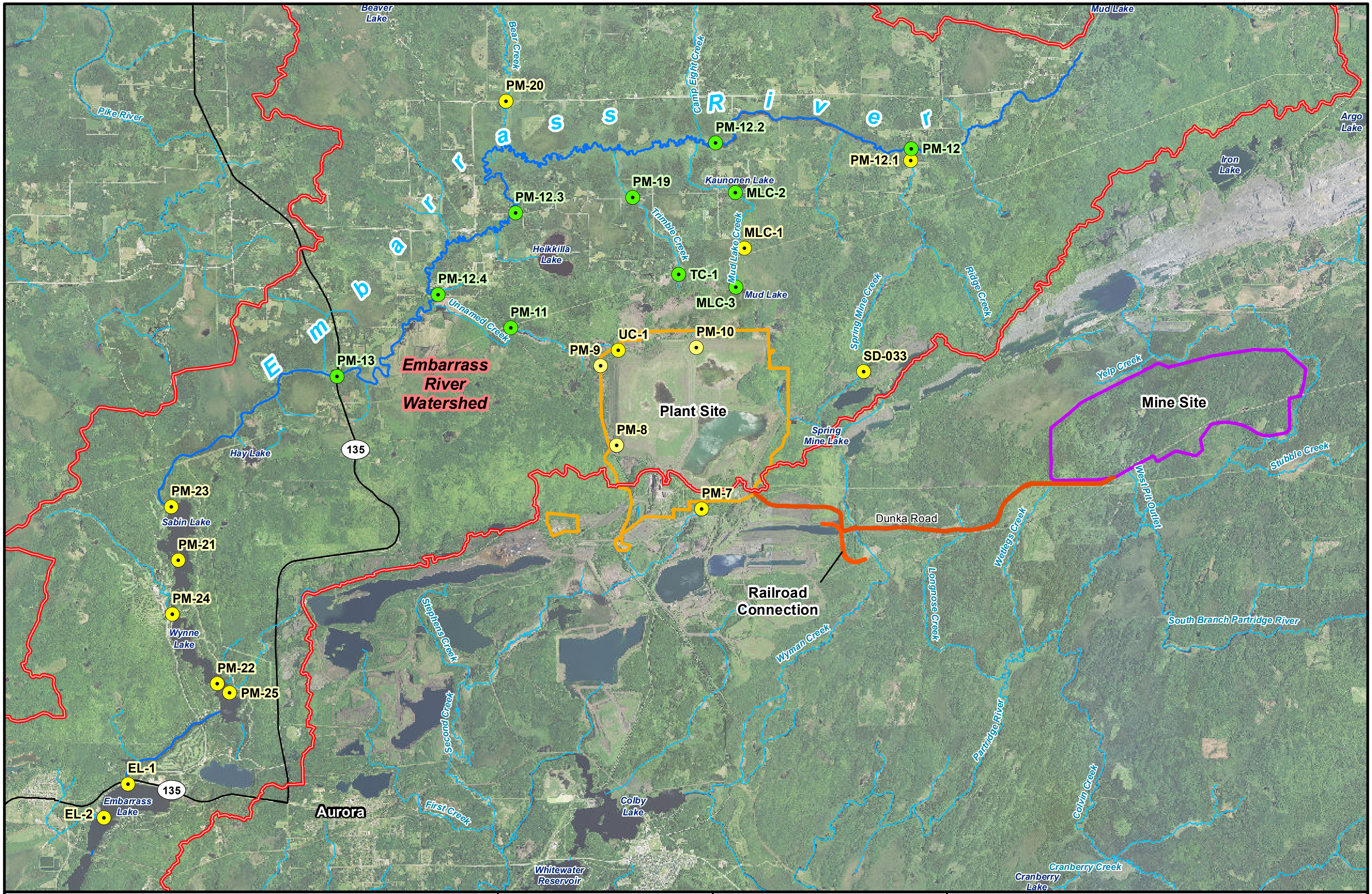

Mine Site
Plant Site
Transportation and Utility Corridor
Embarrass River
Surface Water Monitoring/Modeling Location
Surface Water Monitoring Location
Embarrass River Watershed
Extisting Road

Minnesota Department of Natural Resources
US Army Corps of Engineers St. Paul District
Forest Service U.S. Department of Agriculture

This document is a working document. This document may change over time as a result of new information, further deliberation, or other factors not yet known to the Co-lead Agencies.

N W E S

0 0.5 1 2 3 Miles

Figure 4.2.2-17

Surface Water Monitoring and Modeling Locations within the Embarrass River Watershed

NorthMet Mining Project and Land Exchange PFEIS

Minnesota

June 2015

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Overflow and seepage from several former mining facilities, including the Area 5 NW Pit upstream of the Tailings Basin, contribute to the flow farther downstream in the Embarrass River, as shown in Table 4.2.2-29 and Figure 4.2.2-9. Based on measurements between 2012 and 2014, an average of approximately 1.2 cfs overflows from Pit 5NW to Spring Mine Creek where it flows north about 5 miles before joining the Embarrass River just downstream of monitoring station PM-12 (see Figure 4.2.2-1).

Table 4.2.2-29 NPDES/SDS Discharges to the Embarrass River Watershed

NPDES/SDS Permit Number	Permit Number	Outfalls ID	Outfall Description	Receiving Waters	Flow (cfs) Avg.[1]	Flow (cfs) Max.
Mesabi Mining LLC	MN0069078	SD-022	Pit 9 Dewatering Pipe	Wynne Lake	0 0	0.0
Cliffs Erie LLC	MN0042536	SD-033	Pit 5NW overflow	Spring Mine Creek	1.2;v	--
Mesabi Mining LLC	MN0069078	SD-004	Pit 1 dewatering discharge	Wynne Lake	0.0	0.0
Cliffs Erie LLC	MN0054089	SD-001	NW seepage collection ditch	Unnamed creek	--	--
		SD-002	NE seepage collection ditch	Trimble Creek	--	--
		SD-004	Tailings Basin Cell 2W Seep A	Unnamed creek	0.28	3.00
		SD-005	Tailings Basin Cell 2W Seep B	Kaunonen Creek	--	0.46
		SD-006	Power line access road culvert	Unnamed creek	5.0	6.2

Sources: MPCA 2012; 2012j; 2012l; 2013a; 2013h; 2013j; 2013k; 2014d; 2014e; 2014f.

Note:
[1] Average flow when discharging. Many of these discharges only occur intermittently and may be currently inactive.

There are no large surface water withdrawals or water appropriation permits issued for the Embarrass River in the NorthMet Project area. The headwaters of the Embarrass River Watershed include a portion of the City of Babbitt, but are otherwise relatively undeveloped and unaffected by any mining. The City of Babbitt WWTP has an annual average discharge of approximately 0.33 cfs to the headwaters (PolyMet 2015j).

Embarrass River Water Quality

As indicated in Table 4.2.2-30, PolyMet collected water quality data from five locations that can be used to establish baseline water quality along the Embarrass River. Samples from two primary locations, PM-12 and PM-13, were subject to evaluation for all water quality parameters, while samples from locations PM-12.2, PM-12.3, and PM-12.4 were analyzed for a more limited set of parameters. The locations of the monitoring stations, all along the main branch of the Embarrass River, are shown in Figure 4.2.2-17. Table 4.2.2-32 summarizes the water quality data for the five Embarrass River sites sampled by PolyMet between 2004 and 2013. Average parameter concentrations above evaluation criteria were observed for aluminum at PM-12.3 and PM-13, for sulfate at PM-13 (where the 10 mg/L wild rice sulfate standard is applicable), and for mercury at PM-12 and PM-13.

Table 4.2.2-30 Available Surface Water Quality Monitoring Data in the Embarrass River Main Branch (see Figure 4.2.2-1)

Sample Location	Source	Sampling Period
Mainstem Embarrass River		
PM-12[1]	PolyMet / C-N Study / Cliffs Erie	1976, 2001–2013
CN120	USGS/C-N Study	1955–1963, 1976–1977
PM-12.2	PolyMet	2010–2013
PM-12.3	PolyMet	2010–2013
PM-12.4	PolyMet	2010–2013
PM-13	PolyMet / Cliffs Erie	2001–2013

Sources: Barr 2007h; Barr 2014d.

Notes:
C-N Study – Regional Copper-Nickel Study (Siegel and Ericson 1980)

[1] Monitoring station formally designated as CN121.

The Regional Copper-Nickel Study (Siegel and Ericson 1980) considered monitoring station PM-12 (formally designated as CN121) as representative of "undisturbed" conditions. Under current assumed conditions, this monitoring station receives stormwater runoff and WWTP discharges (0.33 cfs of predominantly domestic wastewater) from the City of Babbitt, but is otherwise unaffected by mining or other significant development (PolyMet 2015j). Table 4.2.2-31 compares 1976 data from the Regional Copper-Nickel Study with recent data from PolyMet for monitoring station PM-12. These data show that mean water quality at this monitoring station currently meets surface water quality standards for the parameters monitored. Most of the measured parameters exhibit relatively little change over the 30-year period, although concentrations of several constituents (notably iron, manganese, and zinc) have increased, while concentrations of aluminum and cobalt appear to be decreasing slightly.

Table 4.2.2-31 Comparison of Historic and Recent Mean Water Quality Data for Selected Parameters at PM-12 on the Embarrass River

General Parameter	Units	Evaluation Criteria	1976	2004–2013[(1)]
Hardness	mg/L	500	50[(4)]	60.4
pH	s.u.	6.5–8.5	6.9	6.9
Sulfate	mg/L	--[(2)]	6.1	7.2
Metals – Total				
Aluminum	µg/L	125	**127**	99.8
Arsenic	µg/L	53	0.9	1.6
Cobalt	µg/L	5	2.3[(4)]	1.0
Copper	µg/L	5.2[(3)]	0.9[(4)]	1.1
Iron	µg/L	--	1,121	4,151
Lead	µg/L	1.3[(3)]	0.2	0.26
Manganese	µg/L	--	234	429
Nickel	µg/L	29[(3)]	1.0[(4)]	1.4
Zinc	µg/L	67[(3)]	1.1[(4)]	9.5

Sources: Siegel and Ericson 1980; Barr 2007i for 1976 data; Barr 2014d for 2004–2013 data.

Notes:
1 Includes non-detects at half the detection limit.
2 Sulfate standard of 10 mg/L applies to designated “waters supporting the production of wild rice.”
3 Water quality standard for this metal is hardness-dependent. Listed value assumes a hardness concentration of 50 mg/L.
4 Based on fewer than five samples.

As indicated in Table 4.2.2-30, PolyMet collected water quality data from five locations that can be used to establish baseline water quality along the Embarrass River. Samples from two primary locations, PM-12 and PM-13, were subject to evaluation for all water quality parameters, while samples from locations PM-12.2, PM-12.3, and PM-12.4 were analyzed for a more limited set of parameters. The locations of the monitoring stations, all along the main branch of the Embarrass River, are shown in Figure 4.2.2-17. Table 4.2.2-32 summarizes the water quality data for the five Embarrass River sites sampled by PolyMet between 2004 and 2013. Average parameter concentrations above evaluation criteria were observed for aluminum at PM-12.3 and PM-13, for sulfate at PM-13 (where the 10 mg/L wild rice sulfate standard is applicable), and for mercury at PM-12 and PM-13.

Surface water monitoring station PM-12 does receive a small discharge from the City of Babbitt WWTP, but is otherwise upstream of all NorthMet Project Proposed Action activities and therefore serves as a control location.

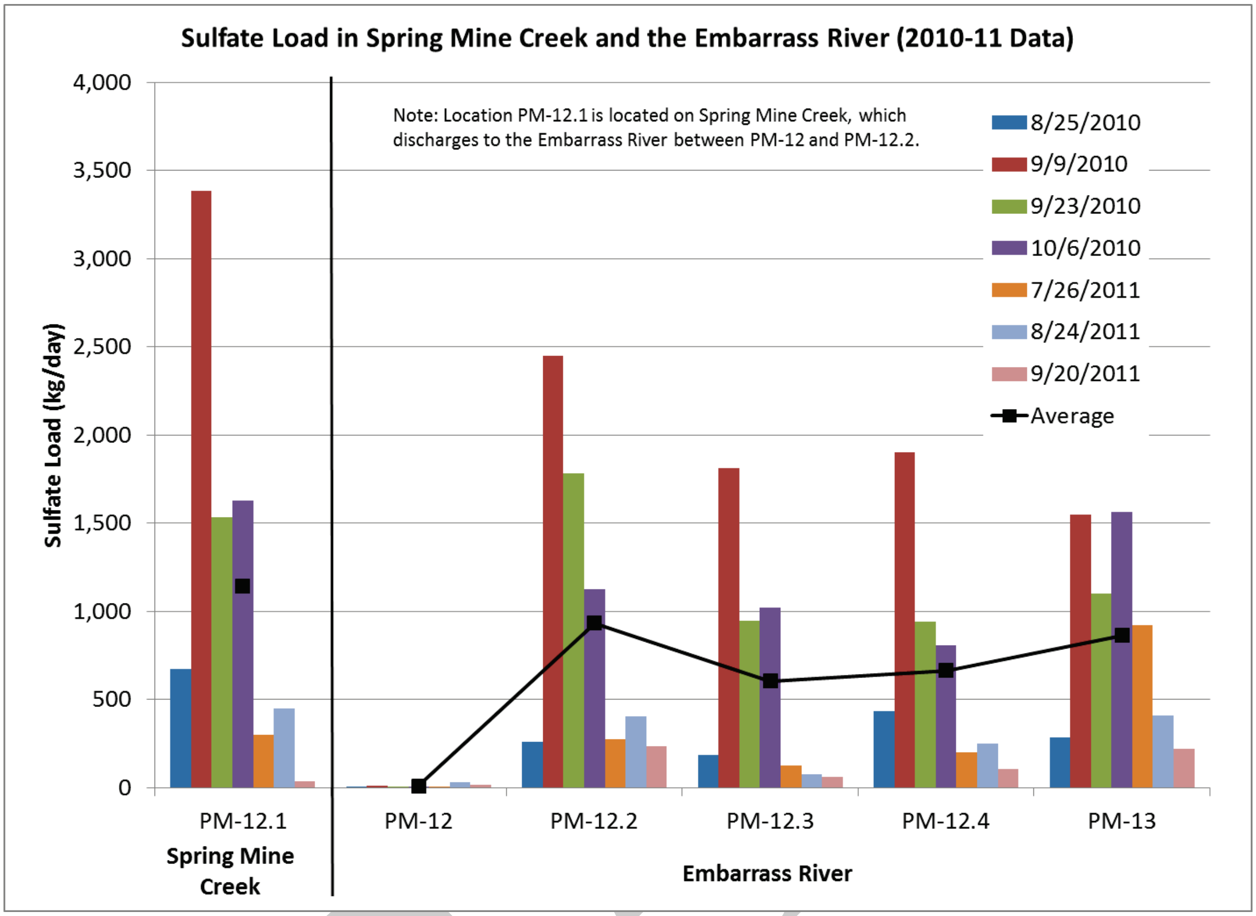
Samples of limited water quality data collected at PM-12.2, PM-12.3, and PM-12.4 between 2010 and 2013 allow the identification of progressive trends for major anions and some metals between PM-12 and PM-13 along the mainstem of the Embarrass River. Chloride appeared relatively constant with location, varying from an average of 4.7 mg/L at PM-12 to 5.0 mg/L at PM-12.4 and 5.8 mg/L at PM-13. pH also appeared relatively constant, from an average of 6.9 at PM-12 to 7.3 at PM-12.4 and 7.4 at PM-13. Sulfate, however, varied substantially, increasing from an average of 7.2 mg/L at PM-12 to 131 mg/L at PM-12.2, and then decreasing to an average of 39.4 mg/L at PM-13, indicating either dilution or a process that sequesters sulfate in the Embarrass River and the surrounding wetlands.

The increase in sulfate concentrations between PM-12 and PM-12.2 can be attributed to sulfate loading from Spring Mine Creek, which flows into the Embarrass River immediately downstream from PM-12. Limited water quality data were collected at PM-12.1 on Spring Mine Creek, which receives drainage from former LTVSMC Pit 5NW (see Figure 4.2.2-1). These data are summarized in Table 4.2.2-32 alongside the Embarrass River mainstem sites. Pit 5NW is completely flooded and has been overflowing since before 2001, with an annual average flow of about 1.5 cfs to Spring Mine Creek, which discharges into the Embarrass River. This discharge has sulfate concentrations that average 1,060 mg/L (PolyMet 2015j), as measured at the Pit 5NW outflow. Sulfate concentrations at PM-12.1 averaged 388 mg/L and ranged as high as 944 mg/L, indicating that the Pit 5NW outflow via Spring Mine Creek provides a significant source of sulfate loading to Embarrass River, which accounts for the increase in sulfate concentrations between PM-12 and PM-12.2. As noted in Table 4.2.2-2, Spring Mine Creek from Ridge Creek to Embarrass River was listed by the MPCA as impaired for aquatic macroinvertebrates and fish while the Embarrass River Watershed from the headwaters to Embarrass Lake was listed as impaired for fish.

Sulfate and chloride loading data were collected concurrently with water quality data in Spring Mine Creek and the Embarrass River in 2010 and 2011, and were consistent with the observations discussed above (see Figures 4.2.2-18 and 4.2.2-19). Sulfate loading increased from an average of 10.2 kg/day at PM-12 to an average of 932 kg/day at PM-12.2, due to sulfate loading contributed from Pit 5NW via Spring Mine Creek (average sulfate load of 1142 kg/day measured at PM-12.1). Between PM-12.2 and PM-13, the average sulfate load decreased by approximately 70 kg/day, even though there is approximately 3,120 kg/day currently leaving the Tailings Basin towards the Embarrass River (the sum of loads leaving the northern, northwestern, and western toes of the Tailings Basin; PolyMet 2015j). Meanwhile, the calculated load of chloride (Figure 4.2.2-19), a parameter which serves as a tracer for Tailings Basin seepage, increased in the downstream direction along the Embarrass River, indicating that the Tailings Basin seepage is reaching the Embarrass River. Consequently, the decrease in sulfate loading between PM-12.1 and PM-12.2, and between the Tailings Basin and the Embarrass River, is attributable to some natural process such as biological sulfate reduction that is sequestering sulfate in the wetlands and tributaries between the Tailings Basin and the Embarrass River.

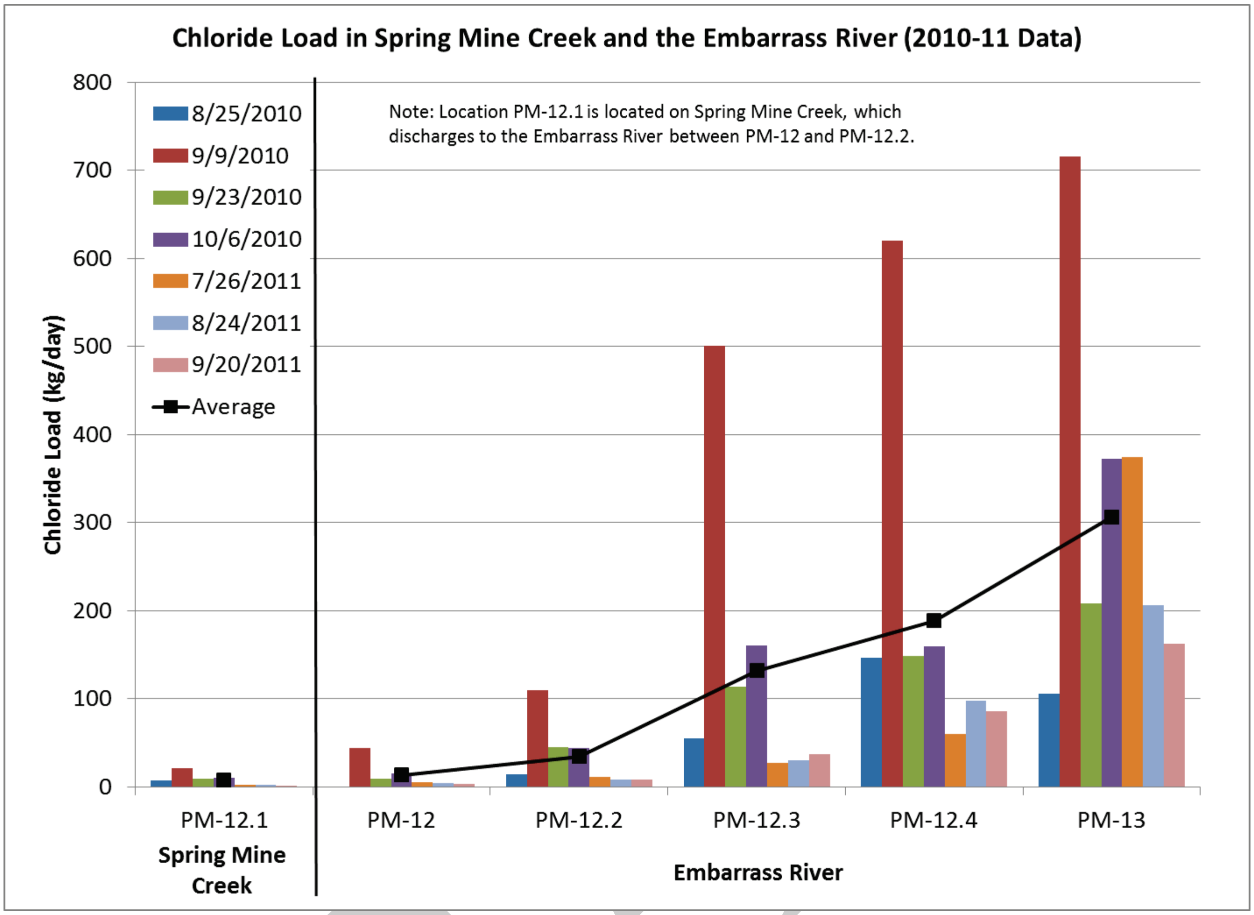
Flows from groundwater and surface seepage from the existing LTVSMC Tailings Basin reach the Embarrass River via several small tributaries including Mud Lake Creek and Trimble Creek, which enter upstream of station PM-12.3, and Unnamed Creek, which enters upstream of station PM-13 (see Figure 4.2.2-1). These tributaries are described in more detail below. There are also extensive wetlands on the northern, northwestern, and western sides of the LTVSMC Tailings Basin. While much of the wetlands water likely flows into the tributaries, other flows may directly reach the Embarrass River by means of the system of wetlands.

The effects of Pit 5NW, the existing LTVSMC Tailings Basin, and groundwater seepage and surface runoff from elsewhere within the watershed are reflected in the water quality at station PM-13, which is located downstream of these and all NorthMet Project area sources of pollution within the Embarrass River Watershed (see Table 4.2.2-29). Since PM-13 is downstream of all Tailings Basin seepage, it was used to evaluate NorthMet Project Proposed Action effects on flow and water quality in the Embarrass River in Section 5.2.2.



Source: Adapted from PolyMet 2015j.

Figure 4.2.2-18 Sulfate Load Calculated in Spring Mine Creek and the Embarrass River (2010-2011)



Source: Adapted from PolyMet 2015j.

Figure 4.2.2-19 Chloride Load Calculated in Spring Mine Creek and the Embarrass River (2010-2011)

Table 4.2.2-32 Average Existing Water Quality in the Embarrass River, 2004-2013[(1)]

Parameter	Units	Evaluation Criteria	Spring Mine Creek PM-12.1			Embarrass River PM-12			PM-12.2			PM-12.3			PM-12.4			PM-13		
			Detection	Mean	Range	Detection	Mean	Range	Detection	Mean	Range	Detection	Mean	Range	Detection	Mean	Range	Detection	Mean	Range
General																				
Alkalinity	mg/L	--	2 of 2	140	120–159	33 of 33	50.2	15.2–152	--	--	--	--	--	--	--	--	--	31 of 31	90.5	26.0–197
Calcium	mg/L	--	2 of 2	36.3	33.0–39.6	46 of 46	13.8	4.1–29.3	--	--	--	--	--	--	--	--	--	44 of 44	21.7	7.0–44.7
Chloride	mg/L	230	29 of 29	2.5	0.62–4.9	61 of 61	4.7	1.3–22.3	27 of 27	3.4	1.3–10.3	27 of 27	4.7	1.5–11.2	27 of 27	5.0	1.6–13.0	59 of 59	5.8[(2)]	2.0–94.8
Fluoride	mg/L	--	0 of 0	--	--	11 of 21	0.10	<0.05–0.20	--	--	--	--	--	--	--	--	--	18 of 21	0.37	<0.05–2.3
Hardness	mg/L	500	2 of 2	380	330–429	46 of 46	60.4	17.8–171	--	--	--	--	--	--	--	--	--	44 of 44	129	35.6–337
Magnesium	mg/L	--	2 of 2	70.2	60.2–80.1	46 of 46	6.4	1.9–27.3	--	--	--	--	--	--	--	--	--	44 of 44	18.3	6.1–54.7
pH	s.u.	6.5-8.5	28 of 28	7.5	6.7–**8.6**	61 of 61	6.9	**5.8**–7.9	25 of 25	7.0	**6.1**–8.1	26 of 26	7.2	**6.3–**7.9	26 of 26	7.3	**6.4**–8.2	59 of 59	7.4	**6.3–8.6**
Potassium	mg/L	--	2 of 2	15.3	12.7–17.8	13 of 15	1.1	<0.25–4.0	1 of 1	7.4	7.4–7.4	--	--	--	--	--	--	13 of 13	2.8	1.5–7.4
Sodium	mg/L	--	2 of 2	27.7	23.0–32.4	17 of 17	3.6	2.2–9.0	--	--	--	--	--	--	--	--	--	15 of 15	13.0	5.2–29.8
Sulfate	mg/L	10[(4)]	29 of 29	388	81.6–944	48 of 65	7.2	<0.5–116	27 of 27	131	30.4–490	27 of 27	50.2	5.6–221	27 of 27	42.8	5.7–181	64 of 64	**39.4**[(3)]	7.6–**688**
TDS	mg/L	700	2 of 2	521	490–551	46 of 46	130	46.0–258	--	--	--	--	--	--	--	--	--	44 of 44	210	48.0–494
Metals																				
Aluminum	µg/L	125	20 of 23	57.4	<10–**210**	40 of 40	99.8	44.3–**210**	22 of 23	80.2	<10–**174**	23 of 23	**130**	26.8–**433**	22 of 23	122	<12.5–**349**	40 of 40	**188**	43.9–**505**
Antimony	µg/L	31	0 of 1	0.25	<0.25–<0.25	0 of 19	0.51	<0.25–<1.5	--	--	--	--	--	--	--	--	--	0 of 18	0.53	<0.25–<1.5
Arsenic	µg/L	53	0 of 2	0.38	<0.25–<0.5	19 of 25	1.6	<0.25–<5	--	--	--	--	--	--	--	--	--	17 of 23	1.2	<0.25–2.5
Barium	µg/L	--	2 of 2	19.5	18.5–20.4	11 of 15	19.0	<5–55.9	--	--	--	--	--	--	--	--	--	13 of 13	34.7	14.3–57.5
Beryllium	µg/L	--	0 of 2	0.10	<0.1–<0.1	0 of 12	0.10	<0.1–<0.1	--	--	--	--	--	--	--	--	--	0 of 10	0.10	<0.1–<0.1
Boron	µg/L	500	1 of 2	37.7	<25–50.4	0 of 13	24.0	<17.5–<50	--	--	--	--	--	--	--	--	--	3 of 10	32.7	<17.5–68.9
Cadmium	µg/L	2.5[(5)]	0 of 2	0.055	<0.01–<0.1	1 of 15	0.094	<0.01–<0.1	--	--	--	--	--	--	--	--	--	1 of 13	0.10	<0.1–<0.1
Cobalt	µg/L	5	0 of 2	0.10	<0.1–<0.1	23 of 44	1.0	<0.1–4.1	--	--	--	--	--	--	--	--	--	21 of 42	0.46	<0.1–0.89
Copper	µg/L	9.3[(5)]	1 of 2	0.61	<0.35–0.86	39 of 46	1.1	<0.25–2.8	--	--	--	--	--	--	--	--	--	40 of 44	1.4	<0.35–<2.5
Iron	µg/L	--	21 of 21	308	172–749	28 of 28	4,151	1.7–11,200	19 of 19	2,183	642–4,450	19 of 19	2,522	999–6,620	19 of 19	2,253	1,020–5,790	26 of 26	2,109	2.1–5,610
Lead	µg/L	3.2[(5)]	1 of 2	0.15	<0.25–<0.25	4 of 33	0.26	<0.15–<0.5	--	--	--	--	--	--	--	--	--	3 of 31	0.28	<0.15–0.63
Manganese	µg/L	--	21 of 21	225	76.9–669	31 of 31	429	15.0–1,490	19 of 19	627	78.9–1,440	19 of 19	569	43.3–1,660	19 of 19	406	53.7–1,050	28 of 29	279	<0.25–757
Mercury	ng/L	1.3	24 of 30	--**4.8**	**--**<1.0 to 9.	28 of 34	**5.1**	<1 to <10										23 of 35	**4.3**	**<1 to 12.4**
Methylmercury	ng/L	--	0 of 0	--	**--**	13 of 13	0.53	0.12–1.3	--	--	--	--	--	--	--	--	--	13 of 13	0.38	0.074–1.1
Nickel	µg/L	52[(5)]	2 of 2	1.2	0.88–1.4	41 of 46	1.4	<0.25–2.8	--	--	--	--	--	--	--	--	--	37 of 44	1.5	<0.25–2.7
Selenium	µg/L	5	1 of 1	0.10	0.096–0.096	1 of 29	0.87	<0.5–<5	--	--	--	--	--	--	--	--	--	0 of 28	0.76	<0.5–<1.8
Silver	µg/L	1.0[(5)]	0 of 2	0.10	<0.1–<0.1	0 of 17	0.20	<0.1–<0.5	--	--	--	--	--	--	--	--	--	0 of 15	0.21	<0.1–<0.5
Thallium	µg/L	0.56	0 of 2	0.10	<0.1–<0.1	7 of 28	0.19	<0.0002–<1	--	--	--	--	--	--	--	--	--	6 of 26	0.20	<0.0002–<1
Vanadium	µg/L	--	0 of 0	--	--	0 of 6	1.5	<1.5–<1.5	--	--	--	--	--	--	--	--	--	0 of 6	1.5	<1.5–<1.5
Zinc	µg/L	120[(5)]	0 of 2	3.0	<3–<3	11 of 46	9.5	<3–104	--	--	--	--	--	--	--	--	--	7 of 44	7.9	<3–51.2

Source: Barr 2014d.

Notes:
Values in bold indicates an exceedance of surface water quality standards.
1 2010 data not collected for all parameters. Includes non-detects at half the detection limit.
2 Excludes 94.8 mg/L value from November 8, 2006.
3 Excludes 688 mg/L value from November 8, 2006.
4 The MPCA has listed the waters within and downstream from Embarrass Lake, the northernmost tip of Wynne Lake, and the segment of the Embarrass River from Sabin Lake to the Highway 135 bridge as waters used for the production of wild rice, so the 10 mg/L sulfate standard is only applicable to that portion of the Embarrass River (PM-13).
5 Water quality standard for this metal is hardness-dependent. Listed value assumes a concentration of 100 mg/L.

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Embarrass River Tributary Streams

There are several tributaries to the Embarrass River that also serve as receiving waters for seepage from the existing LTVSMC Tailings Basin, including Mud Lake Creek, Trimble Creek, and Unnamed Creek. This Tailing Basin seepage occurs from both observable surface water seeps and diffuse surface water and groundwater seepage.

The existing LTVSMC Tailings Basin, proposed for tailings deposition by PolyMet, was operated from 1953 until it was shut down in January 2001. The Tailings Basin is unlined and the perimeter embankments do not have a clay core or cutoff, which allows for both surface seepage through the embankment and groundwater seepage under the embankment.

Most of the uncontrolled groundwater and surface water seepage from the existing LTVSMC Tailings Basin ultimately reaches the Embarrass River between monitoring stations PM-12 and PM-13. Table 4.2.2-33 identifies the observable Tailings Basin seeps and the flow range for the period from 2002 to 2006 for the 33 LTVSMC seeps shown in Figure 4.2.2-11 (Barr 2007f), but most of the existing Tailings Basin seepage is diffuse and not associated with these observed seeps.

As the flow monitoring shows, flow at most of these identified surface seeps has declined or stopped since tailings disposal was discontinued in 2001. Only Seep 30, which drains to wetlands north of the Tailings Basin in the Embarrass River Watershed, and Seeps 32/33, which drain to Second Creek in the Partridge River Watershed, still have flow greater than 10 gpm (Table 4.2.2-33). A portion of seeps 32/33 (outfall SD026) and all seepage from the vicinity of outfalls SD006 and SD004 are presently being pumped back into the Tailings Basin under the Consent Decree agreement between the MPCA and Cliffs Erie. In addition to surface Seep 32/33, it is possible that a relatively small amount of seepage may bypass the collection system at outfall SD026 and discharge to Second Creek.

PolyMet estimates that the current combined groundwater seepage from the Tailings Basin to the Embarrass River is 2,590 gpm (PolyMet 2015j). The MPCA will evaluate information relative to water quality standards during the NPDES/SDS permitting process as part of its analysis to determine which pollutants in the discharge have a reasonable potential to cause or contribute to violation of a water quality standard.

PolyMet has collected water quality data at four locations along the toe of the tailings embankment (PM-8, PM-9, PM-10, and UC-1) and along the three receiving streams, including three locations along Trimble Creek (PM-19, TC-1, and TC-1A), one location along Unnamed Creek (PM-11), and three locations along Mud Lake Creek (MLC-1, MLC-2, and MLC-3A). Table 4.2.2-34 lists the sampling periods for each location and Figure 4.2.2-17 shows the monitoring locations. Tables 4.2.2-35 through 4.2.2-38 contain summaries of the data from these locations.

Table 4.2.2-33 Summary of Existing LTVSMC Tailings Basin Surface Seeps (see Figure 4.2.2-11)

Seep ID	Average Seepage Flow (gpm) 2005-2014	Notes
Seep 1	0	
Seep 2	0	
Seep 3	0	
Seep 4	0	
Culvert (WS-011)	1	Includes combined flow of Seeps 1–4; may include both Tailings Basin seepage and watershed runoff
Seep 5	0	
Seep 6	0	
Seep 7	0	
Seep 8	0	
Seep 9	0	
Weir (WS-012)	2	Includes combined flow of Seeps 4–9; may include both Tailings Basin seepage and watershed runoff
Emergency Basin Outflow	681	Includes watershed runoff
Seeps 10–17	0	
Weir (West Side Seep)	0	Includes combined flow of area including Seeps 11–17
Culvert/Pipe	1	Culvert beneath road; may include both Tailings Basin seepage and watershed runoff
SD006	515	No discharge since 2011; Tailings Basin pump-back system installed and operating; may include both Tailings Basin seepage and watershed runoff
Seep 18	6	
Seep 19	0	
Seep 20	2	Flow from pipe
Seep 21	0	
Seep 22 (SD004)	3	No discharge since 2011; Tailings Basin pump-back system installed and operating
Seep 23	0	
Seep 24 (North Side Seep)	10	Flow from pipe
Seep 25	7	Flow from pipe
Seep 26	0	Flow from pipe
Seep 27	0	Flow from pipe
Seep 28	0	Flow from pipe
Seep 29	0	Flow from pipe
Seep 30	134	
Seep 31	0	
Seeps 32–33	579	Tailings Basin pump-back system installed and operating

Sources: Barr 2014e; PolyMet 2015i.

Table 4.2.2-34 Water Quality Monitoring Locations for Embarrass River Tributary Streams and Tailings Basin Receiving Streams (see Figure 4.2.2-17)

Sample Location	Source	Sampling Period
Tailings Basin		
PM-8	PolyMet	2001–2006
PM-9	PolyMet	2001–2006
PM-10	PolyMet	2001–2007
UC-1	PolyMet	2012-2013
PM-11	PolyMet	2004, 2006, 2008–2013
PM-19	PolyMet	2009–2013
MLC-1	PolyMet	2011–2013
MLC-2	PolyMet	2011–2013
MLC-3/MLC-3A[1]	PolyMet	2012
TC-1	PolyMet	2012
TC-1A	PolyMet	2012–2013

Sources: Barr 2007h; Barr 2014d.

Note:
[1] The sample location was originally identified as MLC-3, but was inaccessible. The actual sample location, which was approximately 50 yards from the intended sample location, was identified as MLC-3A at the time. However, because of the close proximity of the intended and actual sample locations, and the fact that samples have only been taken at one location at the headwaters of Mud Lake Creek, these samples have been re-labelled as MLC-3.

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Table 4.2.2-35 Summary of Surface Water Quality Monitoring Data for the Tailings Basin Surface Seeps (see Figure 4.2.2-11)

Parameter	Units	Surface Water Evaluation Criteria	PM-8[6]				PM-9[6]				PM-10[6]				UC-1			
General			Detection	Mean[5]	Range	# Exceed	Detection	Mean[5]	Range	# Exceed	Detection	Mean[5]	Range	# Exceed	Detection	Mean[5]	Range	# Exceed
Alkalinity	mg/L	--	--	--	--	--	--	--	--	--	--	--	--	--	3 of 3	437	399–471	NA
Ammonia as Nitrogen	mg/L	--	0 of 4	0.1	<0.1	NA	0 of 4	0.1	<0.1	NA	0 of 4	0.1	<0.1	NA	2 of 3	0.13	<0.05–0.24	NA
Calcium	mg/L	--	47 of 47	42.4	9.2–73.9	NA	124 of 124	53.9	33.0–98.9	NA	132 of 132	66.4	17.5–92.4	NA	11 of 11	61.8	35.9–91.7	NA
Carbon, total organic	mg/L	--	8 of 8	5.4	2.6–6.9	NA	8 of 8	8.4	1.7–18.5	NA	15 of 15	7.5	5.2–9.4	NA	11 of 11	11.4	7.1–18.0	NA
Chloride	mg/L	230	19 of 19	20.3	3.1–30	0	122 of 122	28.1	12.6–66.5	0	130 of 130	27.7	7.2–33.6	0	11 of 11	26.0	11.0–43.9	0
Fluoride	mg/L	--	42 of 42	2.9	1.0–5.8	NA	128 of 128	2.4	0.6–5.8	NA	136 of 136	2.3	0.5–4.8	NA	--	--	--	--
Magnesium	mg/L	--	--	--	--	--	--	--	--	--	--	--	--	--	11 of 11	94.2	54.2–149	NA
Hardness	mg/L	500	36 of 36	431	230–721	**9**	41 of 41	452	268–818	**11**	48 of 48	438	327–649	**7**	11 of 11	**542**	313–844	**6**
Nitrate + Nitrite as Nitrogen	mg/L	--	--	--	--	--	--	--	--	--	--	--	--	--	0 of 3	0.050	<0.05–<0.05	NA
pH	s.u.	6.5–8.5	81 of 81	7.9	6.8–8.7	**1**	130 of 130	7.8	6.4–8.8	**7**	136–136	6.7	6.4–8.9	**5**	11 of 11	7.4	7.0–7.8	0
Potassium	mg/L	--	--	--	--	--	--	--	--	--	--	--	--	--	3 of 3	5.0	4.1–6.3	NA
Sodium	mg/L	--	--	--	--	--	--	--	--	--	--	--	--	--	3 of 3	47.6	44.7–52.3	NA
Sulfate	mg/L	--[2]	61 of 61	161	27.1–312	NA	125 of 125	159	56.8–344	NA	133 of 133	182	8.1–473	NA	11 of 11	185	67.5–380	NA
TDS	mg/L	700	--	--	--	--	--	--	--	--	--	--	--	--	11 of 11	666	410–1,030	**3**
Metals – Total																		
Aluminum	µg/L	125	3 of 5	25.7	<10–40.7	0	4 of 5	29.9	<25–48.4	0	4 of 12	39.6	<10–230	**1[4]**	7 of 11	26.9	<10–47.3	0
Antimony	µg/L	31	0 of 5	3	<3	0	0 of 5	3	<3	0	0 of 5	3	<3	0	0 of 11	0.25	<0.25–<0.25	0
Arsenic	µg/L	53	5 of 12	3	<2–7.2	0	1 of 12	2.1	<2–2.7	0	2 of 12	2.1	<2–2.7	0	6 of 11	0.78	<0.25–1.6	0
Barium	µg/L	--	15 of 15	25.6	11–76.4	NA	15 of 15	41.6	18.3–140	NA	22 of 22	86.7	39.5–148	NA	3 of 3	53.0	45.3–59.5	NA
Beryllium	µg/L	--	0 of 5	1.64	<0.2–<2	NA	0 of 5	1.64	<0.2–<2	NA	0 of 5	1.64	<0.2–<2	NA	0 of 3	0.10	<0.1–<0.1	NA
Boron	µg/L	500	37 of 37	351	164–483	0	127 of 127	337	115–452	0	135 of 135	379	85–517	**3**	3 of 3	277	228–333	0
Cadmium	µg/L	2.5[3]	0 of 5	1.6	<0.2–<2	0	0 of 5	1.6	<0.2–<2	0	0 of 5	1.6	<0.2–<2	0	0 of 3	0.10	<0.1–<0.1	0
Cobalt	µg/L	5	4 of 43	1.2	<1–<2.5	0	3 of 81	1.1	<1–4.9	0	7 of 82	1.3	<1–16.8	**1**	6 of 11	0.20	<0.1–0.34	0
Copper	µg/L	9.3[3]	5 of 32	2.1	<0.7–5.4	0	19 of 84	2.5	<0.7–12	**1**	16 of 92	2.3	<1–24.2	**1**	9 of 11	1.4	<0.25–3.8	0
Iron	µg/L	--	23 of 23	410	<30–4,500	NA	18 of 19	673	<30–5,100	NA	23 of 25	501	<30–4,020	NA	11 of 11	496	188–1,590	NA
Lead	µg/L	3.2[3]	9 of 10	0.7	<0.3–<1	0	9 of 10	0.7	<0.3–<1	0	10 of 10	1.3	<0.3–7.1	**1**	0 of 11	0.25	<0.25–<0.25	0
Manganese	µg/L	--	40 of 40	3,039	70–110,000	NA	95 of 98	631	<10–50,000	NA	93 of 93	100,192	20–2,950,000	NA	11 of 11	369	78.2–1,520	NA
Mercury	ng/L	1.3	13 of 17	1.7	0.5–4.6	**7**[1]	12 of 65	1.8	0.7–4.1	**6**[1]	14 of 66	1.4	0.6–2.3	**7**[1]	3 of 3	1.1	1.0–1.4	**1**
Methylmercury	ng/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Molybdenum	µg/L	--	12 of 12	50.5	13.9–81.6	NA	110 of 112	43.2	<5–96.8	NA	119 of 121	21.5	<5–47.6	NA	3 of 3	5.7	4.4–7.6	NA
Nickel	µg/L	52[3]	3 of 27	2.5	<2–<5	0	3 of 64	2.3	<2–<5	0	11 of 72	2.3	<2–5.9	0	4 of 11	0.51	<0.25–1.4	0
Selenium	µg/L	5	0 of 10	2.5	<1.0–<3.6	0	0 of 10	2.5	<1.0–<3.6	0	0 of 10	2.5	<1.0–<3.6	0	0 of 11	0.50	<0.5–<0.5	0
Silver	µg/L	1.0[3]	0 of 10	0.6	<0.2–<1	0	0 of 10	0.6	<0.2–<1	0	0 of 10	0.6	<0.2–<1	0	0 of 3	0.10	<0.1–<0.1	0
Thallium	µg/L	0.56	0 of 10	1.2	<0.4–<2	0[1]	0 of 10	1.2	<0.4–<2	0[1]	0 of 10	2.7	<0.4–<2	**1**	2 of 10	0.0013	<0.0002–0.0060	0
Vanadium	µg/L	--	--	--	--	--	--	--	--	--	--	--	--	--	0 of 3	1.5	<1.5–<1.5	NA
Zinc	µg/L	120[3]	2 of 27	13.6	<10–<25	0	2 of 12	10.3	<10–12.7	0	3 of 19	16.2	<10–32.5	0	3 of 11	7.8	<3–30.3	0

Sources: Barr 2007h; Barr 2006f; Barr 2014d.

Notes:
Values in bold indicates an exceedance of surface water quality standards.
1 Some detection limits exceed evaluation criteria; Barr 2006f. Data reported as less than such a detection limit is not included in the number of exceedances.
2 Sulfate standard of 10 mg/L applies to designated "waters supporting the production of wild rice."
3 Water Quality standard for this metal is hardness-dependent. Listed value assumes a hardness concentration of 100 mg/L.
4 Predicted values represent total aluminum concentrations, while the water quality standard is for dissolved aluminum. Since aluminum has a very low solubility in water under relatively neutral pH conditions, it is expected that the predicted aluminum concentration would meet the surface water standard (see discussion in Section 4.1.2.2).
5 Includes non-detects at half the detection limit.
6 Seepage at PM-8 is presently being pumped back into the Tailings Basin in accordance with the Consent Decree between the MPCA and Cliffs Erie. Seepage at PM-9 and PM-10 are discharging to tributaries of the Embarrass River.

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Table 4.2.2-36 Summary of Surface Water Quality Monitoring Data for Unnamed Creek

Parameter	Units	Surface Water Evaluation Criteria	PM-11 Unnamed Creek			
General Parameters			**Detection**	**Mean[3]**	**Range**	**# Exceed**
Alkalinity	mg/L	--	29 of 29	295	108–492	NA
Ammonia as Nitrogen	mg/L	--	4 of 18	11.2	<0.05–<50	NA
Calcium	mg/L	--	42 of 42	44.6	18.2–78.0	NA
Carbon, total organic	mg/L	--	44 of 44	12.2	6.5–23.3	NA
Chloride	mg/L	230	55 of 55	17.5	3.1–34.1	0
Fluoride	mg/L	--	11 of 11	1.5	0.84–2.2	NA
Hardness	mg/L	500	42 of 42	371	109–660	**9**
Magnesium	mg/L	--	42 of 42	63.4	19.8–113	NA
Nitrate + Nitrite as Nitrogen	mg/L	--	1 of 24	17.1	<0.05–110	NA
pH	s.u.	6.5–8.5	51 of 51	7.5	6.6–8.3	0
Potassium	mg/L	--	24 of 24	5.3	1.6–8.4	NA
Sodium	mg/L	--	26 of 26	43.5	13.4–59.4	NA
Sulfate	mg/L	--(1)	59 of 59	122	13.5–233	NA
TDS	mg/L	700	42 of 42	491	186–831	**7**
Metals – Total						
Aluminum	µg/L	125	25 of 40	28.6	<10–92.1	0
Antimony	µg/L	31	0 of 27	0.44	<0.25–<1.5	0
Arsenic	µg/L	53	21 of 34	0.87	<0.25–2.3	0
Barium	µg/L	--	18 of 18	32.3	13.4–67.9	NA
Beryllium	µg/L	--	0 of 15	0.1	<0.1–<0.1	NA
Boron	µg/L	500	15 of 15	225	129–307	0
Cadmium	µg/L	2.5(2)	4 of 18	0.077	<0.015–<0.1	0
Cobalt	µg/L	5	13 of 40	0.22	<0.1–<0.5	0
Copper	µg/L	9.3(2)	36 of 42	0.99	<0.33–<2.5	0
Iron	µg/L	--	37 of 37	527	0.21–1,270	NA
Lead	µg/L	3.2(2)	6 of 36	0.24	<0.15–<0.5	0
Manganese	µg/L	--	40 of 40	260	19.3–1,270	NA
Mercury	ng/L	1.3	24 of 30	**2.5**	<0.25–<10	**19(4)**
Methylmercury	ng/L	--	9 of 9	0.26	0.15–0.46	NA
Molybdenum	µg/L	--	27 of 27	12.1	3.7–29.3	NA
Nickel	µg/L	52(2)	17 of 42	0.77	<0.25–<2.5	0
Selenium	µg/L	5	3 of 32	0.72	<0.5–<1.8	0
Silver	µg/L	1.0(2)	0 of 20	0.18	<0.1–<0.5	0
Thallium	µg/L	0.56	5 of 36	0.15	<0.0002–<1	**4**
Vanadium	µg/L	--	0 of 8	2.4	<1.5–<5	NA
Zinc	µg/L	120(2)	5 of 42	4.5	<3–41.2	0

Source: Barr 2014d.

Notes:
Values in bold indicates an exceedance of surface water quality standards.
1 Sulfate standard of 10 mg/L applies to designated "waters supporting the production of wild rice."
2 Water quality standard for this metal is hardness-dependent. Listed value assumes a hardness concentration of 100 mg/L.
3 Mean includes non-detects at half the detection limit.
4 Minimum detection limit exceeds evaluation criteria; Barr 2006f. Data reported as less than such a detection limit is not included in the number of exceedances.

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Table 4.2.2-37 Summary of Surface Water Quality Monitoring Data for Trimble Creek

Parameter	Units	Surface Water Evaluation Criteria	PM-19 Trimble Creek				TC-1 Trimble Creek				TC-1A Trimble Creek			
General Parameters			Detection	Mean[3]	Range	# Exceed	Detection	Mean[3]	Range	# Exceed	Detection	Mean[3]	Range	# Exceed
Alkalinity	mg/L	--	37 of 37	351	190–514	NA	1 of 1	335	335–335	NA	4 of 4	305	243–355	NA
Ammonia as Nitrogen	mg/L	--	10 of 25	0.11	<0.05–5,830	NA	0 of 1	0.05	<0.05–<0.05	NA	2 of 4	0.14	<0.05–0.31	NA
Calcium	mg/L	--	68 of 68	48.1	18.5–99.3	NA	4 of 4	43.6	38.2–49.8	NA	14 of 14	49.5	22.1–77.6	NA
Carbon, total organic	mg/L	--	63 of 63	17.8	10.9–33.7	NA	4 of 4	23	14.8–31.8	NA	14 of 14	13.8	10.6–23.2	NA
Chloride	mg/L	230	89 of 89	16.5	6.8–55.1	0	4 of 4	11.7	7.5–17.2	0	14 of 14	19.7	7.4–33.5	0
Fluoride	mg/L	--	2 of 2	0.91	0.87–0.95	NA	--	--	--	--	--	--	--	--
Hardness	mg/L	500	68 of 68	311	123–1,350	**2**	4 of 4	273	231–299	0	14 of 14	332	147–532	**2**
Magnesium	mg/L	--	68 of 68	46.3	18.6–270	NA	4 of 4	39.9	33.0–42.3	NA	14 of 14	50.5	22.3–82.1	NA
Nitrate + Nitrite as Nitrogen	mg/L	--	8 of 32	0.050	<0.05–0.41	NA	0 of 1	0.05	<0.05–<0.05	NA	0 of 4	0.050	<0.05–<0.05	NA
pH	s.u.	6.5–8.5	79 of 79	7.2	6.1–8.2	**2**	4 of 4	7.5	7.4–7.7	0	14 of 14	7.3	6.9–7.8	0
Potassium	mg/L	--	32 of 32	3.0	1.4–58.2	NA	1 of 1	2.3	2.3–2.3	NA	4 of 4	3.3	2.4–4.7	NA
Sodium	mg/L	--	32 of 32	51.7	26.9–100	NA	1 of 1	47.0	47–47	NA	4 of 4	55.6	36.3–70.0	NA
Sulfate	mg/L	--(1)	86 of 89	32.7	<0.5–1,170	NA	4 of 4	12.4	1.3–36.6	NA	14 of 14	56.4	1.0–119	NA
TDS	mg/L	700	68 of 68	453	195–1,920	**2**	4 of 4	400	366–416	0	14 of 14	481	231–722	**2**
Metals – Total														
Aluminum	µg/L	125	32 of 57	33.7	<10–184	**1**	3 of 4	44.9	<20.0–82.5	0	9 of 14	23.7	<10–37.4	0
Antimony	µg/L	31	0 of 44	0.25	<0.25–<0.25	0	0 of 4	0.25	<0.25–<0.25	0	0 of 9	0.25	<0.25–<0.25	0
Arsenic	µg/L	53	37 of 59	1.1	<0.25–3.9	0	4 of 4	2.6	0.98–5.2	0	7 of 14	0.78	<0.25–2.7	0
Barium	µg/L	--	22 of 22	80.9	52.0–137	NA	1 of 1	95.2	95.2–95.2	NA	4 of 4	107	83.2–137	NA
Beryllium	µg/L	--	0 of 22	0.10	<0.1–<0.1	NA	0 of 1	0.1	<0.10–<0.10	NA	0 of 4	0.10	<0.1–<0.1	NA
Boron	µg/L	500	22 of 22	136	111–333	0	1 of 1	137	137–137	0	4 of 4	155	142–173	0
Cadmium	µg/L	2.5(2)	0 of 22	0.076	<0.01–<0.1	0	0 of 1	0.1	<0.10–<0.10	0	0 of 4	0.10	<0.1–<0.1	0
Cobalt	µg/L	5	37 of 59	0.29	<0.1–0.98	0	4 of 4	0.62	0.25–1.4	0	7 of 14	0.26	<0.1–0.66	0
Copper	µg/L	9.3(2)	47 of 59	0.65	<0.25–3.8	0	1 of 4	0.32	<0.25–<0.25	0	9 of 14	0.50	<0.25–0.85	0
Iron	µg/L	--	61 of 63	1,284	226–5,830	NA	4 of 4	3,233	941–8,330	NA	14 of 14	871	232–4,040	NA
Lead	µg/L	3.2(2)	2 of 53	0.22	<0.01–<0.25	0	0 of 4	0.25	<0.25–<0.25	0	0 of 14	0.25	<0.25–<0.25	0
Manganese	µg/L	--	59 of 59	830	24.2–3,990	NA	4 of 4	1,305	202–3,670	NA	14 of 14	640	43.9–1,660	NA
Mercury	ng/L	1.3	26 of 26	**1.5**	0.50–5.1	**7**	1 of 1	1.1	1.1–1.1	0	4 of 4	**2.5**	0.90–5.1	**2**
Methylmercury	ng/L	--	1 of 2	0.11	<0.05–0.16	NA	--	--	--	--	--	--	--	--
Molybdenum	µg/L	--	28 of 28	1.3	0.39–7.6	NA	1 of 1	0.89	0.89–0.89	NA	4 of 4	1.1	0.63–1.5	NA
Nickel	µg/L	52(2)	21 of 59	0.50	<0.25–5.1	0	2 of 4	0.52	<0.25–<0.25	0	3 of 14	0.36	<0.25–1.2	0
Selenium	µg/L	5	5 of 51	0.50	<0.5–1.1	0	0 of 4	0.5	<0.50–<0.50	0	0 of 14	0.50	<0.5–<0.5	0
Silver	µg/L	1.0(2)	0 of 24	0.10	<0.1–<0.1	0	0 of 1	0.1	<0.10–<0.10	0	0 of 4	0.10	<0.1–<0.1	0
Thallium	µg/L	0.56	5 of 54	0.017	<0.0002–<0.1	0	0 of 4	0.001	<0.0002–0.003	0	0 of 13	0.0013	<0.0002–<0.0025	0
Vanadium	µg/L	--	0 of 15	2.4	<1.5–<5	NA	0 of 1	1.5	<1.5–<1.5	NA	0 of 4	1.5	<1.5–<1.5	NA
Zinc	µg/L	120(2)	6 of 59	3.9	<3–31.2	0	1 of 4	4.5	<3.0–8.9	0	2 of 14	3.9	<3–11.5	0

Source: Barr 2014d.

Notes:
Values in bold indicates an exceedance of surface water quality standards.
[1] Sulfate standard of 10 mg/L applies to designated "waters supporting the production of wild rice."
[2] Water quality standard for this metal is hardness-dependent. Listed value assumes a hardness concentration of 100 mg/L.
[3] Mean includes non-detects at half the detection limit.

Table 4.2.2-38 Summary of Surface Water Quality Monitoring Data for Mud Lake Creek

Parameter	Units	Surface Water Evaluation Criteria	MLC-1 Mud Lake Creek				MLC-2 Mud Lake Creek				MLC-3/MLC-3A[4] Mud Lake Creek			
General Parameters			Detection	Mean[3]	Range	# Exceed	Detection	Mean[3]	Range	# Exceed	Detection	Mean[3]	Range	# Exceed
Alkalinity	mg/L	--	7 of 7	218	97.7–394	NA	14 of 14	122	76.5–201	NA	1 of 1	448	448–448	NA
Ammonia as Nitrogen	mg/L	--	3 of 7	0.31	<0.05–1.7	NA	4 of 14	0.35	<0.05–2.1	NA	0 of 1	0.05	<0.05–<0.05	NA
Calcium	mg/L	--	18 of 18	31.1	14.5–58.6	NA	27 of 27	19.5	9.1–32.7	NA	2 of 2	47.2	34.5–59.8	NA
Carbon, total organic	mg/L	--	18 of 18	21.9	10.7–43.8	NA	27 of 27	24.7	12.9–48.0	NA	2 of 2	14.7	14.3–15	NA
Chloride	mg/L	230	18 of 18	8.4	2.5–21.6	0	28 of 28	6.0	1.7–12.7	0	2 of 2	18.0	13.2–22.8	0
Fluoride	mg/L	--	2 of 2	0.23	0.15–0.31	NA	4 of 4	0.25	0.20–0.33	NA	--	--	--	--
Hardness	mg/L	500	18 of 18	196	92.6–383	0	27 of 27	113	59.9–194	0	2 of 2	315	236–394	0
Magnesium	mg/L	--	18 of 18	28.6	13.7–60.2	NA	27 of 27	15.7	9.0–27.2	NA	2 of 2	47.9	36.4–59.4	NA
Nitrate + Nitrite as Nitrogen	mg/L	--	0 of 7	0.050	<0.05–<0.05	NA	2 of 14	0.059	<0.05–0.12	NA	0 of 1	0.05	<0.05–<0.05	NA
pH	s.u.	6.5–8.5	16 of 16	7.1	6.7–7.6	0	29 of 29	7.0	6.4–7.7	**2**	2 of 2	7.3	7.1–7.6	0
Potassium	mg/L	--	7 of 7	2.0	1.3–3.2	NA	14 of 14	1.1	0.33–1.9	NA	1 of 1	3	3–3	NA
Sodium	mg/L	--	7 of 7	28.9	15.4–57.5	NA	14 of 14	14.9	9.5–20.7	NA	1 of 1	63.9	63.9–63.9	NA
Sulfate	mg/L	--[(1)]	14 of 18	11.5	<0.5–82.3	NA	21 of 28	3.1	<0.5–12.3	NA	2 of 2	35.3	17.3–53.2	NA
TDS	mg/L	700	18 of 18	302	141–553	0	27 of 27	200	117–292	0	2 of 2	491	369–613	0
Metals – Total														
Aluminum	µg/L	125	14 of 18	31.8	<10–58.3	0	24 of 28	48.7	<10–149	**1**	0 of 2	10	<10–<10	0
Antimony	µg/L	31	0 of 12	0.25	<0.25–<0.25	0	0 of 22	0.25	<0.25–<0.25	0	0 of 2	0.25	<0.25–<0.25	0
Arsenic	µg/L	53	16 of 17	2.6	<0.25–7.0	0	23 of 27	1.3	<0.25–3.1	0	1 of 2	0.42	<0.25–0.59	0
Barium	µg/L	--	7 of 7	36.1	11.0–93.8	NA	10 of 10	28.2	10.5–61.6	NA	1 of 1	37.3	37.3–37.3	NA
Beryllium	µg/L	--	0 of 7	0.10	<0.1–<0.1	NA	0 of 10	0.10	<0.1–<0.1	NA	0 of 1	0.1	<0.1–<0.1	NA
Boron	µg/L	500	5 of 7	57.2	<25–85.3	0	0 of 10	25.0	<25–<25	0	1 of 1	160	160–160	0
Cadmium	µg/L	2.5[(2)]	0 of 7	0.076	<0.015–<0.1	0	1 of 10	0.069	<0.015–<0.1	0	0 of 1	0.1	<0.1–<0.1	0
Cobalt	µg/L	5	11 of 18	0.41	<0.1–1.1	0	17 of 27	0.43	<0.1–1.2	0	1 of 2	0.15	<0.1–0.2	0
Copper	µg/L	9.3[(2)]	5 of 18	0.38	<0.25–1.1	0	15 of 27	0.48	<0.25–1.3	0	2 of 2	0.56	0.53–0.59	0
Iron	µg/L	--	18 of 18	9,098	373–37,600	NA	27 of 27	5,322	266–27,100	NA	2 of 2	280	275–284	NA
Lead	µg/L	3.2[(2)]	1 of 18	0.23	<0.01–<0.25	0	4 of 23	0.23	<0.25–<0.25	0	0 of 2	0.25	<0.25–<0.25	0
Manganese	µg/L	--	18 of 18	413	14.8–1,040	NA	27 of 27	353	8.4–1,310	NA	2 of 2	211	19.1–402	NA
Mercury	ng/L	1.3	7 of 7	**2.2**	1.1–4.0	**6**	14 of 14	**3.1**	0.90–6.5	**12**	1 of 1	0.99	0.99–0.99	0
Methylmercury	ng/L	--	--	--	--	--	3 of 4	1.3	<0.05–3.7	NA	--	--	--	--
Molybdenum	µg/L	--	6 of 7	0.63	<0.15–1.1	NA	13 of 14	0.48	<0.15–0.92	NA	1 of 1	1.7	1.7–1.7	NA
Nickel	µg/L	52[(2)]	4 of 18	0.36	<0.25–0.92	0	9 of 27	0.46	<0.25–1.7	0	1 of 2	0.42	<0.25–0.59	0
Selenium	µg/L	5	1 of 18	0.48	<0.1–0.53	0	3 of 23	0.45	<0.1–<0.5	0	0 of 2	0.5	<0.5–<0.5	0
Silver	µg/L	1.0[(2)]	0 of 7	0.10	<0.1–<0.1	0	0 of 10	0.10	<0.1–<0.1	0	0 of 1	0.1	<0.1–<0.1	0
Thallium	µg/L	0.56	3 of 16	0.0027	<0.0002–0.014	0	7 of 24	0.0059	<0.0002–0.030	0	0 of 2	0.00135	<0.0002–<0.0025	0
Vanadium	µg/L	--	1 of 5	1.9	<1.5–3.7	NA	0 of 10	2.9	<1.5–<5	NA	0 of 1	1.5	<1.5–<1.5	NA
Zinc	µg/L	120[(2)]	4 of 18	4.0	<3–9.0	0	4 of 27	5.4	<3–42.4	0	0 of 2	3	<3–<3	0

Source: Barr 2014d.

Notes:
Values in bold indicates an exceedance of surface water quality standards.
1 Sulfate standard of 10 mg/L applies to designated "waters supporting the production of wild rice."
2 Water quality standard for this metal is hardness-dependent. Listed value assumes a hardness concentration of 100 mg/L.
3 Mean includes non-detects at half the detection limit.
4 The sample location was originally identified as MLC-3, but was inaccessible. The actual sample location, which was approximately 50 yards from the intended sample location, was identified as MLC-3A at the time. However, because of the close proximity of the intended and actual sample locations, and the fact samples have only been taken at one location at the headwaters of Mud Lake Creek, these samples have been re-labelled as MLC-3.

Lower Embarrass River

Approximately 4 miles downstream from monitoring station PM-13, the Embarrass River flows through a chain of lakes: Sabin, Wynne, Embarrass, and Esquagama lakes. In addition to the previously discussed Embarrass River monitoring, PolyMet also conducted limited water quality monitoring for sulfate and chloride in Sabin Lake (PM-21 and PM-23), Wynne Lake (PM-22 and PM-24), and Embarrass Lake (EL-1 and EL-2) in 2010 and 2011 (see Figure 4.2.2-1). Water quality samples were also collected from the chain of lakes in 2009; however, those results are excluded from this discussion as they pre-date the Consent Decree and resulting remedial action, and are therefore not representative of current conditions in the lakes. Samples were taken at the inlet to each lake and near the center of each lake at multiple depths: surface, middle, and near-bottom. Additional monitoring was performed at PM-21 for total and dissolved aluminum (PolyMet 2015j).

The average surface sulfate concentration in Sabin Lake was 11.7 mg/L (average surface concentration at PM-21 and PM-23 for 2010 to 2011) with concentrations increasing with depth. The northernmost tip of Wynne Lake is subject to the 10 mg/L sulfate standard for waters used for the production of wild rice. The monitoring shows that the lake exceeds this standard (average surface concentration 16.0 mg/L at PM-22 and PM-24) and that concentrations increase with depth. Embarrass Lake is also subject to the 10 mg/L sulfate standard for waters used for the production of wild rice. The monitoring shows that the lake exceeds this standard (average surface concentration 19.3 mg/L at EL-1 and EL-2). The data generally shows little fluctuation through the sampling period for all three lakes, although surface sulfate concentrations were typically higher in all three lakes in 2010 than in 2011. The increasing sulfate concentrations through the chain of lakes suggest that there is additional sulfate coming from other sources; however, monitoring did not identify specific sources (PolyMet 2015j). Section 4.2.2.1.3 discusses additional sulfate monitoring conducted as part of wild rice and water quality monitoring surveys.

Several lakes downstream of the NorthMet Project area within the chain of lakes are on the 303(d) list for “mercury in fish tissue” impairment, including Sabin, Wynne, Embarrass, and Esquagama lakes (see Figure 4.2.2-1). Further downstream, most of the St. Louis River is also listed for “mercury in fish tissue” impairment. These lakes and the St. Louis River are not covered by the Statewide Mercury TMDL, but are impaired waters that are still in need of a TMDL pollution reduction study. These waters are not included in Minnesota’s regional mercury TMDL because the mercury concentrations in the fish are considered too high to be returned to Minnesota’s mercury water quality standard using solely the state-wide TMDL approach. Similar to other lakes in Minnesota, the main source of the mercury is atmospheric mercury deposition.

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4.2.3 Wetlands

Wetlands in Minnesota are protected under federal and state laws, including Section 404 of the federal Clean Water Act (CWA), the State of Minnesota's Wetland Conservation Act (WCA), the MDNR's Public Waters Work Permit Program, and the MPCA's Wetland Standards and Mitigation Rules (*Minnesota Rules*, part 7050.0186). In addition, a DA permit pursuant to Section 404 of the CWA is not valid until the state has either certified under Section 401 of the CWA that the discharges comply with state water quality standards or waived the 401 certification requirements. For metallic mineral mining, WCA requirements are addressed under the MDNR Permit to Mine. WCA rules (including those parts applicable to mining projects under *Minnesota Rules* 8420.0930) include a special consideration for wetlands that are rare natural communities (*Minnesota Rules* 8420.0515, subp. 3). See FEIS Section 4.2.4.2.1_for additional information about these communities. The Permit to Mine would address special consideration of wetlands that include rare natural communities. Additional information on rare natural communities would be included in the wetland permit application as part of the Permit to Mine process for further refinement of site-specific conditions.

The state and federal programs that regulate effects on wetlands differ with respect to the types of resources over which each agency will assert jurisdiction. For example, under the state WCA, "incidental" wetlands are not jurisdictional, but those wetlands may be subject to the permitting requirements of Section 404 of the CWA at the federal level. Under the federal CWA, wetlands that do not have a continuous surface connection or a significant nexus to a traditionally navigable water are not regulated under the CWA but those wetlands may be regulated under the WCA. Although there are wetlands within the NorthMet Project area that may be regulated exclusively under state law, or conversely, exclusively under federal law, all of the wetlands in the NorthMet Project area would be regulated under either the CWA or the WCA, with the exception of two wetland areas that would not be regulated by either program as a result of being located within an actively permitted waste storage facility. These two wetland areas are discussed under Section 4.2.3.2 below.

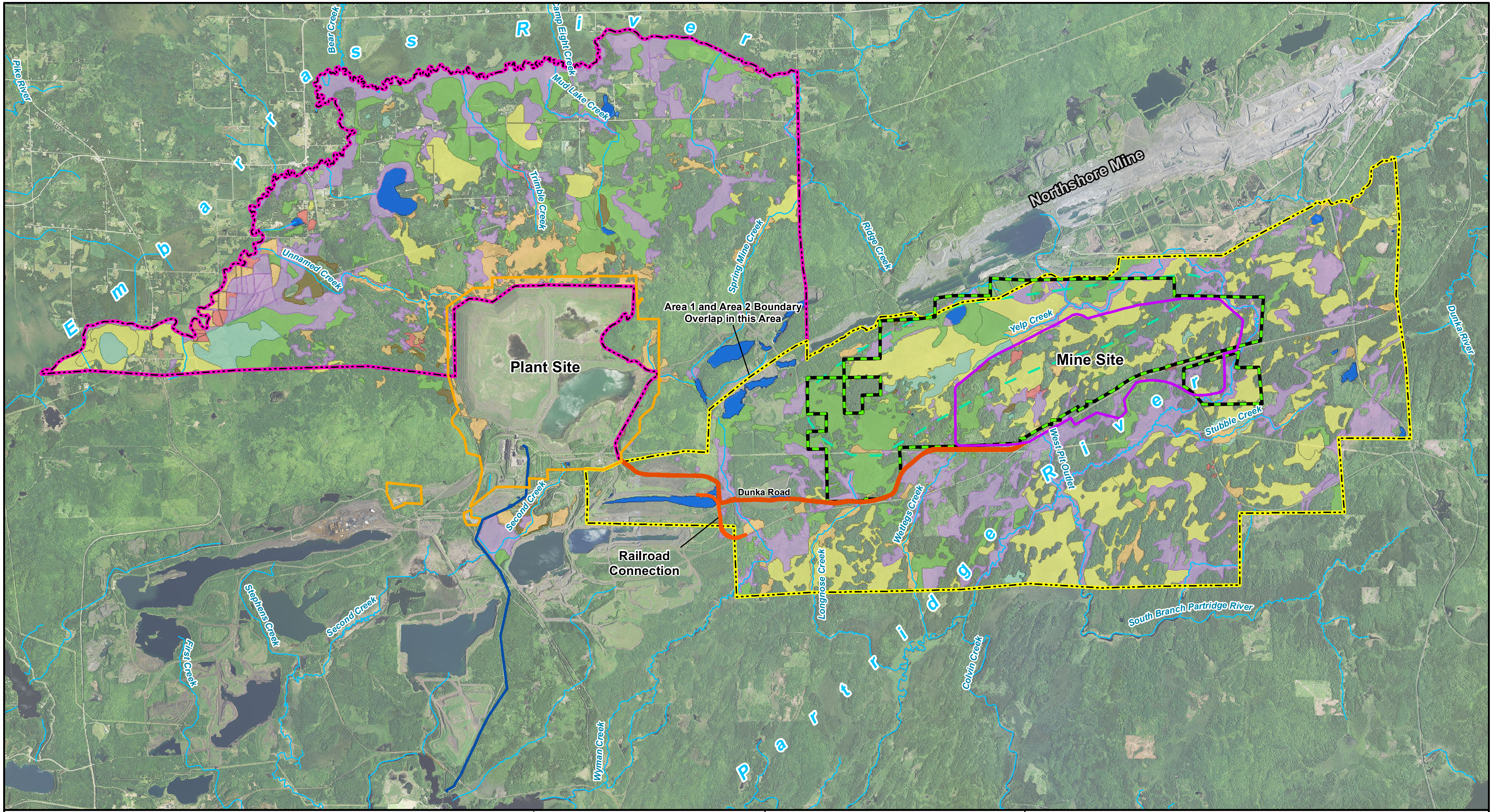
The required public notice to fulfill requirements for Section 404 permitting and Section 401 certification was originally issued by the USACE in May of 2005. The MPCA did not exercise its right to review the NorthMet Project Proposed Action under Section 401 of the CWA at that time; therefore, certification of the original NorthMet Project Proposed Action was waived by default. However, due to the revised NorthMet Project Proposed Action, PolyMet submitted a revised permit application in August 2013, and the public notice for the Section 404 application was reissued on December 13, 2013. The MPCA will need to re-issue the Section 401 public notice for the NorthMet Project Proposed Action. Under the provisions of the CWA, the MPCA has one year from the public notice (December 3, 2014) to act upon an application for Section 401 Certification. However, the MEPA (*Minnesota Statutes* 116.04, subd. 2b) and rules regarding environmental review (*Minnesota Rules* 4410.3100) prohibit final agency decisions, such as the Section 401 Certification, until all environmental review steps are complete. The environmental review process being undertaken by the Co-lead Agencies would not be completed within the 1-year timeframe for issuance of the Section 401 Certification. Therefore, PolyMet has made a procedural decision to withdraw the Section 401 application before the MPCA and resubmit it in the near future to allow for processing of the application.

The wetland section for the NorthMet Project Proposed Action includes a discussion of the Mine Site and Plant Site, as well as Area 1 and Area 2. Area 1 and Area 2 represent the wetland boundaries that were developed and evaluated in 2010 and 2011 for the indirect effects on wetlands and are exclusive to this environmental resource section. The USACE determined that there was a need to evaluate and classify wetland types in the areas surrounding the Mine Site (Area 1) and the Plant Site (Area 2) with the potential for indirect hydrologic wetland effects (Barr 2011d). The Area 1 boundary extends beyond the Mine Site boundary and includes 23,927.4 acres. Area 1 encompasses the Mine Site, the federal lands, and the majority of the Transportation and Utility Corridor, as well as adjacent lands. Area 2 encompasses 19,396.7-acre area just north and northwest of the Plant Site.

Detailed wetland field delineation/mapping was performed in 2004, and supplemented in 2005, 2006, 2007, 2008, and 2010 (Barr 2006d; Barr 2007b; Barr 2008k; Barr 2011d; PolyMet 2015b). These investigations delineated and mapped the portion of each wetland located within the Mine Site, Area 1, Area 2, Plant Site, and the adjoining federal lands (see Section 4.3.3.1.1 for the federal lands discussion).

The NorthMet Project area includes 166 wetlands covering 1,579.6 acres (see Figure 4.2.3-1). The percentage of wetland types identified in the NorthMet Project area include: coniferous bog (55 percent); shrub swamp (12 percent), which includes alder thicket and shrub-carr; shallow marsh (11 percent); coniferous swamp (9 percent); deep marsh (7 percent); sedge/wet meadow (3 percent); open bog (1 percent); hardwood swamp (1 percent); and open water (less than 1 percent) (PolyMet 2015b). Within the NorthMet Project area, 105 of the 166 wetlands (63 percent) are rated as high-quality, 11 wetlands (7 percent) are rated as moderate-quality, and 50 wetlands (30 percent) are rated as low-quality. The low-quality wetlands are located at the Hydrometallurgical Residue Facility and the existing LTVSMC Tailings Basin. The moderate-quality wetlands are located at the Mine Site and the existing LTVSMC Tailings Basin. Wetlands at the Mine Site and Transportation and Utility Corridor are ranked as high-quality.

In addition to the NorthMet Project area, the Colby Lake Water Pipeline Corridor and Second Creek areas were evaluated. The area of analysis for Second Creek includes the origin of the creek at the south end of Tailings Basin and ends at the east edge of the Colby Lake Water Pipeline Corridor (see Figure 4.2.3-1). These two areas include 44 wetlands covering 305.9 acres (see Figure 4.2.3-1). The percentage of wetland types identified in the two areas include: shrub swamp (44 percent), which includes alder thicket and shrub-carr; shallow marsh (36 percent); deep marsh (7 percent); hardwood swamp (7 percent); coniferous swamp (5 percent); and sedge/wet meadow (1 percent) (PolyMet 2015b). The majority of the wetlands within the Colby Lake Water Pipeline Corridor have been rated low quality (93 percent), with the remaining wetlands related as moderate quality (7 percent).



Mine Site
Plant Site
Transportation and Utility Corridor
Colby Lake Water Pipeline Corridor
Federal Lands
Area 1
Area 2
Stream/River
One Hundred Mile Swamp (Approximate Boundary)

Eggers & Reed Wetland Types

Coniferous Bog
Coniferous Swamp
Deep Marsh & Shallow Marsh
Hardwood Swamp
Open Bog
Sedge Meadow & Wet Meadow
Shrub Swamps (Alder Thicket & Shrub-Carr)
Shallow, Open Water & Lake

Minnesota Department of Natural Resources
US Army Corps of Engineers St. Paul District
Forest Service Department of Agriculture

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N W E S

0 0.5 1 2 Miles

Figure 4.2.3-1
Wetland Community Types
Overview
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

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4.2.3.1 Mine Site and Transportation and Utility Corridor

The Mine Site is 3,014.5 acres (see Figures 4.2.3-1, 4.2.3-2, and 4.2.3-3) and is located in the Partridge River Watershed, about 3 miles south of the Laurentian Divide. The Partridge River is located in the East St. Louis River Watershed, which discharges into Lake Superior. The Transportation and Utility Corridor (120.1 acres), which includes the Railroad Connection Corridor, is discussed below (see Figures 4.2.3-1 and 4.2.3-4). The following sections provide baseline information on the Mine Site, Transportation and Utility Corridor, and Area 1.

4.2.3.1.1 Wetland Delineation and Classification

Wetland characterization, mapping, and surveys for the Mine Site, Transportation and Utility Corridor, and Area 1 were conducted between 2004 and 2010 (Barr 2006d; Barr 2007b; Barr 2008k; Barr 2011d; PolyMet 2015b). Wetland acreages were determined using USGS topographic and USFWS National Wetlands Inventory (NWI) maps, aerial photographs, soil survey data, and field investigations.

Wetlands on the Mine Site were initially mapped in June 2004 based on a general survey of the area for wetland and upland habitats potentially used by various species of fish and wildlife. Wetland and upland plant communities were mapped on 1997 infrared aerial photographs of the site. A wetland delineation of the Mine Site and lands surrounding the Mine Site was subsequently conducted in August 2004, June 2005, and July 2006. This wetland delineation consisted of applying a combination of on-site and off-site procedures in accordance with the 1987 USACE Wetland Delineation Manual (Manual; USACE 1987). Wetland boundaries were field-mapped using Global Positioning System (GPS), aerial photographic interpretation, topography, and soils information.

Along Dunka Road and other possible transportation routes, field studies were conducted to determine wetland boundaries, vegetation cover types, and plant species composition of identified wetlands. For areas outside of Dunka Road and possible transportation routes, wetlands were mapped primarily based on the presence of photographic signatures with limited field-truthing and GPS locating.

Subsequent to publication of the DEIS, baseline wetland types were re-evaluated. Additional field visits were conducted from April to October 2010, in addition to further mapping efforts. A Wetland Impact Assessment Planning (IAP) Workgroup was formed and facilitated the refinement of the wetland resource mapping efforts. In addition to the ground surveys, wetlands were evaluated during a helicopter reconnaissance in October 2010. Photographs were taken during the aerial reconnaissance using a GPS-equipped digital camera from a distance of 20 to 100 ft above the ground.

In 2010 and 2011, a baseline wetland evaluation was conducted using information from studies and surveys undertaken between 2004 and 2010. Wetlands were evaluated and classified in the areas around the Mine Site and the existing LTVSMC Tailings Basin to determine the potential for indirect hydrologic wetland effects using the Eggers and Reed (1997) community classification system, as determined by the Wetlands IAP Workgroup. This system classifies the wetlands into 15 unique plant communities (see Table 4.2.3-1).

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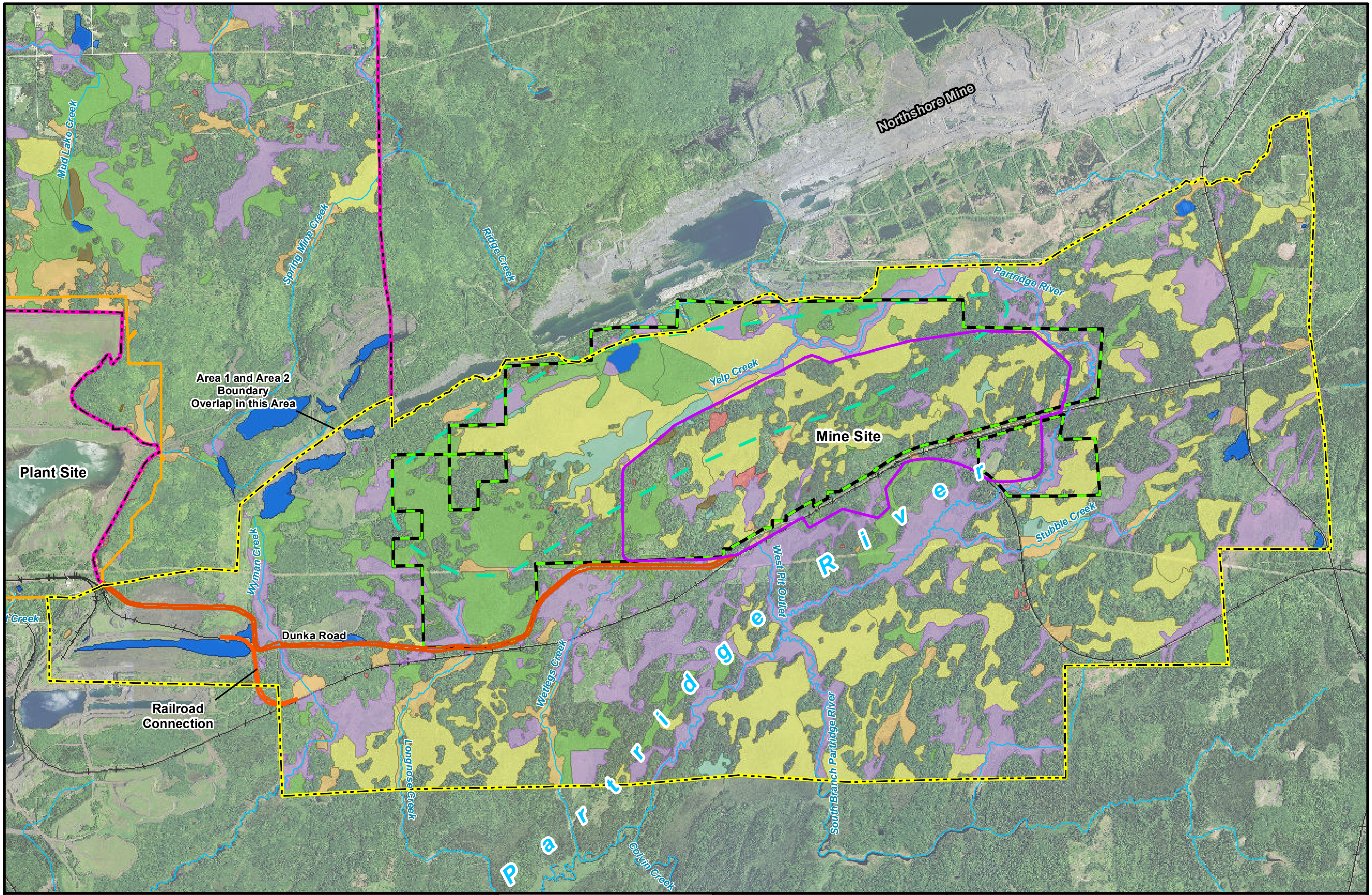

Area 1
Area 2
Mine Site
Plant Site
Transportation and Utility Corridor
Federal Lands
Stream/River
One Hundred Mile Swamp (Approximate Boundary)

Eggers & Reed Wetland Types

Coniferous Bog
Coniferous Swamp
Deep Marsh & Shallow Marsh
Hardwood Swamp
Open Bog
Sedge Meadow & Wet Meadow
Shrub Swamps (Alder Thicket & Shrub-Carr)
Shallow, Open Water & Lake

US Army Corps of Engineers
St. Paul District

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0 0.25 0.5 1 1.5 Miles

Figure 4.2.3-2
Wetland Community Types
Mine Site, Federal Lands, and Area 1
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

124

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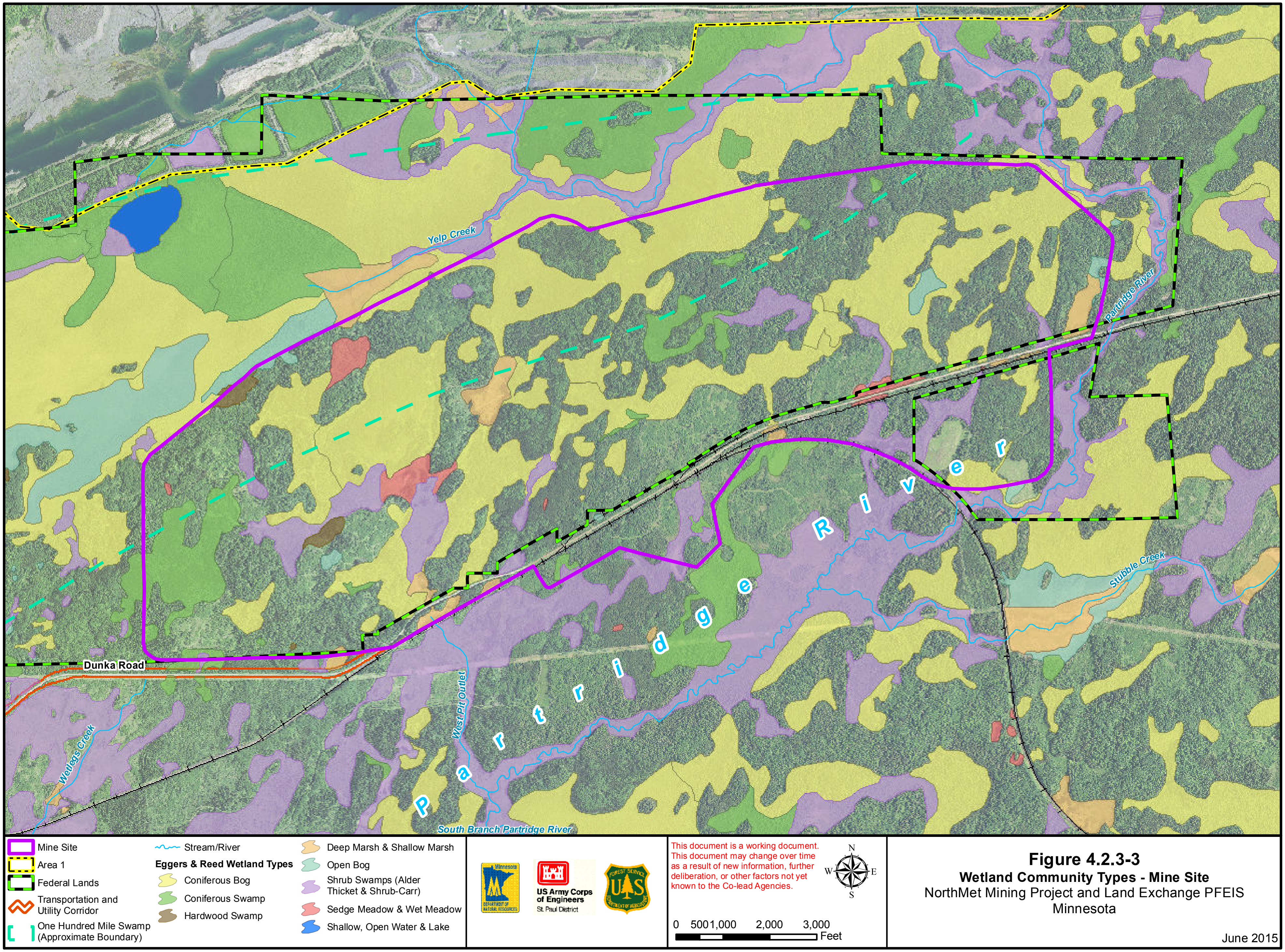


Figure 4.2.3-3

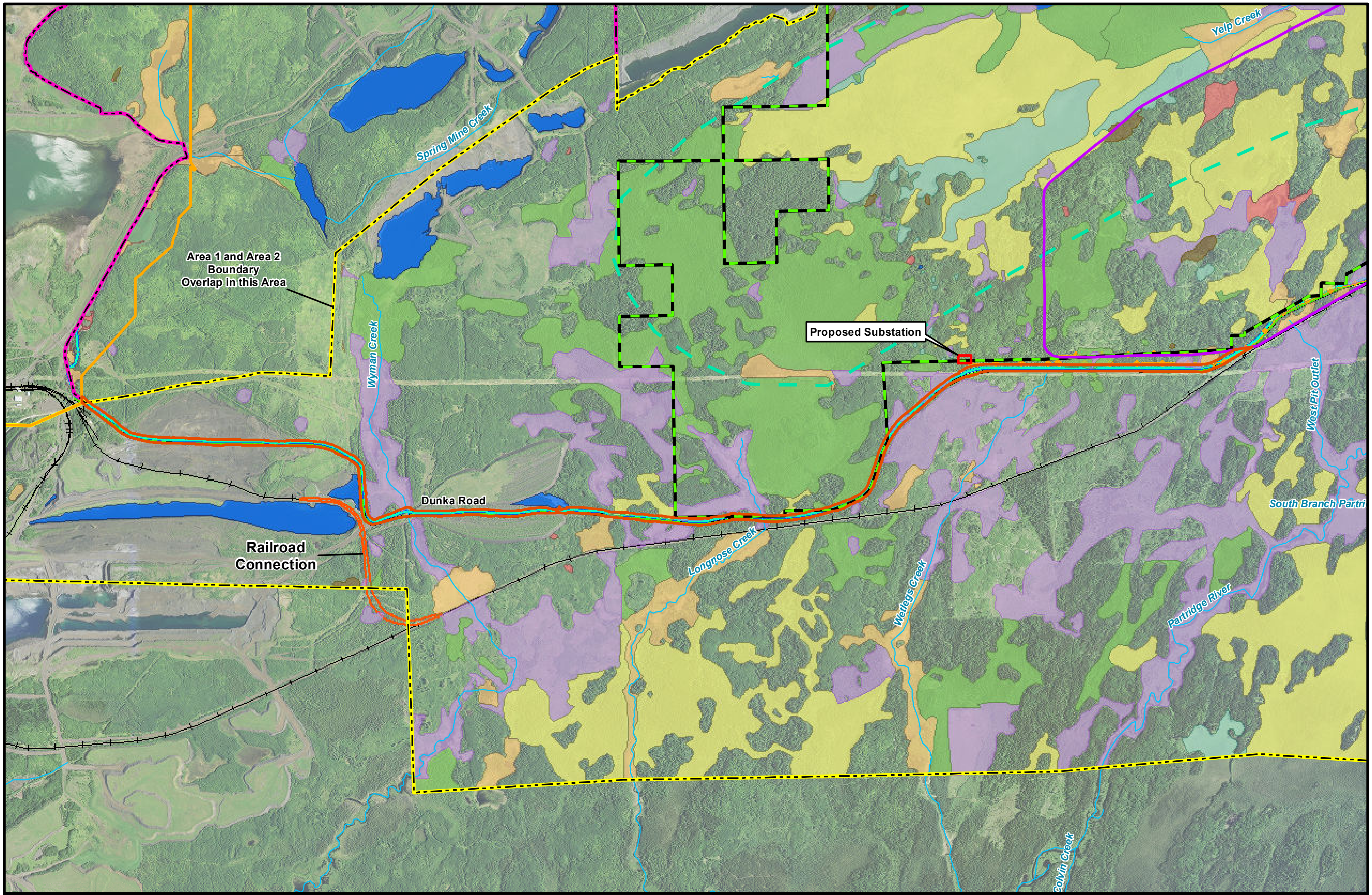
Wetland Community Types - Mine Site

NorthMet Mining Project and Land Exchange PFEIS

Minnesota

June 2015

126 -Page Intentionally Left Blank-



Transportation and Utility Corridor
Mine Site
Plant Site
Federal Lands
Area 1
Area 2
One Hundred Mile Swamp (Approximate Boundary)

Eggers & Reed Wetland Types

Coniferous Bog
Coniferous Swamp
Hardwood Swamp
Deep Marsh & Shallow Marsh
Open Bog
Sedge Meadow & Wet Meadow
Shrub Swamps (Alder Thicket & Shrub-Carr)
Shallow, Open Water & Lake
Transmission Line
Treated Water Pipeline
Dunka Road
Stream/River
Existing Railroad

US Army Corps of Engineers
St. Paul District

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N W E S

0 1,000 2,000 4,000 Feet

Figure 4.2.3-4

Wetland Community Types - Transportation and Utility Corridor

NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

128 -Page Intentionally Left Blank-

Table 4.2.3-1 Wetland Classification System Descriptors

Wetland Plant Community Types[1]	Water Depth	Soils	Common Vegetation
Shallow, open water	6.6’ deep; permanently inundated	Lacustrine deposits and sediments	Pondweed, duckweed, coontail, water milfoil, water lily
Deep marsh	6” to > 3’ deep; permanently to semi-permanently inundated	Lacustrine deposits	Cattail, reed, bulrush, pickerelweed, giant bur-reed, Phragmites, spikerush, wild rice, pondweed, naiad, coontail, water milfoil, waterweed, duckweed, water lily, spatterdock
Shallow marsh	Saturated soils to < 6” deep	Organic or mineral	Manna grass, spikerush, cattail, arrowhead, lake sedge, pickerelweed, smartweed
Sedge meadow	Saturated soils	Organic	Sedges-dominant; spike rush, bulrush, nut grass, Canada blue-joint grass, true rush, forbs
Fresh (wet) meadow	Saturated soils	Mineral or organic	Grass and forbs-dominant; redtop, reed canary grass, manna grass, prairie cordgrass, mint
Wet to wet-mesic prairie	High groundwater table < 12” during portion of growing season	Mineral	Native grasses and forbs-dominant; prairie cordgrass, big bluestem, aster, culver’s root, sunflower
Calcareous fen	Upwelling, calcareous, groundwater discharge	Organic alkaline	Calciphiles-dominant; shrubby cinquefoil, sterile sedge, wild timothy, beaked spike rush, Riddell’s goldenrod, common valerian, lesser fringed gentian
Open bog	Saturated	Organic acid	Continuous sphagnum moss mat present; scattered immature (dbh < 6 in) black spruce or tamarack, ericaceous shrubs, sedges and forbs, such as pitcher plants
Coniferous bog	Saturated	Organic acid	Continuous sphagnum moss mat present; mature (dbh > 6 in) black spruce or tamarack, ericaceous shrubs, sedges and forbs such as pitcher plants
Shrub-carr	Saturated to seasonally flooded	Organic or mineral	Woody vegetation < 20 ft high and dbh < 6 in dominated by willows and/or dogwoods with various sedges, grasses and forbs
Alder thicket	Saturated to seasonally flooded	Organic or alluvial	Woody vegetation < 20 ft high and dbh < 6 in dominated by speckled alder with various sedges, grasses and forbs
Hardwood swamp	Saturated to < 12” deep during most of growing season	Organic alkaline	Continuous sphagnum moss mat absent; black ash, red maple, yellow birch, silver maple, aspen, American elm, dogwood, alder and various sedges, grasses and forbs
Coniferous swamp	Saturated to < 12” deep during most of growing season	Organic ranging from acid to alkaline	Continuous sphagnum moss mat absent; northern white cedar, tamarack, balsam fir, birch, black ash, alder and various sedges, grasses and forbs

Wetland Plant Community Types[1]	Water Depth	Soils	Common Vegetation
Floodplain forest	Inundated during flood events; somewhat well-drained during growing season	Alluvial	Silver maple, green ash, river birch, plains cottonwood, American elm, black willow, jewelweed, nettle
Seasonally flooded basin	Poorly drained; inundated for a few weeks during the growing season	Mineral	Smartweed, beggartick, nut-grass, wild millet and other annual species

Source: Eggers and Reed 1997, 2014; Barr 2011d.

dbh = Diameter at breast height

[1] All wetland classification systems have some limitations; however, wetlands identified as open bogs or coniferous bogs under the Eggers and Reed (1997, 2014) classification system were further subcategorized as either ombrotrophic (hydrology and mineral inputs entirely from direct precipitation) or somewhat minerotrophic (some degree of mineral inputs from groundwater and/or surface water runoff) (Eggers 2011a, 2015; PolyMet 2015b). See Section 4.2.3.1.2 and Section 5.2.3 for more information.

Wetlands were evaluated within Area 1 and Area 2 (see Figures 4.2.3-1). The boundaries for each evaluation area generally follow the St. Louis County section lines and large streams, including portions of the Partridge and Embarrass rivers. The baseline wetland type evaluation was deemed final by the USACE at the wetland workgroup meeting on March 30, 2011 (Barr 2011d). Updates to previous wetland delineations were made between April 2011 and the fall of 2012 as a result of additional site visits and aerial photograph review. Wetland boundaries and types were further refined (PolyMet 2015b).

Prior to conducting the various field delineations, numerous sources of existing information were gathered and reviewed to assist in developing a strategy for evaluating wetlands within the NorthMet Project area. Wetlands within Area 1 and Area 2 that were not delineated between 2004 and 2010 were also identified and classified using the following sources:

- Farm Service Administration true color aerial photographs between 2003 and 2010;
- Farm Service Administration color infrared aerial photographs (2003 and 2008);
- USFWS NWI maps;
- Superior National Forest USFS stand data GIS shapefile (Area 1 only);
- USFS Ecological Land Type (ELT) soils data (where available);
- Natural Resources Conservation Service (NRCS) soils data for St. Louis County (where available);
- USGS topographic maps and digital elevation models; and
- MDNR 2005 color infrared photography stereo pairs with 60 percent overlap (Barr 2011d).

During the field surveys, data were collected for the functions and values of the wetlands within the Mine Site. Wetland functions and values were rated using the guidelines in the Minnesota Routine Assessment Method (MnRAM) for Evaluating Wetland Functions, Versions 3.0 to 3.2. Final wetland locations and wetland functional assessment areas are shown on Figure 4.2.3-2.

4.2.3.1.2 Hydrology, Wetland Vegetation, and Community Types

The NorthMet Project area is located near the headwaters of the Partridge River and Embarrass River watersheds. The Partridge River is a tributary to the St. Louis River, which is located within the Lake Superior Basin. The Mine Site and Transportation and Utility Corridor are located within the Upper Partridge River Watershed. See Section 4.2.2 for more information on water resources.

Currently, runoff from the northernmost area of the Mine Site generally drains north into the One Hundred Mile Swamp and associated wetlands along the Partridge River. These wetlands form the headwaters of the Partridge River, which meanders around the east end of the Mine Site before turning southwest. Runoff from the majority of the Mine Site naturally drains to the south through culverts under Dunka Road and the adjacent rail line, into the Partridge River downstream of the Dunka Road crossing. The Partridge River hydrology is affected by the periodic and variable dewatering of the Northshore Mine pits near the headwaters of the Partridge River, upstream of the proposed Mine Site.

The hydrology of the wetlands at the Mine Site has been stable over time (Barr 2008h). Factors contributing to this stability include: 1) the general lack of continuity between the bedrock and surficial aquifers within the perched wetlands, 2) slow water movement through heterogeneous soils, 3) a slow lateral groundwater flow component that helps sustain downgradient wetlands with a continual supply of groundwater over time, 4) recharge from surrounding uplands slowly providing local groundwater discharge to wetlands over time, 5) relatively flat topography across most of the site, and 6) the high water-holding capacity of the soils (Barr 2008h). However, monitoring would detect connectivity trends and reveal potential drawdown issues, which would then be mitigated as direct effects.

The hydrogeologic setting of the Partridge River watershed consists of a thin veneer of heterogeneous unconsolidated deposits (glacial till) underlain by fractured bedrock (Duluth Complex in most of the Mine Site and Virginia Formation in the northern portion of the Mine Site). In the Mine Site, saturated conditions exist within the unconsolidated deposits and bedrock and the depth to groundwater is typically less than 10 ft. The water table is generally a subdued replica of the land surface, with groundwater divides in the Mine Site expected to roughly coincide with surface water divides. Wetlands cover approximately 43 percent of the Mine Site.

Because of the general lack of interaction between the surficial and bedrock aquifers, the hydrology of many wetlands at the Mine Site is primarily supported by direct precipitation with some variable surficial groundwater components from the uplands. Organic and mineral soils at the Mine Site are typically perched over the dense till or a local sandy textured surficial aquifer, resulting in perched wetlands. The primary method for water to move across the landscape towards the Partridge River is either by lateral flow that is either on the surface or within the subsurface soil. Surface flow laterally across the wetland complexes is negligible because of the flat slopes and surface roughness. The wetlands on the site receive minimal surficial runoff from the upland areas because the soil texture allows rapid infiltration (Barr 2008h). The bedrock has low primary permeability, so groundwater flow within the bedrock is through fractures or other secondary porosity features. Because of the low permeability of the bedrock, the interaction between the surficial deposits and the bedrock aquifers is assumed to be insignificant, according to Siegel and Ericson (1980) (Barr 2010d).

Lateral flow within the soils is typically very slow. Fibric peat at the surface allows infiltration of surficial water; however, the more highly decomposed sapric peat has greatly reduced lateral and vertical hydraulic conductivity compared to the fibric peat. Therefore, water tends to stay perched and stored within the large peat complexes, which typically exhibit only subtle variations in the water tables over time. The silty sand or clay that typically underlies the organic soil has low hydraulic conductivity and, therefore, is a contributing factor that helps maintain the hydrology of the wetlands. The silty sands are sands mixed with clay and silt that are not permeable enough to be used as drainage sands (Barr 2008h).

The soils and hydrology at the Mine Site support stable wetland systems comprised in large part by open and coniferous bogs, as well as shrub carr/alder thickets dominated by alder and willow species, and forested wetland communities comprised of hardwood swamps and coniferous swamps. Most of the wetland vegetation present at the Mine Site (69 percent) is indicative of acid peatland systems (i.e., open and coniferous bogs) that are dependent on precipitation rather than groundwater for hydrologic inputs (i.e., ombrotrophic) and reflect a perched water table. However, it should be noted that although the hydrology of ombrotrophic bogs is solely precipitation-driven, these wetlands can have flowpath connections to groundwater (Eggers 2015). Potential effects are discussed in Section 5.2.3.

The soils at the Mine Site have been mapped by the USFS using the Superior National Forest Ecological Classification System (ECS). This system utilizes ELTs. ELTs present at the Mine Site include Lowland Loamy Moist (ELT 1), Lowland Loamy Wet (ELT 2), Lowland Organic Acid to Neutral (ELT 6), and Upland Shallow Loamy Dry (ELT 16). With the exception of the Wahlsten-Eaglenest-Rock outcrop complex (ELT 16), all the soils associated with these ELTs are listed as hydric soils (USDA 2012). These ELTs have been cross-correlated by the University of Minnesota with the NRCS classification as follows:

- ELT 1 – Babbitt-Bugcreek complex 0 to 2 percent slope;
- ELT 2 – Bugcreek stony loam;
- ELT 6 – Rifle-Greenwood; and
- ELT 16 – Wahlsten-Eaglesnest-Rock outcrop complex, 2 to 8 percent slopes and Eveleth-Conic Rock complex.

Pre-NorthMet Project Proposed Action wetland hydrology monitoring reports, to meet reporting requirements, have been compiled and document 5 years of pre-project planning and monitoring at the Mine Site (2005 to 2009). PolyMet has continued to conduct wetland hydrology monitoring at the Mine Site since 2009. Future wetland hydrology monitoring reports would be submitted in accordance with any permit issued. The degree of hydraulic connection between the wetland areas and adjacent unconsolidated deposits and bedrock at the Mine Site is expected to be variable, depending on the characteristics of the wetlands and the localized hydraulic conductivity and degree of bedrock fracturing. The hydraulic conductivity of the bedrock and surficial deposits have been estimated at the Mine Site by a variety of methods, including conducting aquifer tests and using grain-size distribution data from soil borings and ranges over several orders of magnitude. Data collected during a 30-day pumping test at the Mine Site showed a small amount of drawdown in the deep wetland piezometer nearest to the pumping well, but there was no detectable drawdown at other water table or deep wetland piezometers, indicating that the connection between the bedrock, unconsolidated deposits, and wetlands may be relatively weak. Virtually all water movement in peat wetlands occurs horizontally in the upper layers of peat. The deeper, more decomposed peat soils limit vertical seepage because of the low hydraulic conductivities (approximately 0.0028 ft/day) and the wetland hydrology is generally perched on the relatively impermeable peat layer; however, groundwater flowpaths may still occur. Vertical seepage losses from wetlands without peat soils would only have the potential to occur in isolated areas of contiguous, high hydraulic conductivity bedrock faults and fracture zones located under isolated areas of high hydraulic conductivity glacial till and aligned with wetlands containing high hydraulic conductivity soils (Barr 2010d; Barr 2011j). There is a surface drainage divide oriented generally from southwest to northeast near the northern border of the Mine Site. The majority of the Mine Site, approximately 80 percent, drains south to the Partridge River through extensive wetland complexes. The remaining 20 percent of the Mine Site drains north to the One Hundred Mile Swamp and the Partridge River or northeast to the Partridge River. The 2005 to 2009 wetland hydrology monitoring has determined the following (Barr 2010d):

- The four full years of monitoring wetland well data indicated that the large fluctuations in water levels exhibited within the majority of the wetlands are indicative of wetlands supported primarily by precipitation and local surface runoff. The hydrology of these wetlands tends to fluctuate in a pattern that closely mirrors weather patterns. The shrub swamp wetlands located near the downstream portion of the project generally show more stable water levels due to larger watershed areas and some apparent groundwater inflow. The groundwater flowpaths are generally short with recharge areas (uplands) located close to the discharge areas (wetlands). Surface water runoff and local groundwater contributions from uplands can cause increased mineral content within the water in adjacent wetlands. Wetlands that are solely dependent on precipitation for their hydrology are classified as ombrotrophic. Although the hydrology of ombrotrophic wetlands is solely driven by precipitation, they can have flowpath connections with groundwater. As such, they may be susceptible to effects from groundwater drawdown associated with mining operations; however, that susceptibility is estimated to be low (Eggers 2011a, 2015). Potential effects are discussed in Section 5.2.3.
- There is a general lack of connectivity between the shallow water table in the wetlands and the deeper bedrock aquifer. The depth of soil and till overlying the bedrock ranges up to 33 ft, with bedrock outcrops present that alter local groundwater flowpaths. A pumping and isotope test conducted in 2006 indicated that the groundwater pumped during a 30-day pump test was derived from aquifer recharge rather than surface water seepage from surface water features such as the Northshore Mine Pit or wetlands. The variability of the bedrock and soil surface, along with the location of the surface water divide, creates localized, short, surficial groundwater flowpaths within the watersheds on the Mine Site.
- From 2005 to 2009, the maximum water level fluctuation was less than 12 inches in two wetlands (58 and 114) and between 12 and 18 inches in all other wetlands. Wells located in the southwest and south-central areas of the Mine Site show the greatest range of water table fluctuations, while wells in the northwest area of the Mine Site show the least fluctuation. The wetlands on the Mine Site exhibit stable year-to-year water levels and elevations. Water levels in all wells fluctuated in direct response to precipitation events, with the exception of one well in 2008 and 2009 and one well in 2009. These two wells showed stability indicative of contributing discharge from the larger upstream watersheds.

- The hydrographs in the monitored black spruce and tamarack dominated wetlands (i.e., coniferous bogs) exhibited a stable water table with some fluctuations indicative of saturated, precipitation-driven hydrology (i.e., rapid response to precipitation with mid-summer drawdown). However, Eggers (2015) noted that these coniferous bogs could have flowpath connections to groundwater, albeit limited.

Wetlands were found to consist predominantly of coniferous bog, shrub swamp, and coniferous swamp. Other wetlands include shallow marsh, sedge/wet meadow, open bog, and hardwood swamps. The largest wetland complex near the Mine Site is the One Hundred Mile Swamp (see Figure 4.2.3-2). The swamp is drained by Yelp Creek, which flows east into the Partridge River. The Partridge River flows to the north of the Mine Site and then through the eastern and southeastern portions of the adjoining federal lands. In addition, several impounded wetlands associated with past mine workings and detention ponds were found during the field work along the northern boundary of the adjoining federal lands. These wetlands are best classified as precipitation-driven wetlands on low-permeability soils. Several wetlands have been enlarged due to damming of streams by beaver dams, and other obstructions along the Partridge River have helped to raise water levels that resulted in stands of dead and dying spruce along portions of the river (AECOM 2011a).

The coniferous bog communities have a tree canopy of black spruce and tamarack with occasional balsam fir, while stunted forms of these species may exist in open bog communities. White cedar and deciduous swamp birch are also occasionally found in this community. Shrubs are usually ericaceous (belonging to the heath family) species such as leatherleaf, bog-Labrador tea, and cranberry. Sphagnum moss comprises an almost continuous mat with interspersed, non-dominant forbs such as bunchberry and blue bead lily along with sedges and grasses. Hydrologically, this complex is characterized by a relatively stable year-to-year water table (Barr 2006e; Barr 2010d). All but one of the coniferous bogs identified at the Mine Site are rated as high-quality in accordance with the MnRAM for Evaluating Wetland Functions. This wetland has some fill and therefore was rated as moderate quality.

Wetlands hydrology can be driven by precipitation, or by groundwater, or a combination or both. Wetlands identified as open bogs or coniferous bogs under the Eggers and Reed (1997, 2014) classification system can be further subcategorized as either ombrotrophic (i.e., hydrology and mineral inputs entirely from direct precipitation) or somewhat minerotrophic (i.e., some degree of mineral inputs from groundwater and/or surface water runoff). This is important because ombrotrophic bogs would likely not be affected by groundwater drawdowns associated with proposed mining operations, whereas more minerotrophic bogs would have a higher likelihood of being affected (Eggers 2011a). Eggers (2015) noted that although the hydrology of ombrotrophic bogs is solely precipitation-driven, they can have flowpath connections to groundwater. As such, these wetlands types could be affected by groundwater drawdowns, although the degree of that effect is estimated to be low (Eggers 2015). Please refer to Section 5.2.3 for detailed discussion on effects to these wetland types from drawdown.

An assessment of wetland types within the NorthMet Project area was conducted to distinguish between open and coniferous bogs that are principally precipitation driven (i.e., ombrotrophic peatlands) versus those with some degree of mineral inputs from groundwater and/or surface water runoff (i.e., minerotrophic peatlands). In order to help differentiate ombrotrophic bog communities from bog communities that are somewhat minerotrophic, the *Field Guide to the Native Plant Communities of Minnesota – The Laurentian Mixed Forest Province*

(MDNR 2003b) was used, which characterizes plant communities to a finer level of detail than Eggers and Reed (1997, 2014). Ombrotrophic peatlands develop from minerotrophic peatlands when conditions allow *Sphagnum* peat to accumulate to levels above the groundwater table. Once the peat is above the water table, surface water flows away from or around the elevated peat surface, which reduces inputs of minerals and nutrients (Eggers 2011a; MDNR 2003b). Of the 149 coniferous and open bogs within the Mine Site/Area 1 boundaries, 144 are ombrotrophic and five are minerotrophic (PolyMet 2015b).

The shrub communities generally have a sparse tree canopy and are mostly alder thickets, with some willow and raspberry. Occasionally, balsam fir and paper birch were observed along the perimeter of the wetlands. Grasses, sedges, rushes, and some ferns comprise most of the herb stratum with some areas of sphagnum moss. Hydrologically, this community can be characterized by prolonged periods of shallow inundation with the water table dropping 6 to 12 inches below the ground surface during dry periods (Barr 2006e). Soils are typically fibric (i.e., the least decomposed of the peats and containing un-decomposed fibers) and hemic peat (i.e., peat that is somewhat decomposed) at the surface underlain by bedrock or mineral soils. All of these wetlands are rated as high-quality.

The forested swamp communities (coniferous swamps and hardwood swamps) are dominated by a mix of coniferous (conifers) and deciduous (hardwood) forest complexes. Common trees include black spruce, tamarack, and balsam fir, with some white cedar, black ash, paper birch, and aspen present. The shrub canopy is comprised of speckled alder, willows, and raspberry. Grasses and sedges comprise a majority of the ground story stratum with occasional sphagnum moss. Soils include organic and mineral soils. Some hydrologic observations indicate a greater level of hydrologic fluctuation in the forested swamp community than in the larger bog wetlands, with saturation near the surface early in the growing season and a lower water table in late summer (Barr 2006e). All of these wetlands are rated as high-quality.

Sedges, grasses, and bulrushes dominate wet meadow and sedge meadow communities. Soils are organic at the surface and underlain with mineral soils. These plant communities typically have saturated or inundated water levels for prolonged periods during the growing season (Barr 2006e). Two of these communities, situated between Dunka Road and the railroad, are rated moderate-quality, while the others are rated as high-quality.

Approximately one-half of the shallow marsh communities at the Mine Site have resulted from artificial impoundments by roads, railroads, and beavers. These wetlands are dominated by cattails, bulrushes, sedges, and grasses. Soils are usually organic at the surface underlain by mineral soils. Inundation with 1 to 4 inches of water is common throughout most of the growing season except during dry periods. Eight of these shallow marshes are rated as high-quality and four as moderate-quality. Hydrologic disturbance in these four wetlands is primarily responsible for the moderate-quality rating.

The wetland delineation identified 87 wetlands covering 1,297.8 acres (43 percent) within the 3,014.5-acre Mine Site (see Figure 4.2.3-3) (PolyMet 2015b). Table 4.2.3-2, below, summarizes the wetland areas within the Mine Site represented by each Eggers and Reed (1997, 2014) wetland community type. A large portion of the wetlands to the west of the Mine Site on the federal lands is located in the floodplains of Yelp Creek and the Partridge River or one of their associated tributaries. The most common wetland types within the Mine Site are coniferous bogs (approximately 67 percent); shrub swamps (approximately 14 percent), which includes alder thicket and shrub-carr; and coniferous swamps (10 percent). A total of seven wetlands, each over 50 acres in size within the Mine Site, comprise 773.7 acres of wetlands within the Mine Site. There are an additional five wetlands, each over 20 acres in size within the Mine Site that comprise 164.5 acres of wetlands. Together, these 12 wetlands make up 72 percent of the wetland areas within the Mine Site (PolyMet 2015b). A total of 79 percent of the wetlands in the Mine Site are coniferous swamp, coniferous bog, and open bog communities.

Other wetland community types present at the Mine Site include shallow marshes, sedge/wet meadows, open bogs, hardwood swamps, and deep marshes. The sedge/wet meadows may receive some portion of their hydrology from groundwater while the shallow marsh community generally results from artificial impoundment by beaver dams, roads, and railroads and is primarily dependent on surface waters for hydrology.

Table 4.2.3-2 Wetland Acreage by Wetland Community Type for Mine Site, Transportation and Utility Corridor, and Area 1

	Mine Site									
Eggers and Reed Class[1]	**Mine Site Federally Managed**		**Mine Site Private Lands**		**Mine Site Total**		**Transportation and Utility Corridor**		**Area 1[2]**	
	acres	**%**	**acres**	**%**	**acres**	**%**	**acres**	**%**	**acres**	**%**
Coniferous bog	869.2	71	4.2	6	873.4	67	0.9	12	4,581.2	41
Coniferous swamp	122.0	10	6.6	10	128.6	10	1.6	22	2,071.9	18
Deep marsh	0.0	0	5.0	7	5.0	<1	0.0	0	220.5	2
Hardwood swamp	12.8	1	0.0	0	12.8	1	0.0	0	26.8	<1
Open bog	17.8	1	0.5	<1	18.3	1	0.0	0	283.1	3
Open Water (includes shallow, open water, and lakes)	0.0	0	0.0	0	0.0	0	0.0	0	245.0	2
Sedge/wet meadow	34.9	3	4.6	7	39.5	3	0.0	0	46.0	<1
Shallow marsh	36.5	3	7.5	11	44.0	3	0.6	8	358.7	3
Shrub swamp (includes alder thicket and shrub-carr)	136.0	11	40.0	58	176.0	14	4.1	57	3,368.0	30
Total	1,229.2	100	68.4	100	1,297.8	100	7.2	100	11,201.2	100

Source: PolyMet 2015b.

[1] Eggers and Reed 1997, 2014.
[2] Area 1 acreage is inclusive of the other project area components (e.g., Mine Site, federal lands).

A total of 25 wetlands, encompassing 7.2 acres, have been identified within the Transportation and Utility Corridor (see Figure 4.2.3-4 and Table 4.2.3-2). The wetlands in the corridor include shrub swamps (57 percent), coniferous swamps (22 percent), coniferous bogs (12 percent), and shallow marshes (8 percent). Some of the wetlands adjacent to Dunka Road have been previously logged. Wetlands in the western half of the Dunka Road and Transportation and Utility Corridor are located within areas previously disturbed by mining activities of the former LTVSMC operations (PolyMet 2015b).

Overall, Area 1 encompasses 465 wetlands covering 11,201.2 acres (see Figure 4.2.3-2), and these 465 wetlands represent approximately 47 percent of the overall area. The total number of wetlands and the amount of wetlands within Area 1 is inclusive of the other project area components (e.g., Mine Site, federal lands wetlands). Table 4.2.3-2, above, summarizes the wetland areas represented by each Eggers and Reed (1997, 2014) wetland community type for Area 1 (PolyMet 2015b).

Coniferous bogs are the dominant wetland type present within Area 1, comprising approximately 41 percent of the overall wetland area, while open bogs represent only a small component (approximately 3 percent). Coniferous bogs generally have a tree cover greater than 50 percent, which is typically made up of black spruce and/or tamarack. Forested wetlands that are acid peatlands dominated by dense cover of black spruce and/or tamarack with a more or less continuous carpet of Sphagnum mosses have been classified as coniferous bogs in the Eggers and Reed (1997, 2014) classification system. Occasionally, there are areas with balsam fir, jack pine, and northern white cedar present within the large coniferous bog complexes. The open bogs do not support a dense tree cover and it was observed that typically only a scattering of immature black spruce and/or tamarack are present (Barr 2011d). Additionally, Eggers (2015) and MDNR (2003b) state that ombrotrophic bogs exhibit four specific characteristics: 1) the landform type is a raised bog that is always higher than the peatland margin; 2) there is an absence of minerotrophic (i.e., fen) indicator species; 3) the surface water chemistry has a pH of less than 4.2 and calcium concentrations of less than 2 mg/L; and 4) the hydrology and source of minerals is entirely sourced from precipitation.

The shrub layer and ground layer of coniferous bogs and open bogs have similar composition. The shrub layer is typically dominated by ericaceous shrubs such as leatherleaf, bog-Labrador tea, and cranberry. The ground layer herb stratum commonly includes a continuous sphagnum moss mat with various sedges and other herbaceous vegetation also observed. Northern pitcher plants are abundant in the large bog areas that surrounded Mud Lake. Soils in the coniferous bogs and open bogs generally consist of fibric peat that is usually saturated to the surface throughout much of the growing season (Barr 2011d).

Shrub swamps, which include both alder thicket and shrub-carr community types, represent the second most dominant wetland type within Area 1, comprising approximately 30 percent of the overall wetland area. These shrub swamps are dominated by either alder or willow species, with some dogwoods also present. The ground layer was made up of Canada bluejoint grass and various sedge species, with woolgrass, rushes, and ferns also present. Sphagnum mosses may be present but do not typically form a continuous mat within these shrub swamps. Soils in the shrub swamps are usually fibric and hemic peat at the surface underlain by bedrock or mineral soil (Barr 2011d).

Coniferous swamps represent the third-most dominant wetland type within Area 1, comprising approximately 18 percent of the overall wetland area. These swamps are dominated by black spruce and/or tamarack, with balsam fir and northern white cedar. Deciduous tree species, such as aspen, birch and, on a few occasions, black ash, are also observed in some areas. The shrub layer is observed to be typically dominated by alder and willows. The ground layer commonly includes Canada bluejoint grass, sedges, bunchberry, wild sarsaparilla, and starflower. Sphagnum mosses are also present in the ground layer; however, a continuous sphagnum mat is usually absent. Soils in the coniferous swamps are generally organic and are usually saturated to the surface throughout much of the growing season (Barr 2011d).

Although shallow and deep marshes are present within Area 1, they represent a relatively small percentage of the overall wetland area. These wetlands are dominated by cattails, with sedges and Canada bluejoint grass also present. Soils in the shallow and deep marshes are typically organic at the surface and underlain by mineral soils. The shallow marshes are typically inundated with up to 6 inches of water throughout the entire growing season, while the deep marshes are inundated with over 6 inches of water throughout the entire growing season. These wetlands are often associated with disturbances, such as beaver activity (Barr 2011d).

Hardwood swamps are present but not abundant in Area 1. The hardwood swamps that are present are dominated by black ash, aspen, and birch. Coniferous trees, such as balsam fir, black spruce, and northern white cedar are occasionally present in these hardwood swamps. The shrub layer is generally dominated by alder and young trees while the ground layer species present includes Canada bluejoint grass, sedges, and ferns. Sphagnum mosses were also observed; however, they typically did not form a continuous mat. Soils in the hardwood swamps vary between organic or mineral and are usually saturated throughout much of the growing season (Barr 2011d).

Sedge meadow and wet meadow communities are present within Area 1 but represent a very small portion of the total wetland area. These wetlands are dominated by sedges, Canada bluejoint grass, woolgrass, manna grass, and bulrushes. Soils in the sedge meadow and wet meadow communities are typically organic at the surface underlain by mineral soils. These wetlands are generally saturated close to the ground surface or have shallow inundation for prolonged periods during the growing season (Barr 2011d).

4.2.3.1.3 Wetlands Functional Assessment

Wetlands can serve many functions, including groundwater recharge/discharge, flood storage and alteration/attenuation, nutrient and sediment removal/transformation, toxicant retention, fish and wildlife habitat, wildlife diversity/abundance for breeding migration and wintering, shoreline stabilization, production export, aquatic diversity/abundance, vegetative diversity/integrity, and support of recreational activities. Both the USACE and MDNR use MnRAM for rating wetland functions in Minnesota.

MnRAM is an assessment tool designed to assess functions and values of Minnesota wetlands. MnRAM versions 3.0, 3.1, and 3.2 were used to assess wetland functions and values on the Mine Site (Barr 2006d) and the federal lands (AECOM 2011d; AECOM 2011a). Information on the overall functions and values of the wetland and vegetative quality of each wetland community at the Mine Site was obtained during wetland surveys in 2005 and 2006 and included: 1) plant cover and types, 2) plant community diversity and interspersion, 3) outlet characteristics, 4) watershed and adjacent upland land uses and condition, 5) soil condition, 6) erosion and sedimentation, and 7) past and present human disturbance (Barr 2006d).

Landscape characteristics are also important for evaluating wetland functions within the NorthMet Project area. Key landscape wetland characteristics considered in rating functional quality in the MnRAM assessment are provided in Table 4.2.3-3.

Table 4.2.3-3 Key Landscape Factors Influencing Wetland Functional Scores in MnRAM 3.0

MnRAM 3.0 Factor	Role in Wetland Function and Quality
Wetland or Lake Outlet Characteristics	Outlets influence flood attenuation, downstream water quality, and other hydrologic processes
Watershed and Adjacent Land Uses and Condition	Adjacent land uses influence wetland hydrology, sediment and nutrient loading to wetlands, connectivity for wildlife habitat, and other factors
Soil Condition	Soil condition influences plant community type, vegetative diversity, overall wetland quality and productivity (trophic state)
Erosion and Sedimentation	Influences downstream water quality, trophic state of wetlands, vegetative diversity, and overall wetland quality
Wetland Vegetative Cover and Vegetation Types	Influences vegetative diversity and wildlife habitat as well as hydrologic characteristics (e.g., evapotranspiration or resistance to flow in floodplain wetlands)
Wetland Community Diversity and Interspersion	Influences the vegetative diversity and overall wetland quality as well as value for wildlife habitat
Human Disturbance (both past and present)	Mining, logging, road-building, stream channelization, and other alterations to the landscape

Source: MnRAM 3.0.

These broader landscape factors were applied and evaluated on a larger scale than a single wetland because there are soil and vegetation similarities within the sub-watersheds that are characteristic of large groups of similar wetland types. Human disturbance factors were also similar across broad areas, notably that the majority of the Mine Site is relatively undisturbed by humans and the limited disturbance that does exist is due to logging. Other local factors were considered for each wetland or small groups of wetlands.

Approximately 92 percent of the wetlands in the Mine Site are of high overall wetland quality, and 8 percent of wetlands are of moderate overall wetland quality. High-quality wetlands have low disturbance levels and high vegetative diversity and integrity. Moderate-quality wetlands have impounded open water because of beaver dams and downstream culverts under Dunka Road or the railroad, are adjacent to USFS roads, the Dunka Road corridor, or the railroad corridor (PolyMet 2015b). Summaries of the 87 wetlands evaluated for vegetative diversity/integrity and overall functional quality rating (low, moderate, or high) for wetlands at the Mine Site are presented in Table 4.2.3-4. The overall wetland quality rating was based on professional judgment and considered several wetland functions and the overall degree of human disturbance (Barr 2006d). The plant community diversity/integrity ratings incorporate two principal components, integrity and diversity (MnRAM). Diversity refers to species richness (i.e., number of plant species). The more floristically diverse a community is, the higher the rating. Integrity refers to the condition of the plant community in comparison to the reference standard for that community. The degree and type of disturbance typically play an important role in the diversity/integrity rating.

Table 4.2.3-4 Wetland Functions and Value Assessment for the Mine Site from 2004 and 2006

Wetland Functions and Values Rating	Vegetative Diversity/Integrity (%)	Overall Wetland Quality (%)	Existing Disturbance Level (%)
High	75	92	8
Moderate	8	8	5
Low	0	0	70
Not Available	17	0	17
Total	100	100	100

Source: Barr 2006d.

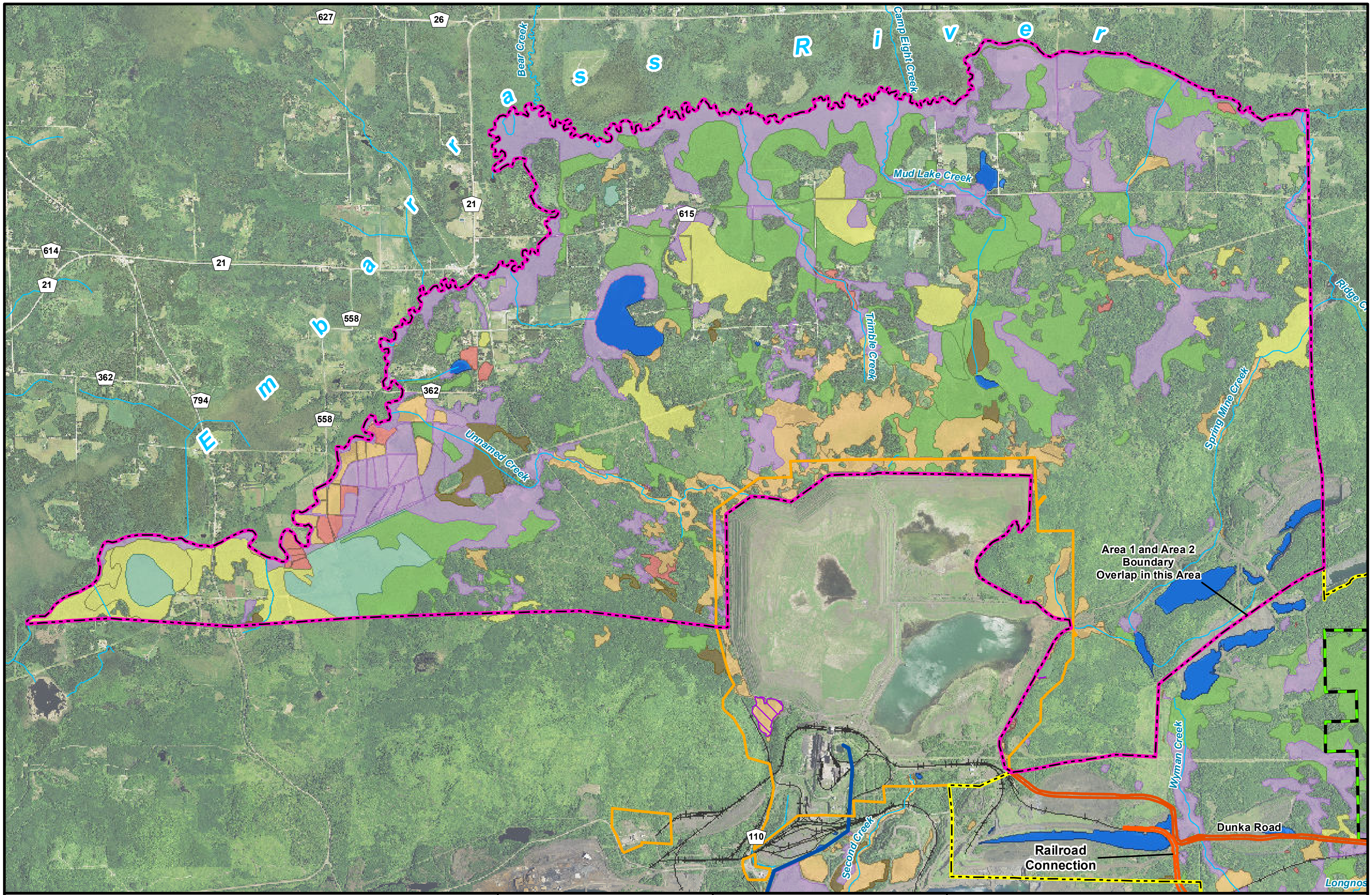
The wetlands along the Transportation and Utility Corridor have all been rated as high-quality. While the wetlands along the Railroad Connection Corridor are moderately affected by either a haul road or an existing railroad, they have a high vegetative diversity/integrity (PolyMet 2015b).

4.2.3.2 Plant Site

4.2.3.2.1 Wetland Delineation and Classification

The Plant Site and Area 2 were delineated and classified using the same methodology as discussed in Section 4.2.3.1.1 above. The Plant Site encompasses 4,515.4 acres, which includes the former LTVSMC processing plant, the existing LTVSMC Tailings Basin, Area 1 Shops, the Hydrometallurgical Residue Facility, and the administration buildings. Area 2 encompasses about a 19,396.7-acre area just north and northwest of the existing LTVSMC Tailings Basin (see Figures 4.2.3-1, 4.2.3-5, and 4.2.3-6).

In addition to the NorthMet Project area, two non-project areas (i.e., the Colby Lake Water Pipeline Corridor (50.6 acres) and Second Creek) are included within this discussion (see Figures 4.2.3-6 and 4.2.3-7).



Area 1
Area 2
Plant Site
Transportation and Utility Corridor
Colby Lake Water Pipeline Corridor
Federal Lands
Stream/River
Exempt Wetland

Eggers & Reed Wetland Types

Coniferous Bog
Coniferous Swamp
Deep Marsh & Shallow Marsh
Hardwood Swamp
Open Bog
Sedge Meadow & Wet Meadow
Shrub Swamps (Alder Thicket & Shrub-Carr)
Shallow, Open Water & Lake

US Army Corps of Engineers
St. Paul District

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Figure 4.2.3-5
Wetland Community Types - Area 2 and Plant Site
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

532

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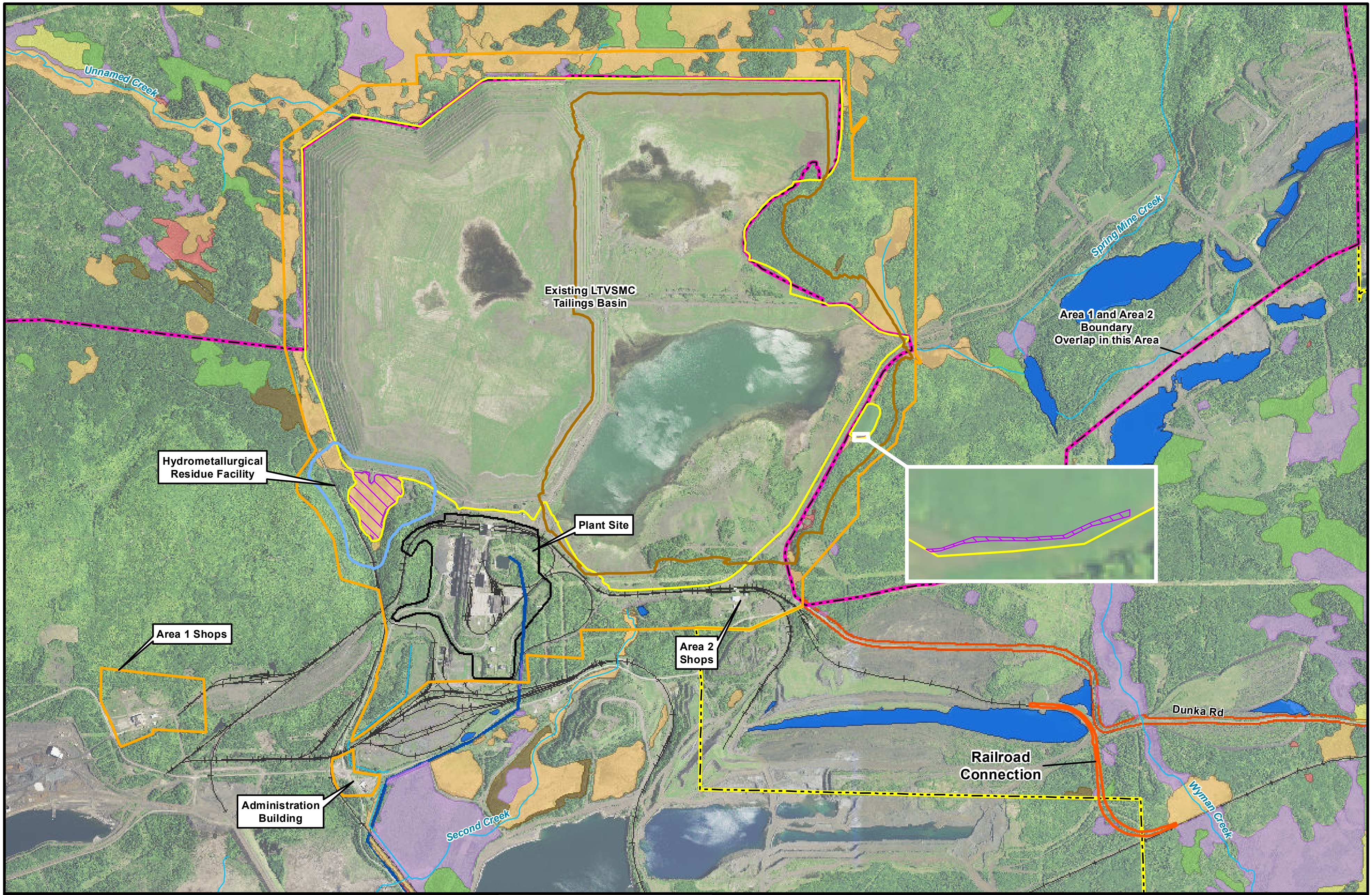

Plant Site
Tailings Basin
Hydrometallurgical Residue Facility
Colby Lake Water Pipeline Corridor
Transportation and Utility Corridor
Cliffs Erie, LLC Permit to Mine Ultimate Tailings Basin Limit
Exempt Wetland

Eggers & Reed Wetland Types

Coniferous Bog
Coniferous Swamp
Hardwood Swamp
Deep Marsh & Shallow Marsh
Open Bog
Sedge Meadow & Wet Meadow
Shrub Swamps (Alder Thicket & Shrub-Carr)
Shallow, Open Water & Lake
Area 1
Area 2
Existing Railroad
Stream/River

US Army Corps of Engineers
St. Paul District

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Figure 4.2.3-6
Wetland Community Types - Plant Site
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

534

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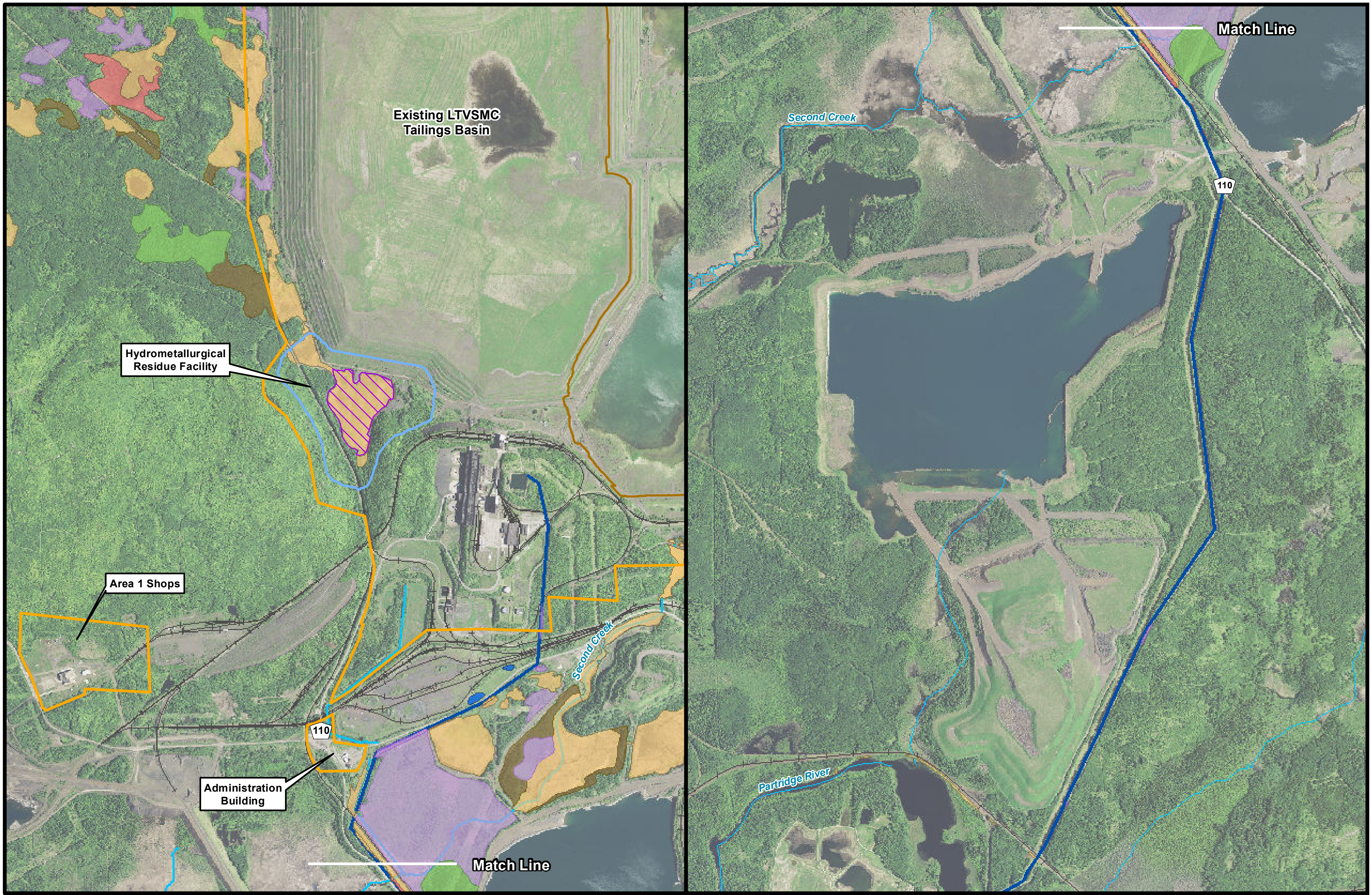

Colby Lake Water Pipeline Corridor
Plant Site
Hydrometallurgical Residue Facility
Stream/River
Exempt Wetland

Eggers & Reed Wetland Types

Deep Marsh & Shallow Marsh
Shrub Swamps (Alder Thicket & Shrub-carr)
Sedge Meadow & Wet Meadow
Shallow, Open Water & Lake
Coniferous Bog
Coniferous swamp
Hardwood swamp
Open bog

US Army Corps of Engineers
St. Paul District

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Figure 4.2.3-7
Wetland Community Types -
Colby Lake Water Pipeline Corridor
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

536 -Page Intentionally Left Blank-

4.2.3.2.2 Hydrology, Wetland Vegetation, and Community Types

The NorthMet Project area is located near the headwaters of the Partridge River and Embarrass River watersheds. The Partridge River and the Embarrass Rivers are both tributary to the St. Louis River, which is located within the Lake Superior Basin. A portion of the Plant Site and the Colby Lake Water Pipeline Corridor are located within the Upper Partridge River Watershed, while the majority of the Plant Site and the remaining portion of the Colby Lake Water Pipeline Corridor are located in the Embarrass River watershed. See Section 4.2.2 for more information on water resources.

Currently, groundwater and surface water seepage from the Tailings Basin drain towards Mud Lake Creek to the north, Trimble Creek to the northwest, and Unnamed Creek to the west. Runoff from the outer slopes of the Tailings Basin is tributary to the surrounding creeks and precipitation falling within the Tailings Basin is contained in the basin.

The hydrogeologic setting of the Embarrass River watershed is generally similar to the Partridge River watershed, although the unconsolidated deposits are generally thicker and more continuous north of the Plant Site area along the Embarrass River valley. The Plant Site is located south of the Laurentian Divide and the area is underlain by granitic rocks of the Giants Range batholith. Although these rocks may be fractured to some extent, they are expected to have significantly lower hydraulic conductivity than the bedrock units at the Mine Site. There are some wetlands located within the Plant Site and saturated conditions generally exist less than 10 ft below the ground surface, like the Mine Site. Similar to the Mine Site, the degree of hydraulic connection between the wetland areas and adjacent unconsolidated deposits and bedrock at the Plant Site is expected to be variable, depending on the characteristics of the wetlands and the localized hydraulic conductivity and degree of bedrock fracturing. Given the very low hydraulic conductivity of the underlying bedrock, there is minimal potential for hydraulic connection between bedrock and wetlands.

The southwest corner of the Plant Site, the former LTVSMC processing plant, has almost entirely been disturbed by past mining activities. Although there is a plant reservoir located east of the concentrator, the plant reservoir is not regulated as a wetland and is exempt (see Figure 4.2.3-6) (PolyMet 2015b). Wetland hydrology at the Plant Site has been affected by the operation of the existing LTVSMC Tailings Basin. Evidence suggests that hydrologic changes from seepage originating from the Tailings Basin, along with beaver dams, have resulted in inundation of wetland areas immediately north of the Tailings Basin (Barr 2008b). Wetlands within the Plant Site are presented in Table 4.2.3-5 and Figure 4.2.3-6.

The existing wetlands differ from the wetlands that occupied the area prior to the construction of the existing LTVSMC Tailings Basin. Historical aerial photographs (1940 and 1948) indicate the presence of large wetland complexes that were a mixture of forested and shrub swamp wetlands, which were primarily saturated to the surface with relatively few open water areas. Past disturbances that have affected the hydrology and vegetative characteristics of the wetlands in the vicinity of the existing LTVSMC Tailings Basin include seepage from the basin along with beaver dams, culverts, road construction, parking areas, railroad embankments, and diversion of flowages (Barr 2008k).

The Plant Site, the Colby Lake Water Pipeline Corridor, and the Second Creek area contain wetland resources (see Table 4.2.3-5). Portions of the existing LTVSMC Tailings Basin and the

Hydrometallurgical Residue Facility are located within the LTVSMC Permit to Mine Ultimate Tailings Basin Limit Boundary. When LTVSMC ceased production in January 2001, the mining-related assets were transferred to Cleveland Cliffs, Inc., which formed Cliffs Erie LLC. Wetlands (28.6 acres) located within the Cliffs Erie (formerly LTVSMC) Permit to Mine Ultimate Tailings Basin Limit Boundary are not regulated by state and federal wetland regulations, as it is an actively permitted waste storage facility (see Figure 4.2.3-6) (PolyMet 2015b).

The regulated wetlands within the Plant Site include a total of 52 wetlands covering 246.1 acres. Wetlands located within the Plant Site are presented in Table 4.2.3-5 and Figure 4.2.3-6. A 0.03-acre area of sedge/wet meadow within the Tailings Basin and a 28.6 acre area of shallow marsh within the Hydrometallurgical Residue Facility are exempt from state and federal wetland regulations as they are both located within the Cliffs Erie Permit to Mine Ultimate Tailings Basin Limit Boundary. Existing wetland resources within the Plant Site consist largely of deep marshes and shallow marshes with dead black spruce trees scattered throughout (Barr 2008l; PolyMet 2015b). Other smaller wetland areas are coniferous swamps, hardwood swamps, sedge/wet meadows, and shrub swamps.

There would be no construction within the Colby Lake Water Pipeline Corridor as the existing pipeline would be used to provide water for the NorthMet Project Proposed Action. A total of 14 wetlands covering 7.0 acres were identified within the Colby Lake Water Pipeline Corridor (see Figure 4.2.3-7 and Table 4.2.3-5). The wetlands in the corridor include shallow marshes (37 percent), shrub swamps (29 percent), sedge/wet meadows (19 percent), and deep marshes (14 percent). The wetlands are adjacent to an unpaved, gravel road and within a previously disturbed corridor (PolyMet 2015b).

There would be no construction within the Second Creek area, which is located south of the Plant Site. A total of 30 wetlands covering 298.9 acres were identified within the Second Creek area of analysis (see Figure 4.2.3-6 and Table 4.2.3-5). The wetlands in the Second Creek area of analysis included shrub swamps (44 percent), shallow marshes (35 percent), deep marshes (7 percent), hardwood swamps (7 percent), coniferous swamp (6 percent), sedge/wet meadows (less than 1 percent), and open water (less than 1 percent) (PolyMet 2015b).

Overall, Area 2 contains 373 wetlands covering 8,621.9 acres of the 19,396.7-acre area, or approximately 44 percent of Area 2. The wetlands are shown on Figure 4.2.3-5. Table 4.2.3-5, below, summarizes the wetland areas represented by each Eggers and Reed (1997, 2014) wetland community type classification system (Barr 2011d; PolyMet 2015b).

Shrub swamps, which include both alder thicket and shrub-carr wetland types, represent the most abundant wetland type within Area 2 comprising approximately 34 percent of the overall wetland area. These shrub swamps are dominated by either alder or willow species, with some dogwoods also present. The ground layer is dominated by Canada bluejoint grass and sedges, woolgrass, rushes, and ferns are also present. Sphagnum mosses may also be present but do not typically form a continuous mat within these shrub swamps. Soils in shrub swamps are usually fibric and hemic peat at the surface underlain by bedrock or mineral soil (Barr 2011d; PolyMet 2015b).

Coniferous swamps within Area 2 are the second most abundant wetland type, comprising approximately 29 percent of the overall wetland area. These swamps are made up of black spruce and/or tamarack, with balsam fir and northern white cedar present in some areas. Deciduous tree species, such as aspen, birch and, to a minor extent, black ash, are also present in some locations.

The shrub layer is observed to be typically dominated by alder and willow species. The ground layer commonly includes Canada bluejoint grass, sedges, bunchberry, wild sarsaparilla, and starflower. Sphagnum mosses are also present in the ground layer; however, a continuous sphagnum mat is usually absent. Soils in the coniferous swamps are generally organic and are usually saturated to the surface throughout much of the growing season (Barr 2011d; PolyMet 2015b).

Coniferous bogs are the third-most abundant wetland type within Area 2, representing approximately 12 percent of the overall wetland area, while open bogs represent only a small component of wetlands in Area 2 (approximately 4 percent). Coniferous bogs generally have a tree cover greater than 50 percent, which is typically dominated by black spruce and/or tamarack. Forested wetlands that are acid peatlands dominated by dense cover of black spruce and/or tamarack with a more or less continuous carpet of Sphagnum mosses have been classified as coniferous bogs in the Eggers and Reed (1997, 2014) classification system. Occasionally, there are areas with balsam fir, jack pine, and northern white cedar present within the large coniferous bog wetland complexes. The open bogs do not support a dense tree cover and it was observed that typically only a scattering of immature black spruce and/or tamarack are present (Barr 2011d; PolyMet 2015b).

The shrub layer and ground layer of coniferous bogs and open bogs have similar composition. The shrub layer is typically dominated by ericaceous shrubs such as leatherleaf, bog Labrador-tea, and cranberry. The ground layer commonly includes a continuous sphagnum moss mat with various sedges and herbaceous vegetation also observed. Northern pitcher plants are abundant in the large bog areas that surround Mud Lake. Soils in the coniferous bogs and open bogs generally consist of fibric peat that is usually saturated to the surface throughout much of the growing season (Barr 2011d; PolyMet 2015b).

Shallow and deep marshes are present within Area 2, and together represent about 14 percent of the wetland area. These wetlands are dominated by cattails, with sedges and Canada bluejoint grass also present. Soils in the shallow and deep marshes are typically organic at the surface and underlain by mineral soils. The shallow marshes present are typically inundated with up to 6 inches of water throughout the entire growing season, while the deep marshes are inundated with over 6 inches of water throughout the entire growing season. These wetlands are often associated with disturbances, such as beaver activity (Barr 2011d; PolyMet 2015b).

Hardwood swamps are present but not abundant in Area 2. The hardwood swamps that are present are dominated by black ash, aspen, and birch. Coniferous trees, such as balsam fir, black spruce, and northern white cedar are occasionally present in these hardwood swamps. The shrub layer is generally dominated by alder and young saplings while the ground layer species present include Canada bluejoint grass, sedges, and ferns. Sphagnum mosses are also observed; however, they do not typically form a continuous mat. Soils in the hardwood swamps are either organic or mineral and are usually saturated throughout much of the growing season (Barr 2011d; PolyMet 2015b).

Sedge meadow and wet meadow communities are present within Area 2 but represent only a small proportion of the total wetland area. These wetlands are populated by sedges, Canada bluejoint grass, woolgrass, manna grass, and bulrushes. Soils in the sedge meadows and wet meadow communities are typically organic at the surface and underlain by mineral soils. These wetlands are generally saturated close to the ground surface or have shallow inundation for prolonged periods during the growing season (Barr 2011d; PolyMet 2015b).

Table 4.2.3-5 Total Wetland Acreage by Wetland Type for Plant Site, Colby Lake Water Pipeline Corridor, Second Creek Area, and Area 2

	Plant Site[2]		Colby Lake Water Pipeline Corridor		Second Creek Area[5]		Area 2	
Eggers and Reed Class[1]	**Acres**	**%**	**Acres**	**%**	**Acres**	**%**	**Acres**	**%**
Coniferous bog	0.0	0	0.0	0	0.0	0	1017.9	12
Coniferous swamp	14.4	5	0.0	0	16.8	6	2,536.9	29
Deep marsh	106.6	39	1.0	14	19.6	7	513.0	6
Hardwood swamp	1.0	<1	0.0	0	21.1	7	161.2	2
Open bog	0.0	0	0.0	0	0.0	0	353.6	4
Open water (includes shallow, open water, and lakes)	0.9	<1	0.0	0	1.3	<1	285.4	3
Sedge/wet meadow	1.5[(3)]	<1	1.4	19	1.3	<1	137.52	2
Shallow marsh	135.9[(4)]	50	2.6	37	106.0	35	654.0	8
Shrub swamp (includes alder thicket and shrub-carr)	14.4	5	2.1	29	132.9	44	2,961.6	34
Total[6]	274.7	100	7.0	99	298.9	100	8,621.9	100

Source: PolyMet 2015b.

[1] Eggers and Reed 1997, 2014.
[2] There are 52 unique wetland areas at the Plant Site, which includes the Tailings Basin and Hydrometallurgical Residue Facility footprint. Two wetlands (ID 1155 and 1159) have been split between the Tailings Basin and Hydrometallurgical Residue Facility footprint in the Wetland Data Package for a total of 54 wetlands resource areas in Wetland Data Package report.
[3] A 0.03-acre area of this wetland type is classified as exempt from state and federal wetlands regulations.
[4] A 28.56-acre area of this wetland type is classified as exempt from state and federal wetlands regulations.
[5] A total of 30 wetlands are associated with the Second Creek area of analysis; however, only 22 are unique to the Second Creek area of analysis as one wetland is associated with the Plant Site and 7 wetlands are located within the Colby Lake Water Pipeline Corridor. To avoid double counting during the analysis of impacts, these 8 wetlands (6.2 acres) would be excluded from the Second Creek area of analysis.
[6] Percent totals are greater than 100 percent due to rounding.

4.2.3.2.3 Wetlands Functional Assessment

Wetlands within the Tailings Basin have been previously affected by the LTVSMC tailings deposition, roads, and impoundment. The majority (92 percent) of the wetlands within this area are currently rated as low-quality with low vegetative diversity/integrity. Eight percent of the wetlands within the Tailings Basin are rated as moderate quality. The wetlands within the Hydrometallurgical Residue Facility are located on the south side of an unpaved, gravel road with small buildings and associated facilities used in the former LTVSMC operations. These wetlands are currently rated as low-quality (PolyMet 2015b).

The majority of wetlands within the Colby Lake Water Pipeline Corridor, which are located adjacent to an unpaved, gravel road and within a previously disturbed corridor, are rated as low-quality (93 percent), with the remaining wetlands rated as moderate-quality (7 percent) (PolyMet 2015b).

4.2.4 Vegetation

This section describes the existing cover type categories, plant communities, and individual plant species in the NorthMet Project area. Cover type categories and plant communities are defined for each parcel, and their geographic locations are presented on the corresponding figures. Minnesota Biological Survey (MBS) Sites of Biodiversity Significance, Scientific and Natural Areas (SNAs), and culturally important plant species are also discussed for each parcel. Species are grouped into two partially overlapping categories: state-listed Endangered, Threatened, or Special Concern (ETSC) species; and the USFS's Regional Foresters Sensitive Species (RFSS). There are no federally listed plant species within the NorthMet Project area.

Additional information beyond what the MDNR Natural Heritage Information System (NHIS) contained, such as species conservation ranking, distribution, and habitat, were obtained from NatureServe, an online public database that utilizes sources such as scientific literature, web sites, expert knowledge, and information from local data centers. The Bell Museum of Natural History, which maintains an herbarium vascular plant collection database, was also consulted.

Several vegetation surveys have been conducted on the federal lands (including part of the Mine Site) and the non-federal lands. These studies gathered information on dominant plant species within various habitats, as well as the presence or absence of ETSC species.

Rulemaking was conducted with the intent to update the list of ETSC species (*Minnesota Rules*, parts 6134.0100 to 6134.0400), with new listings becoming effective on August 19, 2013 (MDNR 2013h). This FEIS considers any new listings, or changes in the previous listings, associated with the updated list. A Biological Evaluation (BE) has been prepared that contains further information about RFSS. The BE is included in Appendix D and is posted on the USFS website (http://www.fs.usda.gov/goto/superior/northmet).

4.2.4.1 Regional Setting

The Mine Site, Transportation and Utility Corridor, and Plant Site are located in the MDNR-designated Nashwauk Uplands and Laurentian Uplands subsections of the Northern Superior Uplands section of the Laurentian Mixed Forest Province ecoregion, corresponding roughly to the Arrowhead region of northeastern Minnesota (MDNR 2006a; MDNR 2011e). Most of the vegetative cover types in these subsections grow in acidic to neutral glacial materials over Precambrian bedrock (MDNR 2011f; MDNR 2011i). Soils vary from medium to coarse texture, and they support forest communities of aspen-birch, jack pine (*Pinus banksiana*), balsam fir (*Abies balsamea*), white spruce (*Picea glauca*), red pine (*Pinus resinosa*), and white pine (*Pinus strobus*) on the uplands and conifer bogs and swamps on the lowlands.

4.2.4.2 Mine Site

The Mine Site includes a single contiguous 3,014.5-acre tract of land. It is located on both private lands (295.2 acres) and federal lands (2,719.3 acres) within the Superior National Forest.

4.2.4.2.1 Cover Types

Cover types are of several classifications, including MDNR Gap Analysis Program (GAP) land cover types, specific plant communities identified through surveys, MBS Sites of Biodiversity Significance, native plant communities, and SNAs.

Habitat Types

The MDNR uses a hierarchical land classification system called the GAP land cover system, which organizes vegetation communities into 1-acre blocks. The primary GAP land cover types at the Mine Site are upland conifer forest (40 percent) and lowland conifer forest (26 percent), in addition to upland deciduous forest (see Table 4.2.4-1 and Figure 4.2.4-1). Some of the least represented cover types on the Mine Site include cropland/grassland or upland conifer-deciduous mixed forest types. The MDNR GAP land cover types below do not fully represent the extent of mixed forest types, since the cover type level below is fairly specific. As detailed below in ENSR (2005) surveys, there is much more mixed forest types than indicated.

Table 4.2.4-1 NorthMet Mine Site Cover Types

Cover Types	Total Acres	Percent of Area
Upland coniferous forest[1]	1,195.5	40
Lowland coniferous forest[2]	781.2	26
Upland deciduous forest[3]	648.0	21
Shrubland	241.7	8
Disturbed	128.0	4
Aquatic environments	12.7	<1
Cropland/Grassland	4.9	<1
Upland conifer-deciduous mixed forest[4]	2.4	<1
Lowland deciduous forest[5]	0.1	<1
Total	**3,014.5**	**100**

Source: MDNR 2006b.

Notes:
[1] Includes pine and spruce/fir forest cover types.
[2] Includes lowland black spruce, lowland northern white cedar, and tamarack forest cover types.
[3] Includes aspen/aspen-white birch, maple/basswood, and oak forest cover types.
[4] Includes all mixed coniferous-deciduous forest cover types.
[5] Includes black ash forest cover types.

Plant Community Surveys

The primary cover types at the Mine Site are mixed pine-hardwood forests on the uplands and black spruce (*Picea mariana*) swamp/bog in the wetlands (ENSR 2005). USFS stand data and field verification indicate that northern white cedar also occurs at the Mine Site in lowland conifer forests (Barr 2011d). The remaining forest on the Mine Site is made up of aspen (*Populus* spp.), aspen-birch, jack pine, and mixed hardwood swamp. The relatively small amount of grass/brushland habitat that is present is land recovering from past logging through natural succession. There are also small areas of open water and disturbed ground that were previously cleared for logging roads and log landings. Of the wetlands that are located on the Mine Site, the majority (92 percent) is rated as having a high overall wetland quality and 8 percent are of moderate overall wetland quality. Vegetation diversity and integrity are rated moderate to high for all wetlands because recent human contact and alteration are minimal and the wetlands have a relatively constant supply of water. Section 4.2.3 provides a more detailed discussion on wetlands.

Many of the upland forest areas on the Mine Site have been harvested in the last 20 to 60 years. The oldest forest at the Mine Site includes approximately 297 acres of 40- to 80-year-old trees within the mixed pine-hardwood forest in the southwest portion of the Mine Site (ENSR 2005).

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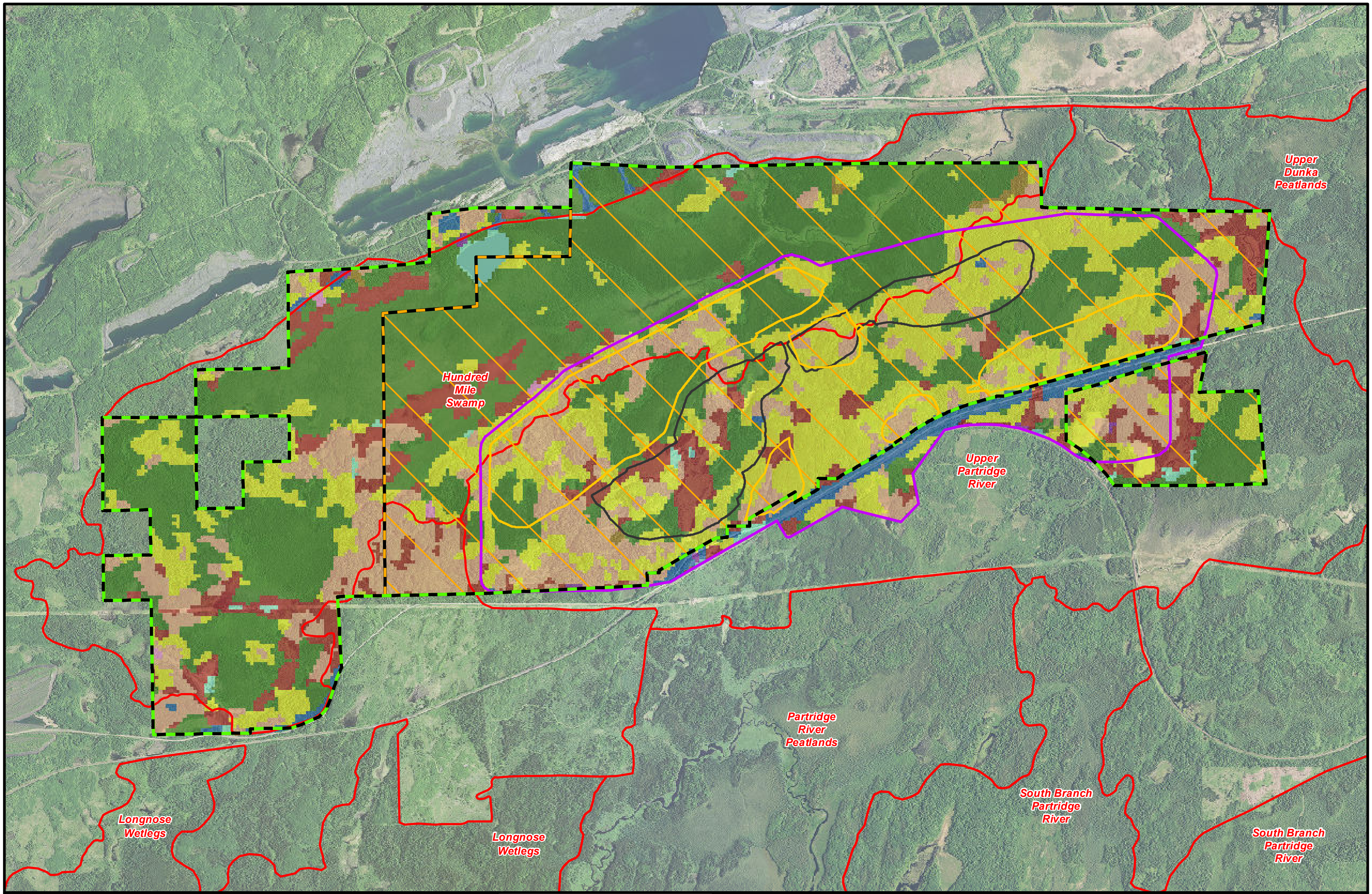

Federal Lands
Alternative B: Smaller Federal Parcel
Mine Site
Stockpile
Mine Pit
MBS Site of Biodiversity Significance

Land Cover Classes

Aquatic Environments
Cropland/Grassland
Lowland Conifer Forest
Lowland Deciduous Forest
Disturbed
Shrubland
Upland Conifer Forest
Upland Conifer-Deciduous mix
Upland Deciduous Forest

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Figure 4.2.4-1
Land Cover/Habitat Types - Federal Lands and Mine Site
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Minnesota

June 2015

78 -Page Intentionally Left Blank-

Minnesota Biological Survey

The MDNR operates the MBS program, which includes spatial information from survey reports on native plant communities and rare species. Sites of Biodiversity Significance are designated and ranked by the MDNR based on the environmental conditions present, including native plant communities, rare species, and unique habitat. The MBS utilizes a four-tiered ranking system: Outstanding, High, Moderate, and Below (from highest to lowest). Sites of High Biodiversity Significance contain very good-quality occurrences of the rarest species, high-quality examples of rare native plant communities, and/or important functional landscapes (MDNR 2008a). The entire 3,014.5-acre Mine Site has been characterized by the MBS as various Sites of High Biodiversity Significance due to the presence of the One Hundred Mile Swamp site, which covers 15 percent of the Mine Site, and the Upper Partridge River site, which is 85 percent of the Mine Site (see Figure 4.2.4-2) (MDNR 2008a).

Native plant communities are also ranked by the MDNR by their quality and abundance in a given area. “Imperiled” or “vulnerable” designations indicate that the communities have high ecological value, are rare in a given area, and/or could face danger of extirpation. Those with “apparently secure” designations are uncommon in a given area, but are not rare. Those with “widespread and secure” designations are fairly common and in no immediate risk of extirpation. Native plant communities are identified by their name and a unique code assigned to them by the MDNR (e.g., FDn32c). Two native plant communities, black spruce-jack pine woodlands (FDn32c; 34 percent of Mine Site) and rich black spruce swamp (FPn62a; 7 percent of Mine Site), have been characterized by the MBS as “imperiled/vulnerable” and “vulnerable,” respectively (MDNR 2008b). Poor tamarack-black spruce swamps (APn81b) and black spruce bogs (APn80a1) are ranked as “apparently secure” based on abundance, distribution, trends, and threats (MDNR 2008b). Aspen-birch forests: balsam fir subtype (FDn43b1), alder (*Alnus* spp.) swamps (FPn73a), poor black spruce swamps (APn81a), and low shrub poor fens (APn91a) are all considered “widespread and secure.”

Scientific and Natural Areas

The MDNR SNA program designates and preserves areas that have outstanding rare resources or features. There are no lands designated or nominated for designation as SNAs on the Mine Site (MDNR 2006c; Wilson, MDNR, Pers. Comm., February 14, 2012).

Culturally Important Plants

Wild rice is an important plant species to the Bands, as well as an important wildlife food source. The MPCA staff have recommended three segments within the Partridge River watershed as waters used for the production of wild rice; the closest segment is about 2 miles from the Mine Site and includes the lower portion of the Upper Partridge River just upstream of the railroad bridge near Allen Junction to where it enters Colby Lake (see Figure 5.2.2-1) (MPCA 2012b). There were no observations of wild rice in Colby Lake itself or the tributary stream Wyman Creek (Barr 2011a; Barr 2012a; MPCA 2012b). The MPCA’s draft staff recommendation identifies the portion of the Partridge River from Colby Lake to its confluence with the St. Louis River as a water source used for production of wild rice. Small populations of wild rice have been observed in Second Creek from First Creek to its confluence with the Partridge River (Barr 2011a). Natural resources culturally important to the Bands are discussed in Section 4.2.9.3.3.

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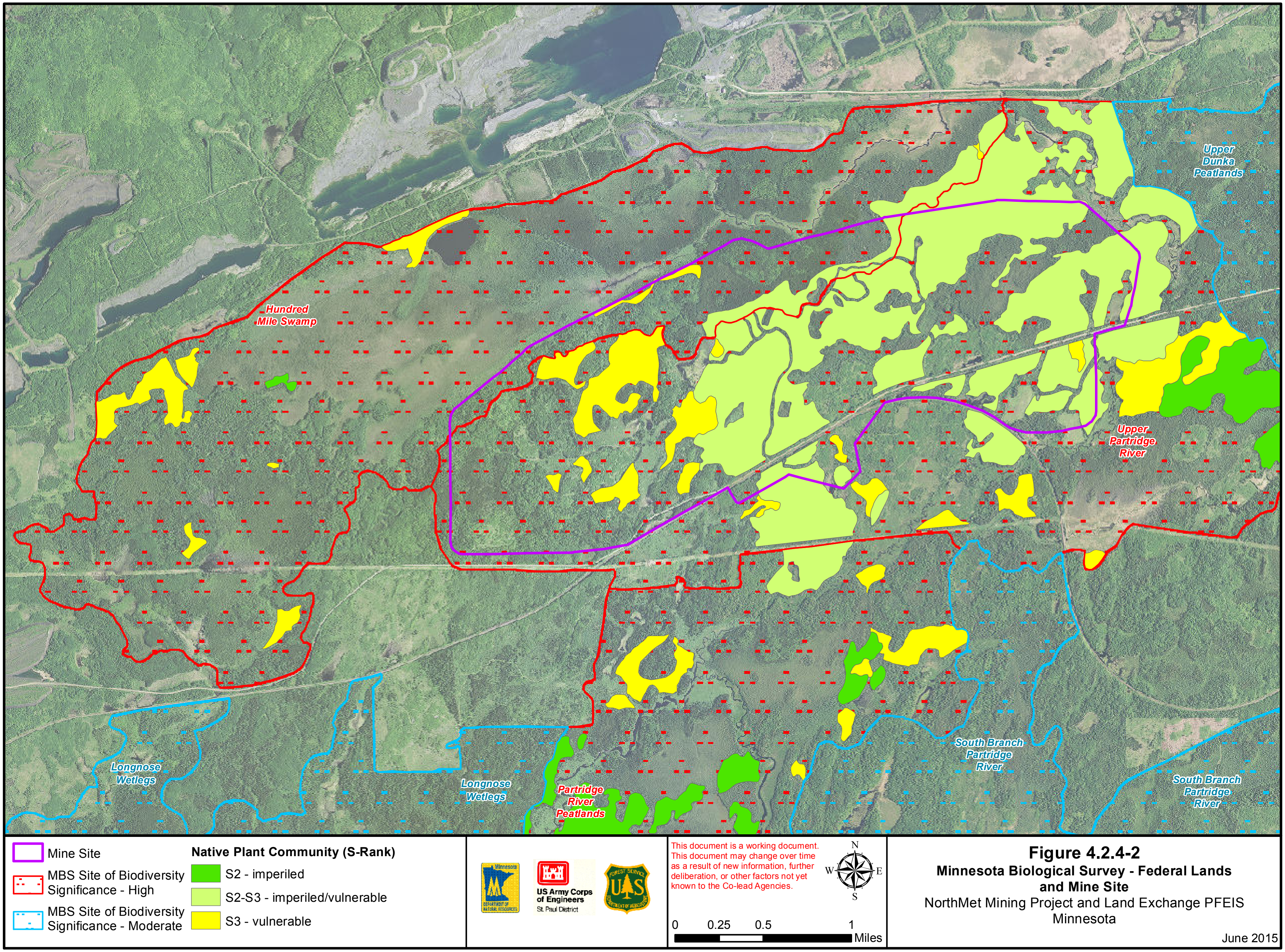

Figure 4.2.4-2
Minnesota Biological Survey - Federal Lands and Mine Site
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

123 -Page Intentionally Left Blank-

National Hierarchical Framework of Ecological Units

The National Hierarchical Framework of Ecological Units (NHFEU) is a land classification system that uses a nested hierarchy of eight levels of ecological units (Cleland et al. 1997). Units are differentiated using a combination of physical and biological factors, such as geology, topography, soils, and vegetation. The Landscape scale contains the Land Type Association (LTA) level, which is defined using several factors, including bedrock types, lake and stream distributions, wetland patterns, and pre-European settlement vegetation (MDNR 2011g). The Land Unit scale contains the ELT level, which is a subtype of the LTA level. The MDNR and USFS also have an ECS that identifies and classifies lands in a similar fashion according to provinces, sections, subsections, and LTAs (MDNR 2011g).

The portion of the One Hundred Mile Swamp that is on the federal lands, including part of the Mine Site, has been identified as a Site of High Biodiversity Significance and was aerially surveyed by Chel Anderson in 1997. The One Hundred Mile Swamp comprises approximately 3,028 acres located within LTA 8A – Big Rice Outwash (MDNR 1997), which has since been reclassified as LTA 212Le11 – Big Lake-Bird Lake End Moraines. Two other sites besides the One Hundred Mile Swamp site were surveyed on the ground and by air in LTA 212Le11. These sites provide a good representation of most of the LTA’s biological and physical attributes at the ELT level, as mentioned above. The One Hundred Mile Swamp and the two other sites surveyed provide a complete representation of the prominent ELTs present within LTA 212Le11.

4.2.4.2.2 Invasive Non-native Plants

Invasive non-native plants are a concern because they can quickly form self-sustaining monocultures that out-compete native plants or reduce the quality of wildlife habitat, particularly in disturbed areas. “Non-native” species are those that have been introduced, or moved, by human activities to a location where they do not naturally occur (MDNR 2011b). “Invasive” species are non-native species that cause ecological or economic problems (e.g., out-competing indigenous species or altering the existing ecological community through rapid development of monocultures). In general, few invasive non-native plants have been observed on the federal lands because wetland disturbance has been minimal, upland disturbance has been restricted to timber harvests, and human access has been limited, thereby reducing the spread of these plants (AECOM 2011a; ENSR 2005). No known occurrences of invasive species on the federal lands are listed in the Superior National Forest invasive plant geodatabase, but no inventories have been performed in the NorthMet Project area (USFS 2010a). The majority of representative wetland locations surveyed on the federal lands yielded 100 percent native plants with no occurrences of non-native species at those sites according to MnRAM 3.2 worksheets (AECOM 2011d). Field surveys indicate that disturbed upland areas on the federal lands contain occurrences of yellow sweetclover and bladder campion, both of which are invasive non-native species. Yellow sweetclover invades grasslands and early successional habitats by overtopping and shading out native species (MDNR 2011b). Bladder campion is a prolific seed-producer and can spread vegetatively, as well.

A vegetation survey of mines on the Mesabi Iron Range (Apfelbaum et al. 1995) identified a large number of invasive non-native plant species that could invade the Mine Site, and some species are estimated to be currently present on the Mine Site (see Table 4.2.4-2). Some of these species are grasses and legumes that were planted on mines and other sites to reduce erosion and to fix nitrogen into the soil as part of a reclamation effort (e.g., redtop, smooth brome, birdsfoot trefoil, yellow sweetclover, white sweetclover, alfalfa, timothy, Kentucky bluegrass, Canada bluegrass, and white clover). In addition, a road weed survey by the Superior National Forest (USFS 2011k) documented several invasive species (species tracked by the USFS and Minnesota Class 2 invasive species) within 3 miles of the Mine Site, primarily along roadways (see Table 4.2.4-3). Species with a high percentage of occurrences in the surveys (e.g., common tansy) are more likely to occur on the Mine Site.

Table 4.2.4-2 Invasive Non-native Plant Species Found on Mine Sites in the Mesabi Iron Range

Scientific Name	Common Name	Percent Occurrence[1]	Wetland/ Upland	Estimated Abundance at NorthMet Mine Site
Bromus inermis	Smooth brome	60	U	Uncommon
Tanacetum vulgare	Common tansy	60	U	Uncommon
Taraxacum officinale	Dandelion	60	U	Common
Cirsium arvense	Canada thistle	40	U	Uncommon
Phleum pratense	Timothy	40	U	Common
Poa pratensis	Kentucky bluegrass	40	U	Common
Leucanthemum vulgare	Oxeye daisy	30	U	Common
Lotus corniculatus	Birdsfoot trefoil	30	U	Common
Hieracium pratense	Yellow hawkweed	20	U	Uncommon
Lychnis alba	Bladder campion	20	U	Uncommon
Melilotus officinalis	Yellow sweetclover	20	U	Uncommon
Agrostis alba	Redtop	10	W/U	Uncommon
Cirsium vulgare	Bull thistle	10	U	Uncommon
Hieracium aurantiacum	Devil's hawkweed	10	U	Common
Medicago lupulina	Black medic	10	U	Common
Trifolium repens	White clover	10	U	Common

Source: Apfelbaum et al. 1995.

Note:
[1] Percent occurrence is the percentage of mine areas in the Mesabi Iron Range with reported observations based on 3-minute surveys at 10 mine areas. Three-minute surveys report the most abundant plant species observed during a 3-minute time period and provide a rough estimate of species abundance.

Table 4.2.4-3 Invasive Non-native Plant Species Found Within 3 Miles of the Mine Site and Plant Site by the USFS Road Weed Survey

Scientific Name	Common Name	Percent Occurrence Near Plant and Mine Sites[1]	Wetland/ Upland
Tanacetum vulgare[3]	Common tansy	35	U
Hypericum perforatum[2]	St. John's wort	29	U
Cirsium arvense[3]	Canada thistle	24	U
Cirsium vulgare	Bull thistle	6	U
Centaurea stoebe (*C. maculosa*)[3]	Spotted knapweed	5	U

Source: USFS 2011k.

Notes:
[1] Percent occurrence is the observed number of populations of the species divided by the 96 total plant populations identified within 3 miles of the Mine and Plant Sites.
[2] Tracked by USFS.
[3] Minnesota Class 2 - Controlled noxious weed as identified by the 2012 Minnesota Noxious Weed Law.

4.2.4.2.3 Threatened and Endangered Plant Species

Endangered, Threatened, and Special Concern Plant Species

No federally listed threatened and endangered plant species are known to occur on the federal lands, including the Mine Site. However, ten state-listed ETSC plant species are known to occur in the vicinity of the Mine Site. Based on a review of the MDNR NHIS and field investigations (AECOM 2009b; Barr 2007i; Johnson-Groh 2004; Pomroy and Barnes 2004; Walton 2004), one state endangered species, and nine state species of special concern have been identified on the Mine Site (see Table 4.2.4-4 and Figure 4.2.4-3). No other state-listed species are known to occur and no appropriate habitat for other species occurs on the Mine Site. Minnesota's endangered species law (*Minnesota Statute,* § 84.0895) and associated rules (*Minnesota Rules,* part 6212.1800 to 6212.2300 and 6212.6134) impose a variety of restrictions, permits, and exemptions pertaining to ETSC species. Rulemaking was conducted with the intent to update the list of ETSC species (*Minnesota Rules*, parts 6134.0100 to 6134.0400), with new listings becoming effective on August 19, 2013 (MDNR 2013h). This FEIS considers any new listings, or changes in the previous listings, associated with the updated list.

Population numbers correspond to the MDNR Element Occurrence within the NHIS database (Joyal, MDNR, Pers. Comm., February 13, 2012). According to the 2011 MDNR NHIS training notes, Element Occurrences may have multiple observations in a given area, but are considered one population if they are "within close enough proximity to one another to allow for gene flow and there are no known barriers to movement." These clusters of observations are described here as colonies for given populations. An individual is defined as a single plant of a species. A colony is a group of individual plants of one species in a distinct geographic location. A population is a group of individuals or colonies of one species that may be separated geographically, but are close enough to interbreed and persist over time.

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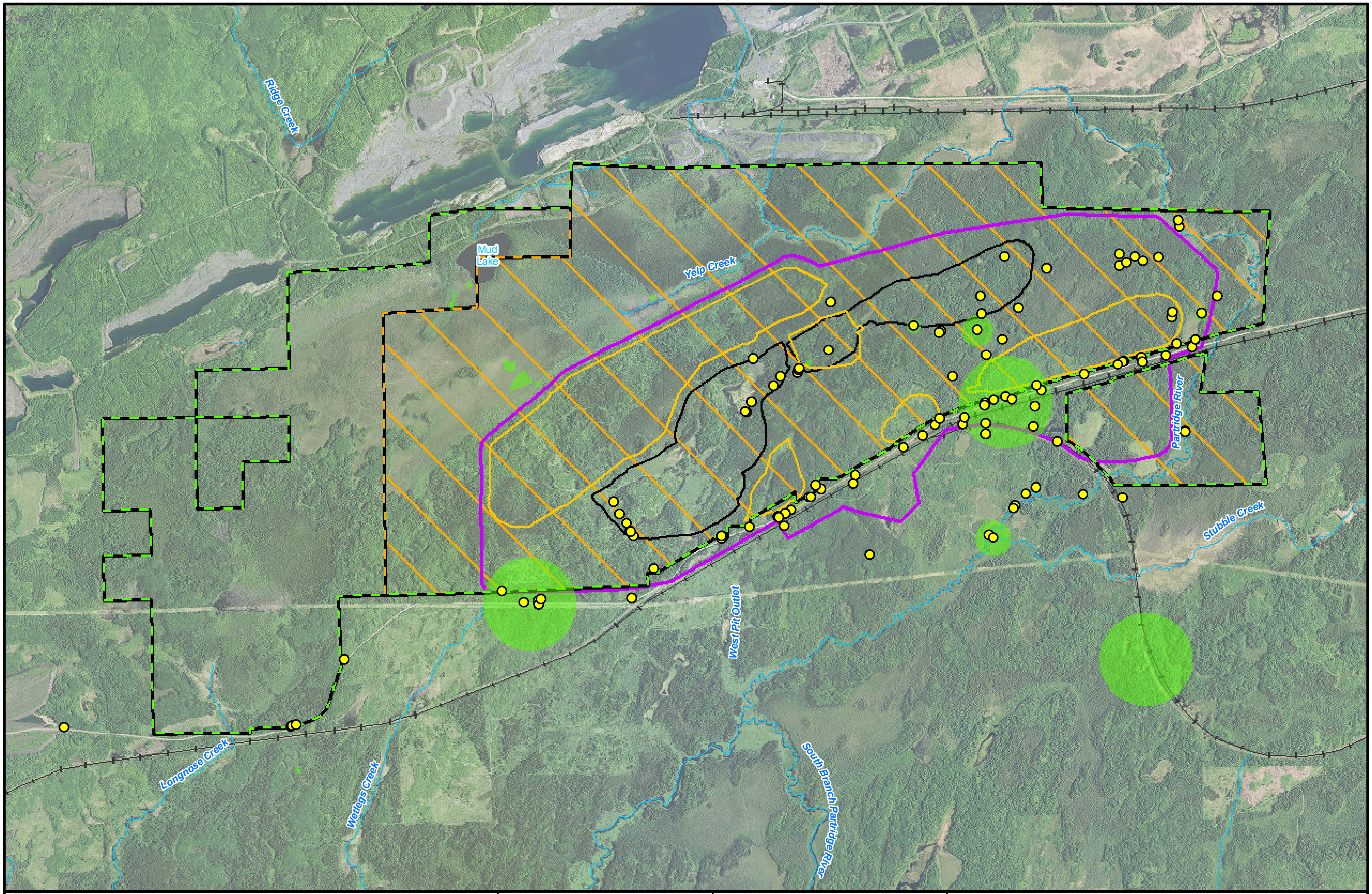

Federal Lands
Alternative B: Smaller Federal Parcel
Mine Site
Rare Species - Pomroy, Johnson - Groh, Barr Reports
Vicinity of Endangered, Threatened, and Special Concern Vegetation Species
Stockpile
Mine Pit
Stream / River
Existing Railroad

US Army Corps of Engineers
St. Paul District

This document is a working document. This document may change over time as a result of new information, further deliberation, or other factors not yet known to the Co-lead Agencies.

N W E S

0 0.25 0.5 1 Miles

Figure 4.2.4-3

ETSC Vegetation - NorthMet Project Area

NorthMet Mining Project and Land Exchange PFEIS

Minnesota

June 2015

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Table 4.2.4-4 Endangered, Threatened, and Special Concern Plant Species Identified on the Mine Site [5]

Scientific Name	Common Name	State Status[1]	No. of Populations[2]	No. of Individuals[2,3]	Habitat and Location
Botrychium campestre	Prairie moonwort	SC	1	Unknown	Dry soils along the Dunka Road.
Botrychium pallidum	Pale moonwort[4]	SC	1	21	Full to shady exposure, edge of alder thicket, along Dunka Road.
Botrychium rugulosum (*ternatum*)	Ternate or St. Lawrence grapefern[4]	SC	1	4	Early successional habitats, fields, open woods, forests, and along Dunka Road.
Botrychium simplex	Least grapefern[4]	SC	3	~1,580	Full to shady exposure, edge of alder thicket, forest roads, along Dunka Road.
Caltha natans	Floating marsh marigold[4]	E	1	56	Shallow water in ditches and streams, alder swamps, shallow marshes, beaver ponds, and Partridge River mudflat.
Eleocharis nitida	Neat spikerush[4]	SC	1	~1,562 ft^2	Full exposure, moist ditches along Dunka Road, wet area between railroad grades, and railroad ditch.
Juncus stygius var. *americanus*	Bog rush[4]	SC	1	Unknown	Open-patterned peatlands, rich and poor fens, northern spruce bog within the One Hundred Mile swamp.
Platanthera clavellata	Club-spur orchid	SC	1	Unknown	Black spruce and/or tamarack swamps, northern spruce bog within the One Hundred Mile swamp.
Ranunculus lapponicus	Lapland buttercup	SC	1	~919 ft^2	On and adjacent to Sphagnum hummocks in black spruce stands, up to 60 percent shaded with alder also dominant.
Torreyochloa pallida	Torrey's manna-grass	SC	1	~25 ft^2	In muddy soil along shore and in water within shallow channels, beaver ponds, shallow marshes, along Partridge River.

Sources: AECOM 2009b; Barr 2007i; Johnson-Groh 2004; MDNR 2005; MDNR 2011L; MDNR 2014d; Pomroy and Barnes 2004; Walton 2004.

Notes:
1 E = Endangered, T = Threatened, SC = Species of Special Concern.
2 Note that the number of populations may differ from those given in the NHIS data because of populations found during other surveys.
3 Where the number of individuals could not be determined without damaging the population, patch size (square feet) was used as a representative abundance measure.
4 These species are also RFSS as tracked by the USFS.
5 Data included here were provided by the Division of Ecological Resources, MDNR, and were current as of August 5, 2014. These data are not based on an exhaustive inventory of the state. The lack of data for any geographic area shall not be construed to mean that no significant features are present.

<u>Species Life Histories</u>

The following summary provides descriptions of the life histories, statewide distributions, and sensitivity to disturbance for each of the 10 ETSC species found on the Mine Site.

Prairie moonwort (*Botrychium campestre*) is listed as a species of special concern in Minnesota; it is not listed as an RFSS in the Superior National Forest. It occurs primarily in prairies, dunes, grassy railroad sidings, and fields over limestone bedrock. *B. campestre* is a perennial fern that emerges in early spring and matures in late spring to early summer (eFlora 2011). This species is among the smallest moonworts and is difficult to observe when occurring among prairie vegetation; therefore, it is likely more widespread and abundant within its range than is typically apparent. It is now known to occur in several counties throughout Minnesota and even across the continent (MDNR 2011L). *B. campestre* is less frequently associated with disturbance than many moonwort species. On the Mesabi Iron Range of Minnesota, however, *B. campestre* has been found growing abundantly on sparsely vegetated mineral soil developed from sediments of iron mine tailings ponds.

Pale moonwort (*Botrychium pallidum*) is listed as a species of special concern in Minnesota and as an RFSS in the Superior National Forest. *B. pallidum* was only first identified in Minnesota in 1992 and new populations are documented each year in a variety of habitats across northern Minnesota (MDNR 2011L). It occurs in open early successional habitats, log landings, roadsides, sandy gravel pits, and mine tailings within the Mesabi Iron Range of northeastern Minnesota. This diminutive perennial fern emerges in the late spring, produces spores, and matures within 3 to 4 weeks. Like many of the moonworts, *B. pallidum* may be sensitive to changes in soil mycorrhizae, herbivory from introduced earthworms, vegetative cover (i.e., increased vegetative competition and shading), soil moisture, or other environmental factors affecting suitable microhabitats. Disturbances such as vegetation clearing, mining, soil scarification, reduction of vegetative competition, decreased canopy cover, or fire likely play an important role in the preservation and proliferation of this species.

St. Lawrence grapefern (*Botrychium rugulosum*) (Synonym: *B. ternatum*, ternate grapefern) is listed as a species of special concern in Minnesota and as an RFSS in the Superior National Forest. The name "rugulosum" refers to the tendency of the segments to become wrinkled and convex. Relatively little is known about the overall distribution, genetics, and life history requirements of *B. rugulosum,* and some taxonomists question whether *B. rugulosum* is a distinct species. It is a perennial semi-evergreen fern that occurs in the northern and south-central portions of Minnesota (MDNR 2011L). In northern Minnesota, *B. rugulosum* prefers partially shaded mine tailings, sandy conifer forests and plantations, and shaded vernal pool margins in rich deciduous hardwood forests. It also occurs in wetland areas within habitats subject to past clearing or cultivation (NatureServe 2014b). *B. rugulosum* is similar morphologically and in its life history requirements to *B. multifidum* (leathery grapefern), and these two species are often confused in the field. *B. rugulosum* is most easily distinguished from similar species in the late summer and early autumn when the trophophore (i.e., photosynthetic branch) has matured. Like *B. pallidum, B. rugulosum* may be associated with soil mycorrhizae and may be sensitive to increased competition, earthworms, changes in soil moisture, and other environmental factors affecting microhabitats. *B. rugulosum* is often found in small stands of 5 to 10 individuals, though larger populations can also occur (eFlora 2011). Disturbance also likely plays an important long-term role in the proliferation of this species.

Least grapefern (*Botrychium simplex*) is listed as a species of special concern in Minnesota and as an RFSS in the Superior National Forest. Least grapefern occurs throughout northern and central Minnesota, with no occurrences documented in southern Minnesota (Bell Museum of Natural History 2011). Least grapefern was first described as a species in 1823 (eFlora 2011) and has been extensively surveyed and studied for over a century. *B. simplex* is a perennial fern that produces a single leaf each year and occurs in a variety of natural and disturbed habitats, including brushy fields (often with other species of *Botrychium*), moist or dry woods, edges of forested vernal pools and swamps, mine tailings, and edges of sand/gravel/exposed forest roads. The morphology of the species is quite variable, and the many environmental forms and juvenile stages of *B. simplex* have resulted in the naming of numerous intraspecific taxa (eFlora 2011). Like the other *Botrychium* species, disturbance likely plays an important role in the proliferation of this species.

Floating marsh marigold (*Caltha natans*) is listed as an endangered species in Minnesota and as an RFSS in the Superior National Forest. *C. natans* was first collected in Minnesota in 1889 from Vermilion Lake in St. Louis County (Coffin and Pfannmuller 1988). All subsequent collections have been from St. Louis County (Bell Museum of Natural History 2011) and all known occurrences in the NHIS database occur in St. Louis County. Very few populations are known in Minnesota. Habitat loss is largely the reason behind recent local extirpations of this species in Minnesota (MDNR 2011L). Floating marsh marigold is a perennial aquatic forb and occurs within shallow open water or on moist mud within northern ponds, lakes, slow-moving rivers, streams, ditches, and wet meadows. The species flowers in late spring-summer (i.e., June to August). *C. natans* is found in relatively stable aquatic systems and may be sensitive to disturbances, including alteration of hydrology or hydro-period, water quality, water chemistry, and non-native species invasion, although a few populations are found in disturbed habitats.

Neat spike-rush (*Eleocharis nitida*) is listed as a species of special concern in Minnesota and as an RFSS in the Superior National Forest. Neat spike-rush's distribution in Minnesota is limited to the northeastern counties of the Arrowhead region and west to Itasca County. *E. nitida* was first collected in Minnesota in 1946 from various wetland habitats in Cook and St. Louis counties. Despite the long collection record for this species in Minnesota, relatively few populations have been documented and little is known about the overall distribution of the species throughout the state. *E. nitida* occurs within various wetland habitats of northern Minnesota, including acid bog pools, small streams, areas of seasonal water drawdown (mucky/peaty flats), disturbed wetland edges, and along roads and trails (MDNR 2011L). *E. nitida* is a perennial plant that flowers in late spring and develops fruit in early to mid-summer. Mature achenes (i.e., seed-containing fruit) are often necessary to positively identify *E. nitida* to species (both in the field and herbarium). This rooted perennial species may be intolerant of hydrologic fluctuations and alterations to water quality and chemistry associated with landscape and wetland alteration and development. However, roadside distributions suggest the species may be semi-tolerant to disturbance and at least mild alterations in water quality in the short term.

Bog rush (*Juncus stygius* var. *americanus*) is listed as a species of special concern in Minnesota and as an RFSS in the Superior National Forest. Within Minnesota, bog rush is distributed across the northern and northeastern Arrowhead counties in large patterned peatlands and calcareous fens. It was first documented in St. Louis County in 1886 (Bell Museum of Natural History 2011). It is generally not a dominant species; even in ideal, large-patterned peatland settings, it occurs in isolated colonies with scattered individuals (MDNR 2011L). Bog rush is a perennial graminoid species that occurs in full sun, and, generally, it is restricted to narrow wet zones of bogs and fens where it can exploit small gaps in surrounding vegetation. Since it often grows in calcareous fens, it is influenced in some way by mineralized groundwater. It flowers and bears fruit in mid to late summer (eFlora 2011). Threats to *J. stygius* var. *americanus* include climate warming, water diversion (since it cannot compete well without vegetation gaps caused by inundation), and invasion of non-native species.

Club-spur orchid (*Platanthera clavellata*) (synonyms: *Habenaria clavellata*, *Gymnadeniopsis clavellata*) is listed as a species of special concern in Minnesota; it is not listed as an RFSS in the Superior National Forest. Club-spur orchid was first recorded in Ramsey County in 1886 and has since been documented in several counties across the northeast Arrowhead region and south to Ramsey and Hennepin counties (Bell Museum of Natural History 2011). It generally occurs in swamp forests with a canopy of black spruce and tamarack, and in non-forested fens with hummocks of *Sphagnum* moss species (MDNR 2011L). *P. clavellata* is a perennial orchid with a root/tuber system that is usually confined to growing within the living moss layer rather than the peat below it. The species flowers in mid-summer (from early to late July), and is insect-pollinated. Germination of the wind-borne seeds requires the presence of certain habitat-specific mycorrhizal fungi. Club-spur orchid may be sensitive to habitat alterations and changes in hydrology. It is suggested that activities several miles from a site could disrupt the hydrological processes (through groundwater and surface water) that are needed to sustain habitat for *P. clavellata* (MDNR 2011L).

Lapland buttercup (*Ranunculus lapponicus*) is listed as a species of special concern in Minnesota; it is not listed as an RFSS in the Superior National Forest. Lapland buttercup occurs throughout much of northern Minnesota, with the exception of extreme northwestern Minnesota. This species was first documented in 1928 in Minnesota from a *Sphagnum* bog in Aitkin County (Bell Museum of Natural History 2011). *R. lapponicus* is a perennial forb species that occurs amongst *Sphagnum* moss hummocks and pools in rich forested swamps in Minnesota, usually under a canopy of northern white cedar (MDNR 2011L). No populations have been found on disturbed sites. Lapland buttercup is sensitive to changes in conifer forest canopy, wetland hydrology/hydro-period, water chemistry, and other environmental factors affecting optimal conifer forest pools and hummock micro-sites.

Torrey's manna grass (*Torreyochloa pallida*) (synonym: *Puccinellia pallida*) is listed as a species of special concern in Minnesota; it is not listed as an RFSS in the Superior National Forest. Torrey's manna grass was first collected in 1886 from Vermilion Lake in St. Louis County (Bell Museum of Natural History 2011). Within Minnesota, *T. pallida* occurs throughout the Arrowhead Region south to Chisago County (along the St. Croix River drainage). Torrey's manna grass is a perennial graminoid species that occurs in various wetland habitats in northern Minnesota. Habitats include shallow muck-bottomed pond and stream shores, bogs, and beaver meadows. Some populations occur within roadside ditches, suggesting the species may be somewhat tolerant of disturbance; however, this rooted perennial wetland species is sensitive to alterations in wetland hydro-period, water level fluctuations, sedimentation, changes in water chemistry associated with landscape alteration, and development and competition from introduced invasive wetland species (e.g., *Typha angustifolia*, *Typha* x *glauca*, *Lythrum salicaria*, *Phragmites australis*, *Phalaris arundinacea*).

Regional Foresters Sensitive Species

The Mine Site is located within the current boundaries of the Superior National Forest; however, following the Land Exchange Proposed Action, the federal lands including a portion of the Mine Site would no longer be National Forest System land. The USFS currently manages 58 vascular and non-vascular plant species that are listed as RFSS in the Superior National Forest (see Table 4.2.4-5). The list of these species was updated in early 2012 (USFS 2012f). The assessment of effects to RFSS would be detailed in the Biological Evaluation; this section provides a summary based on RFSS plants that could exist on the NorthMet Project area lands. The Biological Evaluation is an assessment of the likely effects on species with viability concerns and their suitable habitat as a result of the NorthMet Project Proposed Action.

Eight of the RFSS are state-listed ETSC species relevant to the NorthMet Project Proposed Action (*Botrychium pallidum*, *Botrychium rugulosum*, *Botrychium simplex*, *Caltha natans*, *Eleocharis nitida*, *Juncus stygius*, *Pyrola minor*, and *Saxifraga paniculata*) and are discussed above or in Section 4.3.4. All of these species, except *Pyrola minor* and *Saxifraga paniculata*, occur at the Mine Site. The RFSS plant species in Table 4.2.4-5 are grouped according to predominant habitat types/natural communities in which they occur, specifically Management Indicator Habitat (MIH) types if available. Additionally, more specific suitable habitat descriptions within each MIH type are provided for each species, and whether that habitat is potentially present on or near the federal lands, including portions of the Mine Site.

Table 4.2.4-5 USFS RFSS Plant Species within Superior National Forest

Species Name	**Common Name**	**Habitat Description**	**Potential Habitat on/near Federal Lands**
Upland Forest - MIH 1			
Adoxa moschatellina	Muskroot	Shaded damp cliffs and slopes in upland mature northern hardwood forest on North Shore	No
Botrychium lanceolatum	Triangle grapefern	Mature northern hardwood forests	Yes
Botrychium lanceolatum var. *angustisegmentum*	Lanceleaf grapefern	Northern hardwood forest, old fields, old logging roads, trails	Yes
Botrychium lunaria	Common moonwort	Open habitats such as old log landings, sawmill sites, old building sites	Yes
Botrychium michiganense (hesperium) [3]	Michigan moonwort	Open habitats such as old log landings, old dirt roads, gravel pits, power line corridors, borrow pits, old fields, trails, and dredge spoil dumps	Yes
Botrychium mormo	Little goblin moonwort	Mesic northern hardwood forest with thick leaf litter layer	No
Botrychium pallidum [1,2]	Pale moonwort	Open disturbed habitats, log landings, roadsides, dunes, sandy gravel pits	Yes
Botrychium rugulosum [1,2]	Ternate or St. Lawrence grapefern	Generally open habitats, such as old log landings and edges of trails	Yes
Botrychium simplex [1,2]	Least grapefern	Generally open habitats, such as old log landings, roadside ditch, trails, open fields, base of cliff, railroad rights-of-way	Yes

Species Name	Common Name	Habitat Description	Potential Habitat on/near Federal Lands
Carex novae-angliae	New England sedge	Moist woods with sugar maple, also with birch, aspen, tall shrubs; yellow birch and white spruce-dominated forest	Yes
Crataegus douglasii	Douglas' hawthorn	North Shore rocky, gravelly streambeds/ banks and open areas, rocky borders of woods	No
Osmorhiza berteroi	Chilean sweet-cicely	Northern hardwood forest dominated by sugar maple on North Shore	No
Piptatherum (=Oryzopsis) canadense	Canada mountain ricegrass	Sandy/gravelly soil, red pine/jack pine plantations, borders/edges, trail sides, openings	Yes
Polystichum braunii	Braun's holly fern	Cool, shady cliffs and slopes in northern hardwoods in North Shore Highlands subsection	No
Prosartes trachycarpa (syn=*Disporum trachycarpum)*	Roughfruit fairybells	Semi-open jack pine forest with aspen, birch, shallow rocky soils, in east Border Lakes subsection	No
Taxus canadensis	Canada yew	Wide variety of uplands and lowlands, including cedar/ash swamps, talus and cliffs, northern hardwoods, aspen/birch forest	Yes
Waldsteinia fragarioides	Barren strawberry	Upland coniferous and deciduous forests, in recently harvested areas, established plantations	Yes
Lowland Black Spruce-tamarack Forest - MIH 9			
Caloplaca parvula	Lichen spp.	Smooth bark of young black ash in moist, humid old-growth black ash stand	No
Calypso bulbosa	Fairy slipper	Hummocks in northern white cedar swamps, moist to wet lowland conifer swamps, and to lesser extent in upland coniferous forests	Yes
Cetraria (=Ahtiana) aurescens	Lichen spp.	Conifer bark in lowland conifer swamps (old cedar/black spruce)	Yes
Cypripedium arietinum	Ram's-head lady's-slipper	White cedar swamps, forests dominated by jack pine, red pine, or white pine	Yes
Drosera linearis	Slenderleaf sundew	Minerotrophic water tracks in patterned peatlands	Yes
Frullania selwyniana	Selwyn's scalewort	Lowland cedar swamps on bark of white cedar	Yes
Menegazzia terebrata	Honey-combed lichen	Cedar swamps, especially old growth, base of cedar trees	Yes
Polemonium occidentale ssp. *lacustre*	Western Jacob's-ladder	White cedar swamps, also mixed conifer swamps, thrives in openings	Yes

Species Name	Common Name	Habitat Description	Potential Habitat on/near Federal Lands
Pyrola minor [2]	Snowline wintergreen/small shinleaf	Black spruce swamps, and ecotone between uplands and lowland alder/conifer swamp, prefers closed canopy	Yes
Ramalina thrausta	Cartilage lichen	Cedar swamps, especially old growth	Yes
Rubus chamaemorus	Cloudberry	Black spruce/sphagnum forest, acidic; Superior National Forest at southern edge of species range	Yes
Sticta fuliginosa	Spotted felt lichen	On hardwood trees in humid, old growth cedar or ash bogs	Yes
Usnea longissima	Beard lichen	On old conifer trees in moist situations, often in or near a conifer or hardwood swamp	Yes
Aquatic Habitats – MIH 14			
Astragalus alpinus	Alpine milkvetch	Sandy, gravelly fluctuating shorelines with sparse vegetation	No
Caltha natans [1,2]	Floating marsh marigold	Shallow water of pools, ditches, sheltered lake margins, slow-moving creeks, sloughs/oxbows, pools in shrub swamps	Yes
Juncus subtilis	Creeping rush	Sandy lakeshore – only known occurrence in BWCAW	No
Listera auriculata	Auricled twayblade	On alluvial- or lake-deposited sands or gravels, with occasional seasonal flooding, associated with riparian alder or spruce/fir forest	Yes
Littorella uniflora (=L. americana)	American shoregrass	Shallow margins of nutrient-poor lakes, seepage lakes, sandy substrate, may have fine gravel/organic soil	Yes
Nymphaea leibergii	Dwarf water-lily	Slow-moving streams, rivers, beaver impoundments 1 to 2 meters deep	Yes
Potamogeton oakesianus	Oakes' pondweed	Quiet, acidic waters of bogs, ponds, and lakes	No
Subularia aquatica	Awlwort	Beach zone of sandy nutrient-poor lakes, shallow lake margins, 15- to 45-centimeter-deep water	Yes
Other - Emergent wetland habitats			
Bidens discoidea	Swamp beggarticks	Silty shores, hummocks in floating mats and swamps, partly submerged logs	Yes
Eleocharis nitida [1,2]	Neat spikerush	Mineral soil of wetlands, often with open canopy and disturbance, such as logging roads/ditches through wetlands	Yes
Juncus stygius [1,2]	Moor rush/bog rush	Shallow pools in non-forested peatlands, often in a sedge-dominated community	Yes

Species Name	Common Name	Habitat Description	Potential Habitat on/near Federal Lands
Muhlenbergia uniflora	Bog muhly	Wet sandy beaches, floating peat mats	Yes
Viola lanceolata	Bog white violet	Sandy to peaty lakeshores, borders of marshes and bogs, damp sand ditches	Yes
Other - Cliff, Talus Slopes, and Exposed Rock Habitat			
Arctoparmelia centrifuga	*Arctoparmelia* lichen	Sunny rocks and open talus slopes	No
Arctoparmelia subcentrifuga	*Arctoparmelia* lichen	Sunny rocks and open talus slopes	No
Arnica lonchophylla	Northern arnica	Cool and moist cliffs and ledges on North Shore	No
Asplenium trichomanes	Maidenhair spleenwort	In crevices of moist, mostly east-facing cliffs, ledges, and talus, Rove formation	No
Carex rossii	Short sedge	Rocky summits, dry exposed cliff faces, rocky slopes, in east Border Lakes subsection	No
Cladonia wainioi	Wain's cup lichen	On rock outcrops and thin soil, exposed sites with lots of light	No
Huperzia appalachiana	Appalachian clubmoss	Shelves and crevices on cliff/talus/rock outcrops, and shrub dominated talus piles	No
Moehringia macrophylla	Largeleaf sandwort	Cliffs/rock outcrops, talus, conifer sites on shallow soils, pine plantation with rocky outcrops, usually semi-open shrub or tree canopy	No
Oxytropis borealis var. *viscida*	Viscid locoweed	Slate cliffs and talus slopes in east Border Lakes subsection	No
Saxifraga cernua	Nodding saxifrage	Cliffs, ledges, diabase cliff (calcium-based feldspars)	No
Saxifraga paniculata [2]	White mountain saxifrage/encrusted saxifrage	Cliffs, sheltered crevices, and ledges of north-facing cliffs	No
Tofieldia pusilla	Scotch false asphodel	Sedge mats at edges of shoreline rock pools along Lake Superior	No
Woodsia glabella	Smooth woodsia	Moist, north-facing cliffs along Lake Superior	No
None Specified			
Pseudocyphellaria crocata	*Pseudocyphellaria* moss	Mossy rocks, trees in partially shaded, moist, frequently foggy habitats	Yes
Peltigera venosa	Felt lichen	Soil and moist cliffs, exposed root wads	Yes

Sources: NatureServe 2011; NatureServe 2014b; USFS 2004a; USFS 2010d; USFS 2012f.

Notes:
[1] Listed as a state ETSC species and located at the Mine Site.
[2] Listed as a state ETSC species and located on the federal or non-federal lands.
[3] Known to occur on the federal lands.

Six state-listed ETSC plant species (*Botrychium pallidum*, *Botrychium rugulosum*, *Botrychium simplex*, *Caltha natans*, *Eleocharis nitida*, and *Juncus stygius*) are also RFSS plants and are located on the Mine Site, as discussed in Section 4.2.4.2.3. *Botrychium michiganense* is also located on the Mine Site, according to MDNR NHIS data, and is an RFSS plant (see Table 4.2.4-5). The USFS designates and maintains data about MIH types on federal lands; MIH types are categories of forest types, including dominant species, stand age class, and stand condition. A smaller subset of all MIH types was used for this RFSS discussion, including upland forest (MIH 1), upland conifer forest (MIH 5), lowland black spruce-tamarack forest (MIH 9), and aquatic habitats (MIH 14). Upland forest (MIH 1) and lowland black spruce-tamarack forest (MIH 9) are almost most prevalent in the federal lands portion of the Mine Site (see Table 4.3.4-3 and Figure 4.2.4-4), indicating that the 17 RFSS associated with MIH 1 and the 13 RFSS associated with MIH 9 have the highest probability of occurring on the federal lands, including the Mine Site. Upland conifer forest (MIH 5) occurs in smaller acreage; however, there are no RFSS associated with MIH 5. Since this category overlaps MIH 1, the 17 RFSS associated with MIH 1 may also occur within this category. The lowland emergent habitat type occurs on the federal lands portion of the Mine Site, as well, and the five associated RFSS may be present.

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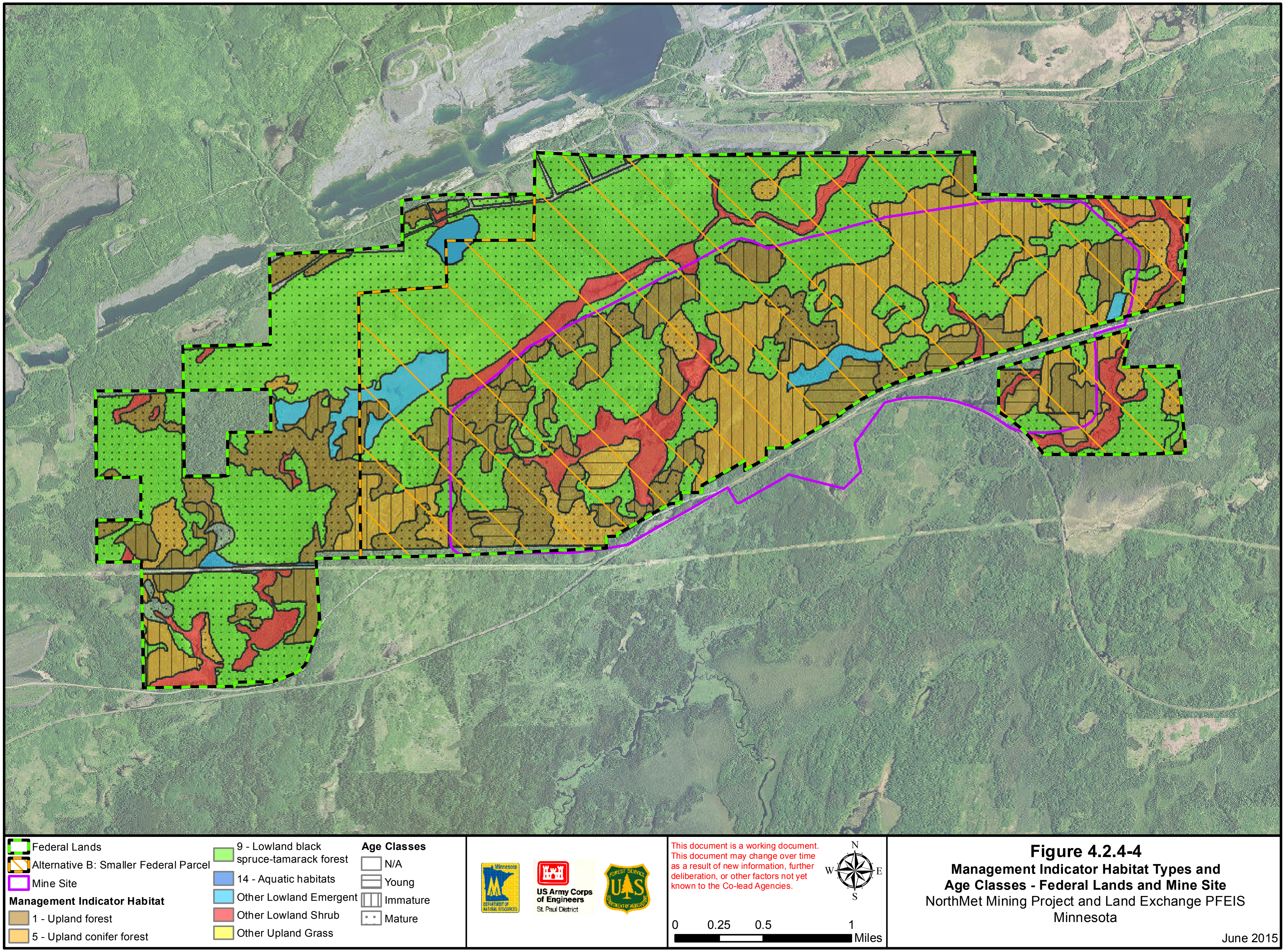

Figure 4.2.4-4

Management Indicator Habitat Types and Age Classes - Federal Lands and Mine Site

NorthMet Mining Project and Land Exchange PFEIS

Minnesota

June 2015

406

-Page Intentionally Left Blank-

4.2.4.3 Transportation and Utility Corridor

The Transportation and Utility Corridor includes the existing private Dunka Road, an existing private PolyMet railroad grade, a Minnesota Power Company 138-kV electric transmission line, a proposed Treated Water Pipeline, a proposed 13.8-kV electric distribution line, and a proposed railroad connection between the Cliffs Erie railroad track and existing PolyMet track.

4.2.4.3.1 Cover Types

Habitat Types

Because of prior use during the former LTVSMC taconite mining operation, the Transportation and Utility Corridor is now defined as having a "disturbed" cover type (see Table 4.2.4-6). The remaining MDNR GAP land cover types that are not disturbed include cropland/grassland (8 percent of the Corridor), shrubland (6 percent of the Corridor), and smaller acreages of the remaining types. The MDNR GAP land cover types below may not fully represent the extent of mixed forest types, since the cover type level below is fairly specific, so there may be more mixed forest types than indicated.

Table 4.2.4-6 NorthMet Transportation and Utility Corridor Cover Types

Cover Types	Total Acres	Percent of Area
Disturbed	94.4	79
Cropland/Grassland	9.8	8
Shrubland	7.7	6
Aquatic environments	2.7	2
Upland deciduous forest[4]	2.7	2
Upland coniferous forest[3]	2.6	2
Lowland coniferous forest[1]	0.2	<1
Lowland deciduous forest[2]	0.0	0
Upland conifer-deciduous mixed forest[5]	0.0	0
Total	**120.2[(6)]**	**100**

Source: MDNR 2006b.

Notes:
[1] Includes lowland black spruce, lowland northern white cedar, and tamarack forest cover types.
[2] Includes black ash forest cover types.
[3] Includes pine and spruce/fir forest cover types.
[4] Includes aspen/aspen-white birch, maple/basswood, and oak forest cover types.
[5] Includes all mixed coniferous-deciduous forest cover types.
[6] Total acres may be more or less than presented due to rounding.

Minnesota Biological Survey

There are two MBS Sites of High Biodiversity Significance (18.8 acres) located within the Transportation and Utility Corridor, including the One Hundred Mile Swamp (2 percent of the Corridor) and the Upper Partridge River (13 percent of the Corridor) (MDNR 2008a).

There are several native plant communities occupying the Transportation and Utility Corridor, most of which have no assigned conservation status rank. The aspen-birch forest: balsam fir subtype (FDn43b1) native plant community (1 percent of the Corridor) is ranked as "widespread and secure" (MDNR 2008b).

Scientific and Natural Areas

There are no SNAs located within the Transportation and Utility Corridor.

Culturally Important Plants

As with the Mine Site discussion, Section 4.2.9.3.3 provides a discussion of natural resources culturally important to the Bands.

4.2.4.3.2 Invasive Non-native Plants

According to the Superior National Forest invasive plant geodatabase, there are no known occurrences of invasive species within the Transportation and Utility Corridor, but no invasive species inventories have been performed in the NorthMet Project area (USFS 2010a). USFS roadside surveys indicate that several invasive non-native species (e.g., common tansy, spotted knapweed, etc.) could be located within the Corridor (see Table 4.2.4-3). A qualitative vegetation field survey conducted by Barr (2012n) indicated that hawkweeds, red and white clover, oxeye daisy, smooth brome, bluegrass, and timothy were observed along the Transportation and Utility Corridor.

4.2.4.3.3 Threatened and Endangered Plant Species

Endangered, Threatened, and Special Concern Plant Species

Based on a review of the MDNR NHIS and field investigations, no federally listed plant species occur on the Transportation and Utility Corridor. However, two state-listed ETSC plant species (*Botrychium pallidum*, *B. simplex*) have been identified within the Transportation and Utility Corridor area (see Figure 4.2.4-3). These two species' populations that occur along Dunka Road immediately adjacent to or overlapping the Mine Site were discussed previously in the review of the Mine Site to avoid repetition. The species (*B. pallidum*) populations that occur along Dunka Road, farther away from and not overlapping the Mine Site are discussed separately below (see Table 4.2.4-7).

Rulemaking was conducted with the intent to update the list of ETSC species (*Minnesota Rules*, parts 6134.0100 to 6134.0400), with new listings becoming effective on August 19, 2013 (MDNR 2013h). This FEIS considers any new listings, or changes in the previous listings, associated with the updated list.

Table 4.2.4-7 Endangered, Threatened, and Special Concern Plant Species Identified within the Transportation and Utility Corridor

Scientific Name	Common Name	State Status[1]	No. of Populations	No. of Individuals	Habitat and Location
Botrychium pallidum	Pale moonwort[2]	SC	3	16	Full to shady exposure, edge of forests along Dunka Road

Source: Barr 2012n.

Notes:
1 SC = Species of Special Concern
2 These species are also RFSS as tracked by the USFS.

<u>Species Life History</u>

Section 4.2.4.2.3 discusses the life history of *Botrychium pallidum*.

4.2.4.4 Plant Site

The Plant Site includes the Beneficiation Plant, Area 1 Shops, Area 2 Shops, Hydrometallurgical Residue Facility and Plant, and the Tailings Basin (PolyMet 2015a). The Plant Site itself comprises 4,515.4 acres, but including the surrounding buffer lands that PolyMet owns or has leased surface rights to, the Plant Site consists of approximately 15,000 acres, one-third of which is estimated to have been disturbed by previous LTVSMC operations. The Colby Lake Water Pipeline Corridor is also included in this section. The pipeline connects the Plant Site to Colby Lake, which is south of the Plant Site.

4.2.4.4.1 Cover Types

<u>Plant Site</u>

Habitat Types

Because of use during the former LTVSMC taconite mining operation, the majority of the Plant Site is now defined as having a "disturbed" cover type (see Table 4.2.4-8 and Figure 4.2.4-5). The remaining MDNR GAP land cover types include approximately equal areas of aquatic environments (14 percent of the Plant Site) and upland deciduous forests (14 percent of the Plant Site), and smaller areas of shrubland, upland conifer forest, and lowland conifer forest. The MDNR GAP land cover types below may not fully represent the extent of mixed forest types, since the cover type level below is fairly specific, so there may be more mixed forest types than indicated.

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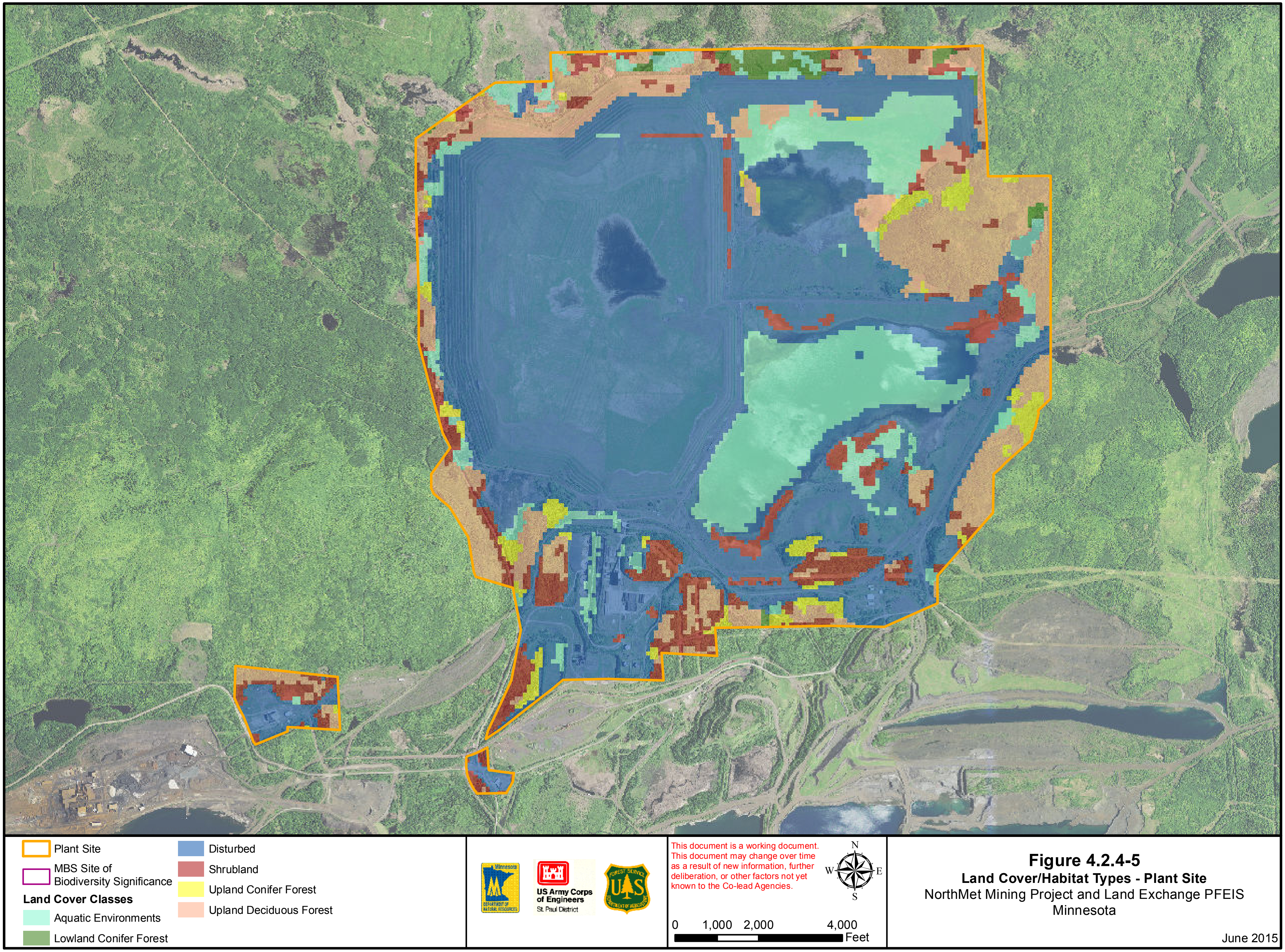

Figure 4.2.4-5

Land Cover/Habitat Types - Plant Site

NorthMet Mining Project and Land Exchange PFEIS

Minnesota

June 2015

495

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Table 4.2.4-8 NorthMet Plant Site Cover Types

Cover Types	Total Acres	Percent of Area
Disturbed	2,755.5	61
Upland deciduous forest[4]	647.6	14
Aquatic environments	636.8	14
Shrubland	333.8	7
Upland coniferous forest[3]	99.8	2
Lowland coniferous forest[1]	41.9	1
Cropland/Grassland	0.0	0
Lowland deciduous forest[2]	0.0	0
Upland conifer-deciduous mixed forest[5]	0.0	0
Total	**4,515.4**	**99**[(6)]

Source: MDNR 2006b.

Notes:
1 Includes lowland black spruce, lowland northern white cedar, and tamarack forest cover types.
2 Includes black ash forest cover types.
3 Includes pine and spruce/fir forest cover types.
4 Includes aspen/aspen-white birch, maple/basswood, and oak forest cover types.
5 Includes all mixed coniferous-deciduous forest cover types.
6 Percent totals are less than 100 percent due to rounding.

Minnesota Biological Survey

There are no MBS Sites of Biodiversity Significance located on the Plant Site (see Figure 4.2.4-4) (MDNR 2008a). Native plant community rankings are not available for the Plant Site.

Scientific and Natural Areas

There are no SNAs located on or near the Plant Site.

Culturally Important Plants

The most upstream portion of the Embarrass River Watershed, recommended as a water source used for production of wild rice, is from the MN-135 highway bridge to the inlet of Sabin Lake (MPCA 2012b). The former Wild Rice Valley Farms is located adjacent to the Embarrass River, but no wild rice was observed within this area or the adjacent portion of the Embarrass River during field surveys, and it is not recommended as a water source used for production of wild rice (MPCA 2012b). Hay Lake, located along the upper stretch of the Embarrass River, is recommended as a water source used for production of wild rice, but Sabin and Wynne lakes are not recommended as waters used for production of wild rice except for the northern-most tip of Wynne Lake (MPCA 2012b). Embarrass Lake is recommended as a water used for production of wild rice (MPCA 2012b). Though low-density beds of wild rice were observed on Embarrass Lake in 2009 and 2010, no rice was observed in 2011 (Barr 2012a). No wild rice was observed in Spring Mine Creek, Trimble Creek, or Unnamed Creek near the Plant Site and they are not recommended as waters used for production of wild rice (Barr 2011a; Barr 2012a; MPCA 2012b). Section 4.2.2 provides a discussion on wild rice survey results and water quality standards (see Figure 4.2.2-3).

A discussion of natural resources culturally important to the Bands is presented in Section 4.2.9.3.3.

Colby Lake Water Pipeline Corridor

Habitat Types

Extending south from the Plant Site is the Colby Lake Water Pipeline Corridor. There would be no construction within this pipeline corridor, as an existing pipeline would be used for the NorthMet Project Proposed Action. The corridor consists of 50.6 acres (see Table 4.2.4-9), and the MDNR GAP land cover types are dominated by disturbed areas (42 percent) and cropland/grassland (23 percent).

Table 4.2.4-9 NorthMet Colby Lake Water Pipeline Corridor Cover Types

Cover Types	Total Acres	Percent of Area
Disturbed	21.4	42
Cropland/Grassland	11.5	23
Shrubland	8.4	17
Upland deciduous forest[4]	6.5	13
Aquatic environments	1.4	3
Lowland deciduous forest[2]	0.6	1
Upland coniferous forest[3]	0.5	1
Lowland coniferous forest[1]	0.2	<1
Upland conifer-deciduous mixed forest[5]	0	0
Total	**50.5[(6)]**	**100**

Source: MDNR 2006b.

Notes:
[1] Includes lowland black spruce, lowland northern white cedar, and tamarack forest cover types.
[2] Includes black ash forest cover types.
[3] Includes pine and spruce/fir forest cover types.
[4] Includes aspen/aspen-white birch, maple/basswood, and oak forest cover types.
[5] Includes all mixed coniferous-deciduous forest cover types.
[6] Total acres may be more or less than presented due to rounding.

4.2.4.4.2 Invasive Non-native Plants

The Tailings Basin at the Plant Site is severely disturbed and already contains invasive non-native plants such as smooth brome grass, reed canary-grass, and yellow sweet clover. These species are tolerant of a wide variety of conditions, and can spread vegetatively or reproductively (MDNR 2011b). They often grow on disturbed lands, roadsides, and ditches. According to the Superior National Forest invasive plant geodatabase, there are no known occurrences of invasive species on the Plant Site, but no inventories have been performed in the NorthMet Project area (USFS 2010a). Similar to the Mine Site, the Plant Site could also have the species listed in Table 4.2.4-3, including common tansy, spotted knapweed, or thistle species.

4.2.4.4.3 Threatened and Endangered Plant Species

Endangered, Threatened, and Special Concern Plant Species

Based on a review of the MDNR NHIS, no federally listed or state-listed ETSC plant species are known to occur on the Plant Site or within Colby Lake Water Pipeline Corridor. A detailed ETSC plant species survey was not conducted at the Plant Site because suitable habitat for these species is not present at this predominantly disturbed and developed site. ETSC species that are disturbance-adapted may exist along the rail line or roads. Consequently, the federal lands (including the Mine Site), Transportation and Utility Corridor, and non-federal lands are the focus of this FEIS vegetation analysis.

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4.2.5 Wildlife

This section describes the existing wildlife species and habitat which are or may be present in the NorthMet Project area. These species or their sign, such as tracks or droppings, have been observed during surveys, were identified as historically present, and/or typically use habitat present in the NorthMet Project area. Species are grouped in four partially overlapping categories: federally and state-listed ETSC (16 species); SGCN (95 species); the USFS's RFSS (18 species, excluding aquatic species); and other wildlife species, including wildlife species important to the Bands.

Several federally and state-listed ETSC wildlife species that were identified in scoping as potentially present in the NorthMet Project area are described in Section 4.2.5.1.1. Others were added to this section upon updating of the NHIS records and new state ETSC list. Federally listed species records are maintained by the USFWS and the state-listed species records are maintained in the Minnesota NHIS. The NHIS is the most complete source of data on Minnesota's rare or otherwise significant wildlife species, but it is not a comprehensive statewide inventory. It is based on historical museum records, published information, and field work, and is continually updated as new information becomes available. Therefore, the lack of a species occurrence in the NHIS database does not necessarily confirm the absence of a particular species in that area (MDNR 2014d). A county-by-county survey of rare natural features is being conducted by the MDNR as part of the Minnesota Biological Survey.

Additional information—such as species conservation ranking, distribution, and habitat—was obtained from NatureServe, an online public database that utilizes sources such as scientific literature, web sites, experts, and information from local data centers.

Several wildlife surveys have been conducted on the federal lands (including the Mine Site), Plant Site, Transportation and Utility Corridor, and non-federal lands. These studies gathered information on general wildlife utilization of the area, presence or absence of species of concern, and identification of habitat used by wildlife.

Rulemaking was conducted with the intent to update the list of ETSC species (*Minnesota Rules*, parts 6134.0100 to 6134.0400), with new listings becoming effective on August 19, 2013 (MDNR 2013h). This FEIS considers any new listings, or changes in the previous listings, associated with the updated list. A Biological Assessment (BA) that provides further information on federally listed species, and a BE that contains further information about RFSS have been prepared. The BA and BE are included in Appendix D and are posted on the USFS website (www.fs.usda.gov/goto/superior/northmet). The Co-lead Agencies met with the USFWS several times during informal consultation. The USACE, USFS, and USFWS initiated informal consultation on February 26, 2010, when the agencies met to discuss the NorthMet Project. The USACE subsequently met with the USFWS on May 3, 2011, September 1, 2011, and February 28, 2013 to discuss it further. The USACE, USFS, and USFWS met on July 9, 2014 to identify tasks to be accomplished in the development of the BA. Specifically, the northern long-eared bat and habitat were discussed, which led to further USFS bat survey work being proposed. The USACE, USFS, and USFWS met on October 29, 2014 to discuss comments received on the draft BA and potential mitigation measures.

4.2.5.1 Mine Site

4.2.5.1.1 Federally and State-listed Species and Species of Special Concern

Canada Lynx

Canada lynx (*Lynx canadensis)* populations in the continental United States are protected under the ESA as a federally listed threatened species. The species is also listed as a species of special concern in Minnesota, but is considered globally secure by NatureServe (NatureServe 2014a). Lynx population cycles are related to snowshoe hare populations, and therefore, lynx are predominantly found in boreal forests, specifically spruce and fir. This habitat type corresponds to USFS MIH types 5, 6, and/or 9. Lynx mortality due to starvation and declining reproduction rates have been documented during periods of hare scarcity (Poole 1994; Slough and Mowat 1996). Hunger-related stress, which induces dispersal, may increase exposure of lynx to other forms of mortality such as trapping and vehicle collisions (Brand and Keith 1979; Ward and Krebs 1985; Bailey et al. 1986). Between 2001 and 2013, the USFWS has documented two lynx killed by trains and seven lynx killed by road traffic in Minnesota (USFWS 2013). Lynx may also be subject to competition and predation from species such as bobcat and cougar (Buskirk et al. 2000).

Lynx have been described as generally tolerant of humans (Sunde et al. 1998). Reports suggest that lynx are not displaced by human activity, including moderate levels of snowmobile traffic (Mowat et al. 2000) and ski resort activities (ENSR 2006). In an area with sparse roads in north-central Washington State, logging roads did not appear to affect habitat use by lynx (McKelvey et al. 2000). By contrast, lynx in the southern Canadian Rocky Mountains, where road density is higher, crossed highways within their home ranges less than would be expected (Apps 2000).

Over three-quarters of lynx records in Minnesota are from the northeastern portion of the state (McKelvey et al. 2000). Research in Minnesota confirmed a resident breeding population of lynx. Of the 426 sightings reported to the MDNR Division of Ecological Resources between 2000 and 2006, 76 percent were in St. Louis, Lake, and Cook counties. Approximately 113 lynx were sighted in St. Louis County between 2000 and 2006 and 8 percent of these lynx showed evidence of reproductive activity (MDNR 2012d).

Current conditions for this species in the NorthMet Project area were determined through review of existing data sources, including various lynx sighting databases (Moen et al. 2006; MDNR 2012d; USFS 2013), project-specific studies during the summer season (ENSR 2005), and a winter tracking survey (ENSR 2006). The winter tracking survey also included interviews with experts, private conservation groups, and the public, who are familiar with lynx use of the survey area.

On February 25, 2009, the USFWS published the *Final Rule for Revised Designation of Critical Habitat for the Contiguous United States Distinct Population Segment of the Canada Lynx* (50 CFR 17). Portions of the Mine Site lie within the revised boundaries of federally designated lynx critical habitat, which includes most of northeastern Minnesota. A recovery plan has not yet been issued for the Canada lynx.

The USFS designates Lynx Analysis Units (LAUs) within the Superior National Forest that include landscape-scale analysis areas for lynx management. These LAUs were developed in consultation with the USFWS. The federal lands, including the Mine Site, are located within

LAU 12, a 70,980-acre area in the southwest portion of the Superior National Forest. According to the USFS (USFS 2013), approximately 69,131 acres, or 96 percent, of LAU 12 currently provide suitable lynx habitat.

Lynx sign has been observed at the Mine Site. Moen et al. (2006) found that at least 20 different individual lynx sightings have occurred within 18 miles of the NorthMet Project area, including several radio-collared and reproductive individuals. During this study, the nearest reported sighting was approximately 6 miles from the Mine Site (Moen et al. 2006). The majority of sightings are clustered along roads and other places frequented by people.

An ENSR 2006 lynx winter tracking survey covered a 250-square-mile area centered on the NorthMet Project area. The survey did not find any sign of lynx within the Mine Site or federal land boundaries, but tracks and DNA analysis of scat indicated four unrelated female lynx had been present at some time within the 250-square-mile survey area approximately five miles south and east of the Mine Site (ENSR 2006). Track surveys suggest that two individuals made most of the trails found. Although preferred cover types for the snowshoe hare exist on the Mine Site (i.e., jack pine, fir-aspen-birch, aspen-birch), the forest may be too old for there to be appreciable hare densities, as snowshoe hare generally favor sapling or young pole stands (ENSR 2006). The USFS observed lynx tracks at the Mine Site in 2010, and multiple observations of lynx sign within 5 miles of the federal lands are noted in the USFS lynx tracking database (USFS 2013). Lynx density may increase as the snowshoe hare population cycles from a low point. Areas of blow down or logging slash where there is both vertical and horizontal cover may be used by lynx for denning sites (Moen 2009). Some logging slash is located on the west end of the Mine Site.

Northern Long-Eared Bat

The northern long-eared bat (*Myotis septentrionalis*), also known as the northern myotis, is proposed to be federally listed as threatened, is currently state-listed as a species of special concern in Minnesota, and is also a Superior National Forest RFSS. It is considered imperiled globally or vulnerable in Minnesota by NatureServe (NatureServe 2014a). Several bat species were added to the Minnesota ETSC list due to the emergence of white-nose syndrome, a fungal disease that could threaten Minnesota bat populations as it has in eastern bat populations. On October 2, 2013, the USFWS published a proposal to federally list the northern long-eared bat throughout its range. There was a 6-month extension and re-opening of the public comment period on the proposed rule listing on June 30, 2014. The final listing and interim 4(d) rule were published on April 2, 2015, and go into effect on May 4, 2015 (50 CFR Part 17, April 2, 2015).

The northern long-eared bat occurs throughout Canada and in much of the eastern United States, west to North and South Dakota. Its preferred summer habitat includes upland forests and riparian areas where they forage for insects in forest clearings, under tree canopies, and over water (MDNR 2014b; NatureServe 2014a). Generally, summer day roost sites include those under loose tree bark or within buildings, while night roosts include areas in caves, mines, and tunnels. It seems to be opportunistic in the selection of roost sites (USFWS 2013b). The northern long-eared bat enters its winter hibernacula (which may include caves, mines, overhangs, crevices, drill holes, and similar sites) in late August to September. Typically, winter hibernacula require constant temperatures, high humidity, and no air currents (USFWS 2013b). It generally hibernates in small colonies (fewer than 100 individuals) (MDNR 2014b; NatureServe 2014a), but the Soudan Underground Mine in northern Minnesota has supported a winter hibernating colony of up to 2,000 individuals. However, there is uncertainty in the high end of this estimate, as much of the mine may not be available for surveys (MDNR 2006e). Both summer and winter habitat types may be found on or near the Mine Site.

Baseline acoustic surveys for bats, which include the northern long-eared bat, the eastern pipistrelle, and the little brown bat, have been completed in the Superior National Forest east of the NorthMet Project area (Abel 2011). Bats were observed at the Mine Site and surrounding federal lands during echolocation surveys, but they were not identified to species (AECOM 2011a). The USFS conducted various bat surveys at the NorthMet Project area during summer of 2014 (USFS 2014b). Passive bat detectors were deployed on exploration trails within the Mine Site to detect bat calls. The northern long-eared bat was responsible for 13.6 percent of all calls detected at the Mine Site during this survey. The USFS also conducted additional bat surveys at sites in Lake and St. Louis counties in spring 2014 (USFS 2014c). Of the 130 bats captured during mist-netting surveys, 28 were northern long-eared bats. A USFS survey in the Kawishiwi District in the summer of 2013 found that of 34 bats captured by mist-netting efforts, 13 were northern long-eared bat (Grandmaison et al. 2013).

Gray Wolf

On July 1, 2009, the U.S. District Court issued a settlement agreement to remand an April 2009 USFWS decision to delist the western Great Lakes population of gray wolves. As a result, the gray wolf (*Canis lupus*) was again a federally listed threatened species. On May 4, 2011, the USFWS once again proposed to reinstate the 2009 decision to delist the gray wolf population in the western Great Lakes. This decision was finalized on December 26, 2011 and was made effective on January 27, 2012. Effective on December 19, 2014, however, the U.S. District Court again reinstated federal protection of the gray wolf, classifying it as a threatened species. The gray wolf was removed from the Minnesota ETSC species list in 2013, but it is still listed as a Superior National Forest RFSS. With the 2014 federal re-listing of the wolf, Minnesota is again divided into the five federal wolf management zones and critical habitat has been reinstated. According to NatureServe, it is globally ranked as apparently secure, but vulnerable in Minnesota (NatureServe 2014a).

Populations of gray wolves have been re-established in several western states from their low point in the mid-1970s when only northeast Minnesota, among the lower 48 states, had a reproducing population. Gray wolf populations in the western Great Lakes Region (i.e., Minnesota, Wisconsin, and Michigan) are expanding and have exceeded recovery goals for several years (Erb and Benson 2004). A 2007 to 2008 winter survey by the MDNR (Erb 2008) estimated that 2,921 gray wolves lived in Minnesota, which is second only to Alaska in wolf populations across the United States. The MDNR considers the gray wolf population fully recovered, as it has surpassed the federal delisting goal of 1,251 to 1,400 wolves (MDNR 2012e). Surveys conducted in the winter of 2013 to 2014 estimate the Minnesota wolf population to be approximately 2,423 animals, 212 more than estimated in 2013 (Erb et al. 2014). In the fall of 2013, the MDNR established a designated wolf hunt with an overall quota of 220 wolves. A total of 238 wolves were harvested during the hunt. The MDNR set a 2014 statewide target harvest of 250 wolves.

In northern Minnesota, the principal prey of the gray wolf includes white-tailed deer, moose, beaver, snowshoe hare, and muskrat, with occasional other small mammals, birds, and large invertebrates. Most wolves live in 2- to 11-member family packs and defend territories of 8 to

184 square miles. In Minnesota, the average pack size during winter 2013-2014 was estimated to be 4.4 individuals (Erb et al. 2014). The forest and brush habitats at the federal lands and Mine Site are typical wolf habitat (MIHs 1 to 14).

Radio-collared wolves have been observed in the vicinity of the federal lands and the Mine Site. Additionally, tracks and scat have been observed along Dunka Road and the roads within the Mine Site. The surrounding area is likely to support a pack of at least three individuals (ENSR 2005).

Moose

The moose (*Alces americanus*) is not federally listed, but was added to the Minnesota ETSC species list as a species of special concern in 2013. It is considered globally secure by NatureServe (NatureServe 2014a). Moose, which have been observed in the NorthMet Project area (ENSR 2005), are a species of importance to the Bands. Moose typically utilize a mosaic of habitat types, including early successional (young) forests, mixed conifer-hardwood forests, wetlands, and lakes (NatureServe 2014a). Waterbodies are often used in summer for foraging aquatic plants, cooling down, or escaping insects, while early successional forests (created by logging, forest fires, or windstorms) are browsed year-round. Dense conifer stands are used for thermal cover in the heat of summer, or used in winter to avoid deep snow. Moose are adapted very well for cold conditions, but are fairly intolerant of heat, making thermal cover or access to water important to reduce heat stress. However, Lenarz et al. (2011) suggest that moose in northeastern Minnesota may display higher preferences for early successional habitat in summer and winter than either aquatic environments or conifer forests. Some research suggests that climate change and warming temperatures may be related to mortality along the southern edge of the moose range (Lenarz et al. 2011). Higher mortality rates could be due to several causes, including heat stress or increased parasites. Several parasites and diseases can negatively affect moose mortality rates; these include winter ticks, brainworm, and liver flukes, among several others (NRRI 2014).

The overall moose population in Minnesota declined approximately 35 percent from 2012 to 2013 (MDNR 2013d). The 2014 winter aerial moose survey estimated the population at 4,350 animals, up from the 2013 estimate of 2,760 (DelGiudice 2014). However, this is likely due to variability in the survey conditions from year to year and uncertainty inherent in the survey itself. The MDNR is currently partnering with several other agencies to conduct multiple research projects to identify the causes of the increase in moose mortalities.

Due to decreased population levels in the state of Minnesota and its new state listing as a species of special concern, there was not a 2013 or 2014 moose hunting season. In previous years, when moose hunting was open, the NorthMet Project area would have been outside of the hunting zone, though moose zone 30 has been located to the south of the Transportation and Utility Corridor in previous hunting seasons. In 2012, two bull moose were harvested in zone 30 (DelGiudice 2012).

Little Brown Bat

The little brown bat (*Myotis lucifugus*), also known as the little brown myotis, is not federally listed, but is state-listed as a species of special concern in Minnesota. It is listed as a Superior National Forest RFSS. It is considered globally vulnerable by NatureServe, but ranges across North America (NatureServe 2014a). Several bat species were added to the Minnesota ETSC list due to the emergence of white-nose syndrome, a fungal disease that could threaten Minnesota populations as it has in eastern populations. A habitat generalist, its preferred habitat includes boreal forests, bogs and fens, open fields, shrublands, and urban areas. It forages primarily in woodlands near water sources. The little brown bat generally enters its hibernacula in September to October, and utilizes caves, tunnels, and abandoned mines with a relatively stable temperature (NatureServe 2014a). The Soudan Underground Mine in northern Minnesota has served as a hibernaculum for an estimated 10,000 bats, the majority of which are little brown bat (MDNR 2006e). Its summer day roost and maternity sites include hollow trees, caves, and human-made structures. This tree roost habitat may potentially be found at the Mine Site. Bats were observed at the Mine Site and surrounding federal lands during echolocation surveys, but they were not identified to species (AECOM 2011a).

The USFS conducted various bat surveys at the NorthMet Project area during the summer of 2014 (USFS 2014b). Passive bat detectors were deployed on exploration trails within the Mine Site to detect bat calls. The little brown bat was responsible for 77.8 percent of all calls detected at the Mine Site during this survey. The USFS also conducted additional bat surveys at sites in Lake and St. Louis counties in spring 2014 (USFS 2014c). Of the 130 bats captured during mist-netting surveys, 59 were little brown bats. A USFS survey in the Kawishiwi District in the summer of 2013 found that of 34 bats captured by mist-netting efforts, 21 were little brown bat (Grandmaison et al. 2013).

Eastern Pipistrelle

The eastern pipistrelle (*Perimyotis subflavus*), also known as the tri-colored bat, is not federally listed, but is state-listed as a species of special concern in Minnesota. It is also listed as a Superior National Forest RFSS. It is considered vulnerable globally and in Minnesota by NatureServe (NatureServe 2014a). Several bat species were added to the Minnesota ETSC list due to the emergence of white-nose syndrome, a fungal disease that could threaten Minnesota populations as it has in eastern populations. Minnesota is located at the western edge of the species' range. Its preferred habitat includes partially open areas with large trees and woodland edges, but it avoids open fields and deep woods (MDNR 2014b; NatureServe 2014a). It primarily forages over open water areas. It generally enters its hibernacula beginning in October, and occupies the deeper portions of caves and mines where temperatures and humidity levels are higher. Typically, they are semi-solitary hibernators, hanging singly and separated from other bats (Nordquist and Birney 1985). The eastern pipistrelle has occasionally been observed hibernating in the Soudan Underground Mine in northern Minnesota (MDNR 2006e). During summer, its day roost sites include trees and human-made structures, while night roosts may include caves. Tree roost habitat can potentially be found at the Mine Site, though the species is more common in the southern half of Minnesota. Bats were observed at the Mine Site and surrounding federal lands during echolocation surveys, but they were not identified to species (AECOM 2011a). The USFS conducted various bat surveys at the NorthMet Project area during summer of 2014 (USFS 2014b). The USFS also conducted additional bat surveys at sites in Lake and St. Louis counties in spring 2014 (USFS 2014c) and on the Kawishiwi District in summer 2013 (Grandmaison et al. 2013). The eastern pipistrelle was not detected during any of the USFS surveys.

Northern Goshawk

The northern goshawk (*Accipiter gentilis*) is not federally listed and is considered globally secure by NatureServe (NatureServe 2014a). It is state-listed as a species of special concern in the state of Minnesota, and the Minnesota NHIS records indicate it does occur on the Mine Site. Its preferred habitat includes older forests, particularly aspen. This habitat is found in the NorthMet Project area. Calling surveys did not identify northern goshawk at the Mine Site (ENSR 2005; AECOM 2009a); however, a northern goshawk nest was identified at the Mine Site. Two northern goshawk territories have been identified at or near the Mine Site, as northern goshawk have nested on the Mine Site and adjacent federal lands in 2000, 2009, 2011, and 2013 (USFS 2013). The One Hundred Mile Swamp northern goshawk territory, which is within the Mine Site, is no longer considered active. The Wetlegs Creek northern goshawk territory, located on the federal lands adjacent to the Mine Site, is still considered active and is currently being monitored.

Boreal Owl

The boreal owl (*Aegolius funereus*) is not federally listed and is considered globally secure by NatureServe (NatureServe 2014a). It is state-listed in Minnesota as a species of special concern. Its preferred habitat includes dense coniferous and mixed forests containing spruce, pine, aspen, and alder trees. This habitat is found on and near the NorthMet Project area. A boreal owl was heard on Dunka Road during surveys in 1988 to 1989 near the Mine Site and federal lands (ENSR 2005); however, Minnesota is at the southern edge of its range in North America. The Minnesota NHIS does not contain any boreal owl records within 10 miles of the NorthMet Project area, and it was not observed during subsequent surveys (ENSR 2000; ENSR 2005; AECOM 2009; AECOM 2011a). The boreal owl nests in tree holes and natural cavities in far northeastern Minnesota, but is rarely seen due to its nocturnal hunting habit (MDNR 2014e).

Wood Turtle

The wood turtle (*Glyptemys insculpta*) is listed as a threatened animal species by the state of Minnesota and as an RFSS by the USFS. The wood turtle is not federally listed, but is considered globally vulnerable (imperiled in Minnesota) by NatureServe (NatureServe 2014a). The species' range extends from Virginia to Nova Scotia and westward to Minnesota and northeast Iowa. The NorthMet Project area is located at the western edge of its range in Minnesota. Significant wood turtle populations, however, are unlikely to be found at the Mine Site because it prefers a habitat of sandy-gravelly streams and bars, used for hibernating, mating, and nesting (Compton et al. 2002), which are not present at the Mine Site.

The Minnesota NHIS records indicate the northernmost population in the state was observed immediately south of the Mine Site. Given this proximity, it is possible that wood turtles may potentially occur along the southern fringes of the Mine Site.

Eastern Heather Vole

The eastern heather vole (*Phenacomys ungava*) is listed as a species of special concern by the state of Minnesota and as an RFSS by the USFS. It is not federally listed, and is globally secure but vulnerable in Minnesota according to NatureServe (NatureServe 2014a). The eastern heather vole is a habitat generalist, but typically inhabits the coniferous zones in upland forests and brushlands and meadows with low shrub species, usually near water. Habitats of this type may occur on the federal lands or at the Mine Site; however, the Minnesota NHIS does not contain any eastern heather vole records within 10 miles of the NorthMet Project area. It was also not found in nearby surveys of small mammals on the Chippewa National Forest (Christian 1993) and in Cook County (Jannett 1998). The NorthMet Project area is at the southern edge of the eastern heather vole's home range in far northern Minnesota and only a few collections of the species occur within Minnesota. The USFS MIH 8, which is primarily jack pine forest, is considered indicative of eastern heather vole habitat. No significant stands of MIH 8 were observed on the federal lands or the proposed Mine Site.

Yellow Rail

The yellow rail (*Coturnicops noveboracensis*) is a state-listed species of special concern. It is not federally listed, and its global rank is considered apparently secure, although vulnerable in Minnesota (NatureServe 2014a). Habitat for yellow rail includes lowland sedge meadows. Several small patches (totaling 39.5 acres) of wet meadow/sedge meadow occur at the Mine Site. The Minnesota NHIS has no records of the yellow rail occurring within 10 miles of the NorthMet Project area and field surveys did not identify any yellow rail (ENSR 2005).

Laurentian Tiger Beetle

The Laurentian tiger beetle (*Cicindela denikei*) is listed as a species of special concern by the state of Minnesota. It is not federally listed, and its global rank is considered vulnerable (imperiled in Minnesota) (NatureServe 2014a). Although it was not searched for during field surveys, the NHIS has no records of Laurentian tiger beetle occurring within 10 miles of the NorthMet Project area. This species inhabits openings in northern coniferous forests, specifically abandoned gravel and sand pits, undisturbed corners of active gravel and sand pits, sand and gravel roads, and sparsely vegetated rock outcrops (MDNR 2012g). Conifer forests occur on the Mine Site, but field surveys did not detect sandy or rocky openings in the forest (ENSR 2005). Rock exposures are evident in areas disturbed by past mining, but conifer forests do not surround these areas.

Taiga Alpine

The taiga alpine (*Erebia mancinus*) butterfly is listed as a species of special concern by the State of Minnesota. It is not federally listed, and it is considered globally secure by NatureServe (NatureServe 2014a). Minnesota is at the southern limit of the species' range. Although it was not searched for during field surveys, the NHIS has no records of taiga alpine occurring within 10 miles of the NorthMet Project area. This species inhabits black spruce bogs and swamps that include Labrador tea shrub layers, and sphagnum moss carpets (MDNR 2014b). These habitat types occur on the Mine Site and federal lands.

Freija's Grizzled Skipper

The Freija's grizzled skipper (*Pyrgus centaureae freija*) butterfly is listed as a species of special concern by the State of Minnesota. It is not federally listed, and it is considered globally apparently secure by NatureServe (NatureServe 2014a). Minnesota is at the southern limit of the species' range, and it is known to occur in Minnesota from only a single locality in Lake County (MDNR 2014b). Although it was not searched for during field surveys, the NHIS has no records of Freija's grizzled skipper occurring within 10 miles of the NorthMet Project area. This species inhabits primarily forest edges and openings; the Lake County location included grassy and sandy openings with willow, alder, and blueberries, bordered by black spruce and tamarack swamps (MDNR 2014b). These habitat types occur on the Mine Site and federal lands.

Nabokov's Blue

The Nabokov's blue (*Lycaeides idas nabokovi*) butterfly is listed as a species of special concern by the State of Minnesota. It is not federally listed, and it is globally unrankable by NatureServe (NatureServe 2014a). This subspecies ranges from the Great Lakes states up into Ontario and southeastern Manitoba (MDNR 2014b). Although it was not searched for during field surveys, the NHIS has no records of Nabokov's blue occurring within 10 miles of the NorthMet Project area. This species' preferred habitat includes open woodlands and upland openings where the larval host plant, dwarf bilberry (*Vaccinium cespitosum*), is abundant (MDNR 2014b). In Minnesota, all known colonies of this butterfly subspecies occur at sandy sites. These habitat types may occur on the Mine Site and federal lands, but the larval host plant was not observed.

Quebec Emerald

The Quebec emerald dragonfly (*Somatochlora brevicincta*) is listed as a species of special concern in the state of Minnesota. It is not federally listed, and is considered globally apparently secure by NatureServe (NatureServe 2015). Field surveys for this species were not completed, but the NHIS has no records of Nabokov's blue occurring within 10 miles of the NorthMet Project area. The Minnesota Odonata Survey Project, however, found an individual in northern Lake County approximately 30 miles north of the NorthMet Project area in 2006. This species' habitat requirements are not well-understood in Minnesota. Reports suggest that it inhabits poor fens found in the NorthMet Project area and wet meadow/sedge meadow habitat such as at the Mine Site. The likelihood of observing Quebec emerald individuals or populations in the vicinity of the federal lands and Mine Site is low.

4.2.5.1.2 Species of Greatest Conservation Need

The Minnesota Comprehensive Wildlife Conservation Strategy (MCWCS), an ecoregion-based wildlife management strategy (MDNR 2006d) identifies SGCN by ecoregion subsections based on a statewide approach. The MCWCS was created with input from multiple stakeholders and expert panels to cover issues of regional, as well as statewide, concern. The Mine Site and Plant Site are located within the Nashwauk and Laurentian Uplands subsections and include five key habitat types. The SGCN species associated with these habitat types at the Mine Site are identified below in Table 4.2.5-1.

Mature upland and lowland forest is the most common habitat type at the NorthMet Project area (primarily at the Mine Site). Section 4.2.4 provides a more detailed discussion of vegetation cover and habitat types (see Figure 4.2.4-1). Northern goshawk, spruce grouse, black-backed woodpecker, and boreal owl were observed in these forests (ENSR 2005). These species represent a group that generally requires large forested blocks and/or minimal human intrusion.

Brush/grassland and very early successional forest are uncommon at the Mine Site (ENSR 2005) and, where present, are typically small patches resulting from recent logging. The USFS has indicated that American woodcock has been observed at the Mine Site and the least weasel may occur as well. Most of the other SGCN species in Table 4.2.5-1 are generally associated with large patches of grassland and savanna habitats that are not present at the Mine Site.

Table 4.2.5-1 Key Habitat, Cover Types, and Associated Species in the Nashwauk and Laurentian Uplands Subsections at the NorthMet Project Area

Key Habitat Type, Cover Types, and Management Indicator Habitats	**Associated Wildlife Species[1]**	**Mine Site (Acres)**	**Transportation and Utility Corridor (Acres)**	**Plant Site (Acres)**
1. Mature Upland Forest, Continuous Upland/Lowland Forest: aspen forest/aspen-birch forest, jack pine forest, mixed pine-hardwood forest (MIH 1-13)	Veery, whip-poor-will, eastern wood-pewee, yellow-bellied sapsucker, ovenbird, Canada warbler, Cape May warbler, **spruce grouse**, winter wren, boreal chickadee, wood thrush, **black-backed woodpecker**, *bald eagle[2]*, **boreal owl (MIH 4, 5, and 9)**, *bay-breasted warbler, black-throated blue warbler*	2,627.2	5.5	789.3
2.Open Ground, Bare Soils: disturbed/ developed (no MIH)	None	128.0	94.4	2,755.5
3.Grassland and Brushland, Early Successional Forest (no MIH)	Eastern meadowlark, Franklin's ground squirrel, brown thrasher, white-throated sparrow, sharp-tailed grouse, golden-winged warbler, *American woodcock*, northern harrier, sedge wren, common nighthawk, black-billed cuckoo, red-headed woodpecker, tawny crescent, *least weasel*	246.6	17.5	333.8
4. Aquatic Environments: Tailings Basin, Partridge River, Embarrass River, former LTVSMC mine pits, wetlands (MIH 14)	Common loon, red-necked grebe, common snapping turtle, northern rough-winged swallow, American white pelican, common tern, Wilson's phalarope, black tern, trumpeter swan, black duck, American bittern, swamp sparrow, eastern red-backed salamander, bog copper, taiga alpine, *marbled godwit*	12.7	2.7	636.8
5. Multiple Habitats (MIH 1-14)	**Gray wolf[2]** (1-4[3]), ***Canada lynx***[2] (1-4), rose-breasted grosbeak (1, 3), Macoun's arctic (1, 3), **least flycatcher** (1, 3), *Connecticut warbler* (1, 3), *olive-sided flycatcher (1, 4)*, grizzled skipper (2, 3), Nabokov's blue (2, 4), wood turtle[2] (1, 3, 4)			
Total		3,014.5	120.1	4,515.4

Source: MDNR 2006d.

Notes:

[1] Bold text indicates SGCN species observed at Mine Site and/or Plant Site (ENSR 2005); italicized text indicates SGCN species targeted by ENSR (2005) that were not found; plain text indicates SGCN species identified as likely to be present at the Mine Site or Plant Site but not targeted in surveys.

[2] Canada lynx, gray wolf, bald eagle, and wood turtle are or have recently been listed as ETSC species, as discussed in detail in the ETSC species section.

[3] Numbers refer to the Key Habitat Types (1-5) where those species may occur or are known to occur.

The Mine Site and adjacent federal lands contain a large expanse of wetland habitat consisting primarily of coniferous bogs and coniferous swamps. No wetland SGCN species have been observed in this area. Marbled godwit was not found likely because its preferred habitat of graminoid wetlands and shallow marshes near extensive upland grassland are not present at the Mine Site. Currently, there are no bodies of open water at the Mine Site.

Multiple habitats are not mapped as such, but are made up of combinations of other key habitat types. This category is used for SGCN species that are known to use multiple habitats during a season. The gray wolf, Canada lynx, least flycatcher, and wood turtle were observed in the general vicinity of the Mine Site and are known to utilize multiple key habitat types, including mature and early-successional upland forest and wetlands. The Connecticut warbler, which also uses mature and early-successional upland forest and wetlands, was searched for, but not found. Similarly, the olive-sided flycatcher was surveyed for in both lowland forest and wetlands, but was not found, most likely because it prefers more open and mature conifer and mixed conifer-deciduous stands. The butterfly species grizzled skipper and Nabokov’s blue are not found within 12 miles of the Mine Site or Plant Site.

4.2.5.1.3 Regional Forester Sensitive Species

RFSS are not protected but their needs are taken into consideration by the USFS when planning natural resource management on USFS lands. The majority of the Mine Site (and adjacent federal lands) is located in the Superior National Forest. Currently, 18 terrestrial wildlife RFSS are included on the Superior National Forest RFSS list, which was updated on February 20, 2012 (USFS 2012f).

Twelve of the RFSS are federally or state-listed ETSC species (i.e., gray wolf, northern long-eared bat, little brown bat, eastern pipistrelle, eastern heather vole, northern goshawk, boreal owl, wood turtle, taiga alpine, Freija’s grizzled skipper, Nabokov’s blue, and Quebec emerald) and are discussed above in Section 4.2.5.1.1. Three other RFSS (the olive-sided flycatcher, bay-breasted warbler, Connecticut warbler) are on the SGCN list and are discussed by habitat type in Table 4.2.5-1 above. Three other RFSS species are discussed briefly below.

Bald Eagle

The bald eagle (*Haliaeetus leucocephalus*) was removed from the federal threatened species list on June 28, 2007. After a period of decline due to hunting and widespread use of dichlorodiphenyltrichloroethane (DDT), bald eagle populations in the lower 48 states rose dramatically beginning in 1972. The bald eagle was removed from the Minnesota ETSC species list in 2013, but continues to be listed as an RFSS by the USFS. According to NatureServe, it is globally secure, but vulnerable in Minnesota (NatureServe 2014a). In addition, the bald eagle is federally protected by the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act.

The Minnesota NHIS (MDNR 2014d) contains records of 18 nesting areas, some with multiple nests, within 12 miles of the federal lands and Plant Site. Some of these areas contained nests in close proximity to each other and were assumed to be used by a single pair of bald eagles (Guinn 2004). No nests were recorded at the Mine Site and field surveys found no evidence of any nests (ENSR 2005). The five closest bald eagle nesting territories were 2.4 to 7.3 miles from the Mine Site or Plant Site (averaging 5.7 miles apart). Bald eagles are typically associated with large lakes surrounded by mature forest where large trees provide suitable nest sites and a perch while searching for fish and other prey. No large lakes are located at the Mine Site and it is unlikely that bald eagles would heavily use these areas.

The NorthMet Project area was also reviewed to evaluate whether it may provide wintering habitat for bald eagles. Eagles generally winter where there is available food at or near open water, and where carrion is available. Animal-vehicle collisions on Dunka Road and/or natural deer mortality are not likely to produce sufficient carrion to sustain bald eagles at the Mine Site (ENSR 2005). While bald eagles have been observed utilizing dead trees on other tailings basins in the Mesabi Iron Range for nesting and perching, no nests have been observed in the NorthMet Project area. Bald eagles may use standing dead trees near the existing LTVSMC Tailings Basin for perching.

MIH 7, which is primarily red and white pine forest, is considered indicative of bald eagle habitat by the USFS. No stands of MIH 7 were specifically observed on the federal lands or proposed Mine Site; however, MIH 7 is a subset of the broader MIH 5, which was observed at the Mine Site (see Figure 4.2.4-3).

Great Gray Owl

The great gray owl (*Strix nebulosa*) is not listed federally or in Minnesota, nor is it tracked in the Minnesota NHIS. It is considered globally secure by NatureServe (NatureServe 2014). Its preferred habitat includes coniferous and mixed forests and boreal bogs, which include MIHs 4, 5, and 9. These habitats are found in the NorthMet Project area. Calling surveys did not identify great gray owls at the Mine Site (ENSR 2000 and 2005); however, 2009 surveys identified a great gray owl hunting along Dunka Road south of the Mine Site, and the USFS has records of a great gray owl nesting in the NorthMet Project area in 2006 (AECOM 2009a), 2010, and 2011 (USFS 2013).

Three-Toed Woodpecker

The three-toed woodpecker (*Picoides tridactylus*) is not listed federally or in Minnesota and is globally secure according to NatureServe (NatureServe 2014a). It is not tracked in the Minnesota NHIS. This species was identified during winter field surveys (ENSR 2000); however, it was not identified during summer field surveys (ENSR 2005). A limiting factor for this species is foraging habitat where sufficient insects can be found to feed its young during the breeding season. Three-toed woodpeckers prefer and are most abundant in large tracts of old growth coniferous forest near recent burns where they forage on dead and dying trees for bark beetles (Burdett and Niemi 2002). MIH 9 and MIH 12 are considered habitat for the three-toed woodpecker. No old growth coniferous habitat or recent burns are present at the Mine Site or adjacent federal lands. A three-toed woodpecker was observed at the Mine Site by USFS personnel in 2007; however, the birds are unlikely to be common due to a lack of suitable habitat.

Bat Species

The northern long-eared bat, eastern pipistrelle, and little brown bat species were added to the 2011 RFSS list due to the spread of white-nose syndrome, which is a fungal disease impacting bats. The disease carries a high mortality rate for all bat species; the Superior National Forest is closely watching the RFSS bat species to identify signs of white-nose syndrome, as discussed above in Section 4.2.5.1.1.

4.2.5.1.4 Other Wildlife Species

Other wildlife species common to the area may be present at the Mine Site and surrounding NorthMet Project area. Species of interest include the monarch butterfly, northern leopard frog, common loon, hooded merganser, osprey, red-tailed hawk, ruffed grouse, spruce grouse, American woodcock, killdeer, common tern, belted kingfisher, pileated woodpecker, black-backed woodpecker, brown creeper, golden-crowned kinglet, Swainson's thrush, magnolia warbler, pine warbler, savannah sparrow, beaver, porcupine, black bear, and white-tailed deer.

Species observed, or their sign, on the Mine Site and surrounding federal lands include black bear, white-tailed deer, coyote, red fox, beaver, marten, snowshoe hare, red squirrel, ruffed grouse, spruce grouse, American woodcock, common snipe, mallard, lesser scaup, hooded merganser, red-tailed hawk, broad-winged hawk, barred owl, saw-whet owl, great-horned owl, great blue heron, pileated woodpecker, and several passerine bird species (ENSR 2005; AECOM 2009a; AECOM 2009b).

Game species such as white-tailed deer and black bear are found in and near the NorthMet Project area, and are of importance to the Bands. The NorthMet Project area is located within bear management unit 31. The 6-year harvest average is 319 animals within unit 31 (MDNR 2013b; MDNR 2014c). Similarly, the NorthMet Project area is within the hunting zone for deer area 176. The 5-year average is 2.3 deer harvested per square mile in this deer area (MDNR 2013c). Sections 4.2.9 and 5.2.9 discuss species of importance to the Bands.

4.2.5.2 Plant Site and Transportation and Utility Corridor

4.2.5.2.1 Federally and State-listed Species and Species of Special Concern

Canada Lynx

The Plant Site is not on USFS land, and therefore is not located within an LAU. The western edge of the Plant Site borders a critical lynx habitat zone but not an LAU. The lynx winter tracking survey (ENSR 2006) did not identify any sign of lynx at the Plant Site.

The eastern portion of the Transportation and Utility Corridor, located directly south of the federal lands, is included in LAU 12 and in a lynx critical habitat zone. The western portion of the Transportation and Utility Corridor is not located in an LAU or critical habitat zone. The Transportation and Utility Corridor is located along areas of potential for moderate and high quality wildlife travel corridors, including surveyed wildlife corridors (Emmons and Olivier 2006; Barr 2009a). Section 6.2.5.4.2 includes further discussion of wildlife travel corridors.

Northern Long-Eared Bat

The USFS conducted various bat surveys at the NorthMet Project area during summer of 2014 (USFS 2014b). Driving surveys were conducted along Dunka Road, the Tailings Basin, and the Plant Site, and the northern long-eared bat was responsible for 4.6 percent of all calls detected. Emergence surveys were also conducted around Plant Site buildings to identify potential roost sites. The largest number of emerging bats was observed at the coarse crusher building. Of the bats observed within and emerging from the buildings, the northern long-eared bat comprised 6.9 percent at the coarse crusher building, and 27.8 percent at the concentrator building.

Gray Wolf

As previously mentioned, collared gray wolves and gray wolf signs have been observed in the vicinity of the NorthMet Project area, including the Plant Site. Gray wolf tracks and scat have been observed along Dunka Road, and radio-collared individuals and call survey responses indicate that gray wolves may be present along the Transportation and Utility Corridor. As noted previously, the area near the federal lands and Mine Site, including the eastern end of the Transportation and Utility Corridor, may support a pack of three or more individual gray wolves.

Moose

The Minnesota NHIS does not contain any records of moose occurring within the Transportation and Utility Corridor or Plant Site, and no wildlife surveys specifically for moose were conducted in these areas. Moose have been observed at the Mine Site and federal lands (ENSR 2005; AECOM 2011a), which are both located in close proximity to the Transportation and Utility Corridor and Plant Site. Due to the areas' primarily disturbed nature, it is possible that moose occur in these areas, but it is unlikely that they utilize them often.

Little Brown Bat

The USFS conducted various bat surveys at the NorthMet Project area during summer of 2014 (USFS 2014b). Driving surveys were conducted along Dunka Road, the Tailings Basin, and the Plant Site, and the little brown bat was responsible for 31.3 percent of all calls detected. Emergence surveys were also conducted around Plant Site buildings to identify potential roost sites. The largest number of emerging bats was observed at the coarse crusher building. Of the bats observed within and emerging from the buildings, the little brown bat comprised 93.1 percent at the coarse crusher building, 72.2 percent at the concentrator building, and 100 percent (8 to 10 bats) at the drive house.

Eastern Pipistrelle

The USFS conducted various bat surveys at the NorthMet Project area during summer of 2014 (USFS 2014b). The eastern pipistrelle was not detected during any of the USFS surveys along Dunka Road, the Tailings Basin, or the Plant Site buildings.

Northern Goshawk

The northern goshawk's preferred habitat includes older forests, particularly aspen. This habitat is found on and near the Plant Site and Transportation and Utility Corridor. The Minnesota NHIS does not contain any northern goshawk records within the Transportation and Utility Corridor or Plant Site. However, since a northern goshawk nest was identified at the Mine Site, and two northern goshawk territories have been identified at or near the Mine Site, it is possible that northern goshawks utilize the Plant Site and Transportation and Utility Corridor.

Boreal Owl

Given the lack of dense coniferous and mixed forests, which is the boreal owl's preferred habitat, it is unlikely that it would occur at the Plant Site. However, this habitat is found in proximity to the Plant Site and Transportation and Utility Corridor. A boreal owl was heard along Dunka Road during surveys in 1988 to 1989 near the Mine Site and federal lands (ENSR 2005); however, the Minnesota NHIS does not contain any boreal owl records within 10 miles of the

NorthMet Project area, and it was not observed during subsequent surveys (ENSR 2000; ENSR 2005; AECOM 2009; AECOM 2011a).

Wood Turtle

No wood turtles were observed during wildlife surveys of the NorthMet Project area. Given the lack of sandy-gravelly streams and bars, which is the preferred habitat for the wood turtle, it is unlikely that the wood turtle would be found at the Plant Site. There are no NHIS records of wood turtles at the Plant Site (MDNR 2014d). The NHIS records indicate that the northernmost population of wood turtle in the state was observed immediately south of the Mine Site. Given the proximity of the Transportation and Utility Corridor, it is possible that wood turtles could be present along the eastern portion of the corridor and southern fringes of the Mine Site.

Eastern Heather Vole

The eastern heather vole is a habitat generalist, but typically inhabits the coniferous zones in upland forests and brushlands and meadows with low shrub species, usually near water. Habitats of this type occur at the Plant Site or along the Transportation and Utility Corridor; however, the Minnesota NHIS does not contain any eastern heather vole records within 10 miles of the NorthMet Project area. The NorthMet Project area is at the southern edge of the eastern heather vole's home range in far northern Minnesota and only a few collections of the species occur within Minnesota.

Yellow Rail

Yellow rail prefer sedge meadow, which is present in a very small amount (1.5 acres) at the Plant Site and in small patches adjacent to the Transportation and Utility Corridor. The Minnesota NHIS has no records of the yellow rail occurring within 10 miles of the NorthMet Project area and field surveys did not identify any yellow rail (ENSR 2005).

Laurentian Tiger Beetle

The Laurentian tiger beetle prefers rocky or sandy areas adjacent to conifer forests. This habitat is found at the Plant Site and along the Transportation and Utility Corridor, though there were no Minnesota NHIS records of occurrences of the species near the Plant Site or Transportation and Utility Corridor.

Taiga Alpine

The taiga alpine butterfly prefers black spruce bogs and swamps. This habitat is found at the Plant Site and along the Transportation and Utility Corridor in limited areas, though there are no Minnesota NHIS records of occurrences of the species near the Plant Site or Transportation and Utility Corridor.

Freija's Grizzled Skipper

The grizzled skipper butterfly prefers forest edges and openings. This habitat is found at the Plant Site and along the Transportation and Utility Corridor, though there are no Minnesota NHIS records of occurrences of the species near the Plant Site or Transportation and Utility Corridor.

Nabokov's Blue

The Nabokov's blue butterfly prefers open woodlands and upland openings where the larval host plant, dwarf bilberry, is abundant. This habitat is found at the Plant Site and along the Transportation and Utility Corridor in limited areas, though there are no Minnesota NHIS records of occurrences of the species near the Plant Site or Transportation and Utility Corridor.

Quebec Emerald

The Quebec emerald dragonfly prefers poor fens and wet meadow/sedge meadow habitat. This habitat is found at and near the Plant Site and along the Transportation and Utility Corridor in limited areas, though there are no Minnesota NHIS records of occurrences of the species near the Plant Site or Transportation and Utility Corridor.

4.2.5.2.2 Species of Greatest Conservation Need

As with the federal lands and Mine Site, the Plant Site is located along the border of the Nashwauk Uplands and Laurentian Uplands subsections. The habitat types and associated species are summarized in Table 4.2.5-1.

Areas of open ground and bare soils are rare at the Mine Site but are abundant at the Plant Site due to LTVSMC operations or deposition in the existing Tailings Basin. Both open ground and bare soils are considered non-natural habitats. No SGCN are associated with this habitat type.

Natural brush/grassland and very early successional forest are uncommon at the Plant Site (ENSR 2005). The existing Tailings Basin re-vegetation is counted as grassland, though it is disturbed habitat and is unlikely to be heavily used by wildlife species. Most of the SGCN species in Table 4.2.5-1 are generally associated with large patches of grassland and savanna habitats that are not present at the Plant Site.

Open water and aquatic communities are confined to the existing LTVSMC Tailings Basin at the Plant Site. The Tailings Basin attracts Canada geese, ducks, common loons, and other waterfowl, though the NorthMet Project area does not otherwise appear to provide good habitat for waterfowl or waterbirds. American white pelican, common tern, Wilson's phalarope, black tern, and trumpeter swan were surveyed for, but not found (ENSR 2000 and 2005).

As previously discussed, multiple habitats are made up of combinations of other key habitat types. Section 4.2.5.1 and Table 4.2.5-1 provide more discussion on species commonly found in multiple habitat types.

As with the federal lands (including the Mine Site) and the Plant Site, the Transportation and Utility Corridor is in the Laurentian Uplands and Nashwauk Uplands subsections. Section 4.2.5.1.2 and Table 4.2.5-1 provide more discussion of the habitat and species which may be present.

4.2.5.2.3 Regional Forester Sensitive Species

Section 4.2.5.1.3 provides additional discussion of the RFSS associated with the NorthMet Project area.

Bald Eagle

Typical bald eagle habitat is not present at the Plant Site, as there are no large nesting trees or waterbodies that are open year-round near the NorthMet Project area. Similarly, there is no bald eagle habitat located along the Transportation and Utility Corridor. As previously mentioned, animal-vehicle collisions on Dunka Road and/ or natural deer mortality are not likely to produce sufficient carrion to sustain bald eagles (ENSR 2005).

Great Gray Owl

The great gray owl preferred habitat includes coniferous and mixed forests and boreal bogs. These habitats are found in proximity to the Plant Site and Transportation and Utility Corridor. Calling surveys did not identify great gray owls at the Plant Site (ENSR 2000 and 2005); however, 2009 surveys identified a great gray owl hunting along Dunka Road south of the Mine Site, and the USFS has records of a great gray owl nesting in the NorthMet Project area in 2006 (AECOM 2009a), 2010, and 2011 (USFS 2013).

Three-Toed Woodpecker

The three-toed woodpecker prefers large tracts of old growth coniferous forest near recent burns where they forage on dead and dying trees for bark beetles (Burdett and Niemi 2002). No old growth coniferous habitat or recent burns are present at the Plant Site or Transportation and Utility Corridor. Though a three-toed woodpecker was observed at the Mine Site by USFS personnel in 2007, the birds are unlikely to be common at the Plant Site or Transportation and Utility Corridor due to a lack of suitable habitat.

4.2.5.2.4 Other Wildlife Species

Other wildlife species common to the region may be present on and around the Plant Site. Section 4.2.5.1.4 provides more discussion on these species.

658 -Page Intentionally Left Blank-

4.2.6 Aquatic Species

The NorthMet Project area encompasses several waterbodies that provide a variety of habitats for fish and aquatic macroinvertebrates. This section describes the known existing conditions of the fish and aquatic macroinvertebrate communities associated with waterbodies found in the Partridge River and Embarrass River watersheds and potentially affected by the NorthMet Project Proposed Action. For purposes of this FEIS, the Strahler Order (USEPA 2011a) is used to describe the hierarchical ordering of streams, where a first-order stream describes a headwater type stream with no branching. Where two first-order streams meet, they become larger, second-order streams, and where two second-order streams meet, they become third-order streams, etc.

The majority of the streams are low velocity; exhibit glide pool characteristics; meander through emergent, scrub-shrub, and forested wetlands; and have silty to boulder substrates.

The riparian edge along these streams is predominantly vegetated, which supports quality habitat for aquatic biota with little evidence of human disturbance. Baseline surveys are indicative of habitat supporting fish communities that are comparable to communities in similar waterbodies in the region. Macroinvertebrate habitat degradation from biological stressors is minimal and fair macroinvertebrate habitat exists. Habitat for several freshwater mussel species likely exists in the vicinity of the NorthMet Project area; however, only two species of mussels were observed in two years of baseline freshwater mussel surveys.

No federally or state-listed threatened or endangered, SGCN, or RFSS aquatic special status species or invasive species were found in the NorthMet Project area during surveys. According to available data, however, there are nine RFSS species, three SGCN species, and three state-listed special concern species known to occur in the general vicinity of the NorthMet Project site. Of these, suitable habitat likely exists for five special status species: headwaters chilostigman caddisfly, Quebec emerald, ebony boghaunter, creek heelsplitter, and northern brook lamprey. However, no occurrences of these species have been documented in baseline surveys in the NorthMet Project area.

Based on Minnesota's fish tissue mercury standard, the MDH has issued fish consumption advisories for the state. Waterbodies within the vicinity of the NorthMet Project area with fish consumption advisories include Colby Lake, Whitewater Reservoir, and the St. Louis River. No advisories have been issued for stream features within the NorthMet Project area. Fish sampling results from the Partridge River in 2014 indicated some species within the watershed exhibited elevated baseline levels of mercury found in the fish tissue. The streams located within the Partridge River Watershed are also tributaries of the St. Louis River, which does have fish consumption advisories.

Rulemaking was conducted with the intent to update the list of ETSC species (*Minnesota Rules*, parts 6134.0100 to 6134.0400), with new listings becoming effective on August 19, 2013 (MDNR 2013h). The FEIS considers any new listings, or changes in the previous listings, associated with the updated list. The FEIS also considers any federal listing changes. A Biological Evaluation has been prepared that contains further information about RFSS species. The BE is included in Appendix D and is posted on the USFS website (www.fs.usda.gov/goto/superior/northmet).

4.2.6.1 Upper Partridge River Watershed

This section describes the aquatic resources found primarily within the Upper Partridge River Watershed portion of the NorthMet Project area generally described as the Partridge River headwaters, downstream to Colby Lake, as well as Second Creek, a tributary of the Lower Partridge River downstream of Colby Lake.

4.2.6.1.1 Surface Water Features and Habitat

The surface water features within the Upper Partridge River include Mud Lake, Partridge River, and several tributaries of the Partridge River (e.g., Yelp Creek, Longnose Creek, Wetlegs Creek, Wyman Creek). The limnological features include a range of aquatic biota habitats consisting of an undeveloped freshwater lake to a river system with several headwater tributaries each combining to form a fourth-order river.

The 30.5-acre Mud Lake is located in the One Hundred Mile Swamp northwest of the Mine Site but within the federal parcel (see Figure 4.2.6-1). It has a shoreline of 4,550.0 ft and a lake frontage index of 0.7 ft per acre (see Table 4.2.6-1). Review of aerial photography indicates the lake is entirely surrounded by a vegetated wetland riparian area with no apparent development, which should provide adequate undeveloped shoreline for quality fish and macroinvertebrate habitat. The lake also has extensive shallow, emergent vegetated areas throughout, which would also provide quality habitat. Mud Lake may be susceptible to winterkill, which would minimize fish habitat.

Yelp Creek is a first order, headwater stream that flows through the One Hundred Mile Swamp where it connects with the Partridge River, forming a second-order stream at the confluence of Yelp Creek and Partridge River (see Figure 4.2.6-1). Both streams combine to encompass 5.3 miles of river through the federal parcel with a frontage index of 8.6 ft per acre. No apparent development and a wide vegetated wetland riparian buffer are exhibited from aerial photograph review, which indicates that quality fish and macroinvertebrate habitat is likely present throughout the entire Yelp Creek and Partridge River wetted water course.

Wetlegs, Longnose, and Wyman creeks are each first-order, headwater streams that flow north to south with origins between the federal parcel and Plant Site and each form confluences with the Partridge River (see Figure 4.2.6-1). These streams exhibit approximately 13.8 miles of river, collectively, prior to their confluence with the fourth-order segments of the Partridge River.

Second Creek is a headwater stream located south of the Plant Site and is joined by several unnamed tributaries as it flows southwest, forming a second-order tributary prior to connecting with the Partridge River (see Figure 4.2.6-1). The riparian zone of Second Creek is characterized by reed canarygrass, grasses, willows and alder shrubs, birch, and other larger trees. Second Creek, upstream of CR 666, is characterized by open-water wetland and numerous beaver ponds, while the lower portion is characterized by riparian woods. Portions of Second Creek are channelized or otherwise altered due to mining activity, particularly between CR 666 and CR 110.

A total of seven habitat assessment surveys were conducted at six locations within the Partridge River Watershed in the vicinity of the NorthMet Project area that describe in-stream channel characteristics and habitat within select study reaches (see Figure 4.2.6-1; Table 4.2.6-2). Five locations (four sites on the Upper Partridge River and one site on Second Creek) were in the direct vicinity of the NorthMet Project area. The site located on the South Branch of the Partridge River is considered a reference site. These survey sites were established as baseline sampling sites for the DEIS in order to analyze habitat and aquatic biota within select study reaches. Data from these and other sampling sites from various MPCA programs are summarized below. Sites PR-B1 and PR-B2 scored near the upper range of the Qualitative Habitat Evaluation Index (QHEI) (Rankin 1989) scale, which indicates good fish habitat was present. The scores for PR-B3, PR-west, and PR-east sites scored lower in the QHEI range, which is likely a function of the dominant silt substrate found at these sites.

Tables 4.2.6-1 and 4.2.6-2 provide information regarding those waterbodies located within the federal parcel and those within the larger Partridge River Watershed, respectively. The USFS tracks MIHs, which are categories of habitat types. One of the MIH categories used by USFS includes MIH 14, which is defined as the wide variety of lakes, rivers, streams, ponds, marshes, or pools (permanent, intermittent, or seasonal) that provide habitat to wildlife (USFS 2004b). The MIH represented within the boundaries of the federal parcel includes 30.5 acres for Mud Lake and 55,968.0 linear ft for Partridge River and Yelp Creek (see Table 4.2.6-1). Based on the in-stream channel characteristics and habitat, these streams and headwater tributaries should support warmwater game fish species such as northern pike, yellow perch, and bass, as they function as important spawning and rearing areas. Maintaining the seasonal variation in hydrological regime is important, especially during the spring when high flows cue spawning activity and provide access to traditional fish spawning and rearing habitat. The wetlands adjacent to all surface water features on the federal lands were not scored for fish habitat during the wetland functions and values assessment, since water levels were inadequate for most of the year to support fish habitat (AECOM 2011d).

Table 4.2.6-1 Federal Land Parcel Surface Water Characteristics

Surface Water	Size on Parcel	Approximate Shoreline Frontage (ft)	MIH Size	Frontage Index (ft/acre)
Mud Lake	30.5 acres	4,555.0	30.5 acres	0.7
Partridge River and Yelp Creek	5.3 miles	55,968.0	55,968.0 linear ft	8.6

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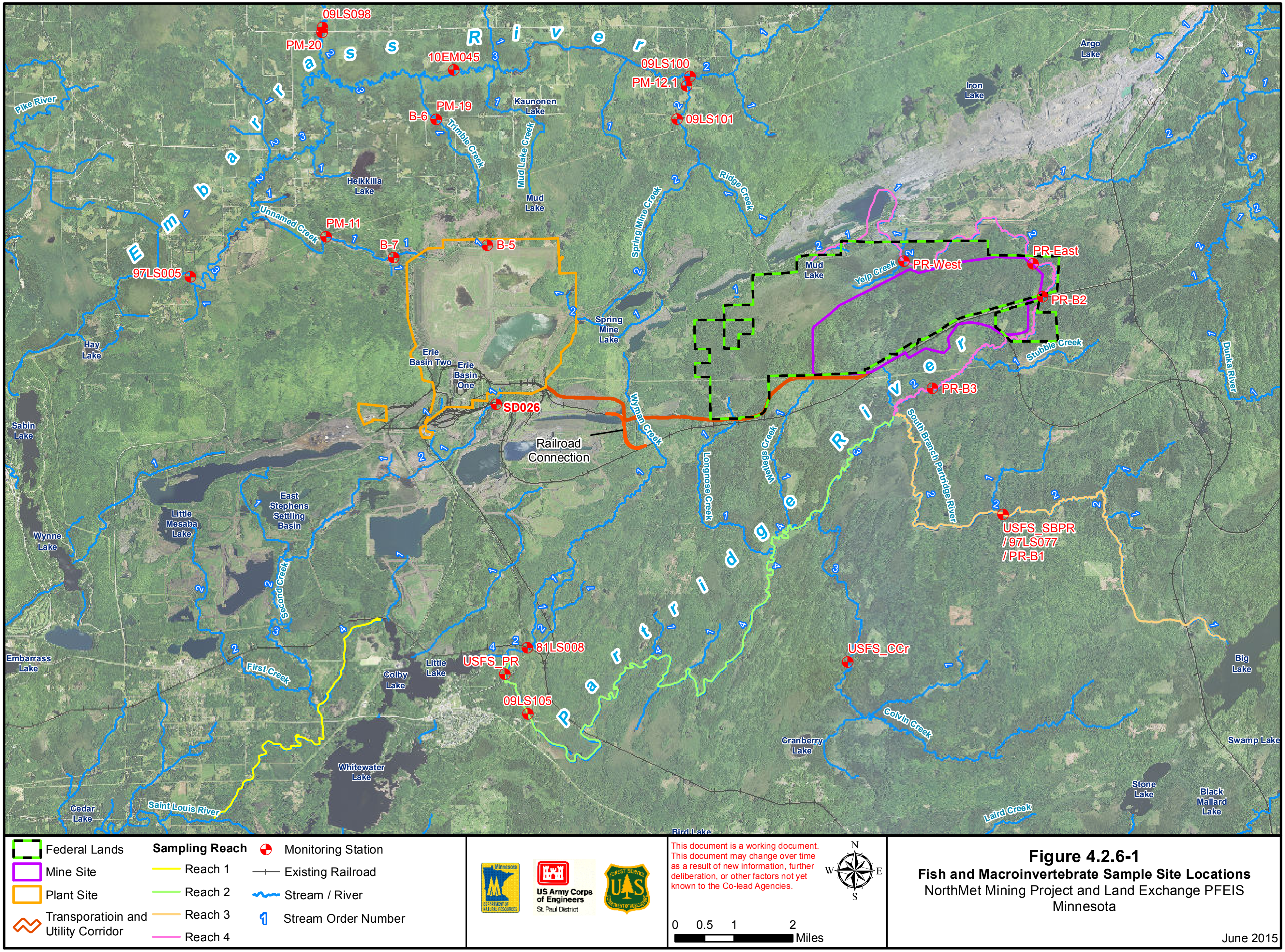

Figure 4.2.6-1
Fish and Macroinvertebrate Sample Site Locations
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

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Table 4.2.6-2 Major Channel Characteristics at Biological Survey Stream Sites in the Partridge River Watershed

Water Body/ Reference	Channel Characteristics: Study Year	Site Location	Stream Order[2]	Catchment (mi[1])	Dominant Substrate	Width (m)	Depth (cm)	Velocity (cm/s)	QHEI[2]
Partridge River (Barr 2011b)	2009	PR-west site	2	na	Silt	4.9	79.25	na	40
Partridge River (Barr 2011b)	2009	PR-east site	2	na	Silt	4.0	88.39	na	41
South Branch Partridge River[3] (Breneman 2005)	2004	PR-B1	2	14.0	Boulder	7.5	26.74	6.90	70
South Branch Partridge River[3] (MPCA 2011c)	2009	MPCAB_ 97LS077	2	14.0	Boulder	7.0	21.1	na	na
Partridge River (Breneman 2005)	2004	PR-B2	2	15.2	Boulder	9.5	20.67	15.13	79
Partridge River (Breneman 2005)	2004	PR-B3	2	23.0	Silt	7.2	72.23	7.03	65
Second Creek (Barr 2011i)	2011	SD026	1	--	Boulder, gravel, silt, detritus	5.0	37	0.03	69

Source: Adapted from Breneman 2005, Barr 2011b, and MPCA 2011c.

Notes:
na = Not available
[1] Referenced from Figure 4.2.6-1.
[2] QHEI is designed to provide an integrated evaluation of physical habitat characteristics important to fish communities and ranges from 0 (low) to 100 (high).
[3] South Branch Partridge River reference sites PR-B1 and 7LS077 are the same location.

Watershed Level Riparian Connectivity

Intact riparian areas are an important factor contributing to diverse and productive aquatic ecosystems. The streams present in any watershed are each part of an intricate web of perennial, defined as waterbodies with water present year-round, and non-perennial streams, lakes, and rivers. They are part of a larger watershed where the connections between these surface water features are affected by the vegetated, undisturbed riparian edges bordering these waterbodies. A Riparian Connectivity Index (RCI), developed by the MDNR, measures the percentage of undeveloped, vegetated land within the riparian zone and is typically derived using a GIS analysis of vegetative cover along riparian areas and takes into consideration agriculture and land development affected natural riparian vegetative cover (MDNR 2015a). The Partridge River is a tributary to the larger St. Louis Watershed where the score for the St. Louis Watershed was rated at 0 percent agriculture in the riparian zone, 5 percent development in the riparian zone, and a total RCI of 95. Localized GIS analysis of the Partridge River within the boundary of the federal lands indicates the score is also representative of this area.

Aquatic Connectivity

Dams, bridges, and culverts in streams, creeks, and rivers may reduce the hydrologic connectivity of watersheds if they become fish barriers and may affect the habitat available for aquatic organisms by influencing stream velocities, sediment deposition, substrate composition, erosion potential, and water quality.

The MDNR has developed an Aquatic Connectivity Index (ACI), which reflects the extent of dams, bridges, and culverts along stream segments. The number of structures that modify aquatic connectivity in Minnesota streams is very high. The vast majority of watersheds score 20 or below on a scale of 0 to 100, where 100 represented the fewest amount of structures per river mile, indicating a high density of bridges, culverts, and dams (MDNR 2015b).

The index exhibited for the St. Louis River Watershed indicated a score of 15 for bridges and culverts and 6 for dams. The overall ACI score for the St. Louis Watershed was 11, which indicates that dams, bridges, and culverts impair the aquatic connectivity of the watershed and limit the available physical habitat for aquatic organisms.

Localized analysis of dams, bridges, and culverts along the Partridge River are limited to one Dunka Road crossing within the vicinity of the Mine Site.

4.2.6.1.2 Existing Water Quality within the Vicinity of the Mine Site

Water quality can have significant effects on aquatic species. The existing water quality data collected within the Partridge River sampling locations provided the basis for the NorthMet Project Proposed Action and Continuation of Existing Conditions (CEC) Scenario models (Section 5.2.2.2.3). Existing condition mercury values were consistently in exceedance of Class 2B water quality standards while aluminum and thallium values were in exceedance of water quality standards at one or more sampling locations (see Figure 4.2.6-2; Table 4.2.6-3). No data were available to evaluate the Mud Lake and Yelp Creek water quality. Wyman Creek is included on the 2012 TMDL list for aquatic life based on Fishes Bioassessment. Additional existing water quality information is contained in Section 4.2.2.

Table 4.2.6-3 Average Existing Water Quality Concentrations in the Partridge River

Parameter	Units	Evaluation Criteria[1]	SW-001	SW-002	SW-003	SW-004	SW-004a	SW-004b	SW-005
General									
Chloride	µg/L	230	1.6	25.7	10.3	9.2	9.3	5.7	5.7
Specific Conductivity	umhos/cm	NA	230	363	217	208	209	148	142
TDS	mg/L	700	119	235	161	155	171	153	143
Temperature	°C	-	13.7	10.7	10.8	11.2	12.5	11.7	11.8
Metals									
Aluminum	µg/L	125	18.0	31.3	51.8	**193**	119	**127**	**129**[(3)]
Antimony	µg/L	31	1.5	0.53	0.53	0.53	0.25	0.25	0.53
Arsenic	µg/L	53	6.5	0.48	0.90	1.1	0.95	0.96	1.0
Boron	µg/L	500	96.0	148	94.8	93.0	116	75.9	51.4
Cadmium	µg/L	2.5[(2)]	0.10	0.10	0.10	0.09	0.08	0.07	0.09
Cobalt	µg/L	5	0.45	0.30	0.33	0.57	0.42	0.43	1.16
Copper	µg/L	9.3[(2)]	1.6	0.8	1.0	1.5	1.5	1.5	1.6
Lead	µg/L	3.2[(2)]	0.30	0.29	0.27	0.32	0.22	0.26	0.41[(4)]
Mercury	ng/L	1.3	**2.3**	**2.7**	**2.8**	**3.3**	**4.1**	**5.4**	**4.3**
Nickel	µg/L	52[(2)]	1.4	0.71	1.1	1.5	1.2	1.6	1.7
Selenium	µg/L	5	1.7	0.90	0.90	0.73	0.44	0.64	0.77
Silver	µg/L	1	0.29	0.21	0.21	0.20	0.10	0.10	0.20

Parameter	Units	Evaluation Criteria[1]	SW-001	SW-002	SW-003	SW-004	SW-004a	SW-004b	SW-005
General									
Thallium	µg/L	0.56	**0.60**	0.19	0.19	0.16	0.01	0.01	0.15
Vanadium	µg/L	NA	--	1.5	1.5	1.5	1.5	1.5	1.5
Zinc	µg/L	120[(2)]	8.9	5.5	8.7	10.3	4.6	4.2	10.5

Source: Barr 2014d.

Notes:
Bold font indicates exceedance of the Class 2B water quality standards evaluation criteria.
[1] Section 5.2.2 includes a detailed discussion of evaluation criteria.
[2] Water quality standard for this metal is hardness-dependent. Listed value assumes a hardness concentration of 100 mg/L.
[3] Excludes single outlier value of 1,550 µg/L from values included in Barr 2014d.
[4] Excludes single outlier value of 12.3 µg/L from values included in Barr 2014d.

4.2.6.1.3 Aquatic Biota Studies

Several aquatic biota surveys are summarized below as referenced from Breneman (2005), Barr (2011b), MPCA (2011c), and USFS (2014). Breneman conducted biological surveys at two sites in the Upper Partridge River near the Mine Site (PR-B2 and PR-B3) and at a third site on the South Branch Partridge River (PR-B1) during August and September 2004, while Barr conducted surveys at two other sites in the upper Partridge River near the Mine Site (PR-east and PR-west) during September 2009 (see Figure 4.2.6-1). Two additional July 2009 surveys were reported by the MPCA (MPCA 2011c and MPCA 2013c) and were located at the South Branch Partridge River (same site as PR-B1) and at a site upstream of the Wyman Creek and Partridge River confluence (MPCA_09LS105). The main stem Partridge River sites have been previously affected by discharges from the Northshore Mine (Breneman 2005). The site on the South Branch Partridge River (PR-B1/MPCAB_97LS077), identified by Breneman (2005) to be a suitable reference site for the Partridge River, is approximately 4.3 river miles upstream of the South Branch Partridge River confluence with the Partridge River and is unaffected by any mining discharge (Breneman 2005).

The results of the fish and macroinvertebrate surveys are summarized in Table 4.2.6-4 and 4.2.6-5. The assemblages observed in the survey are typical of those sampled elsewhere in the northeast region of Minnesota (Barr 2011b). No listed SGCN, RFSS, state, federal, or invasive species were observed during these surveys.

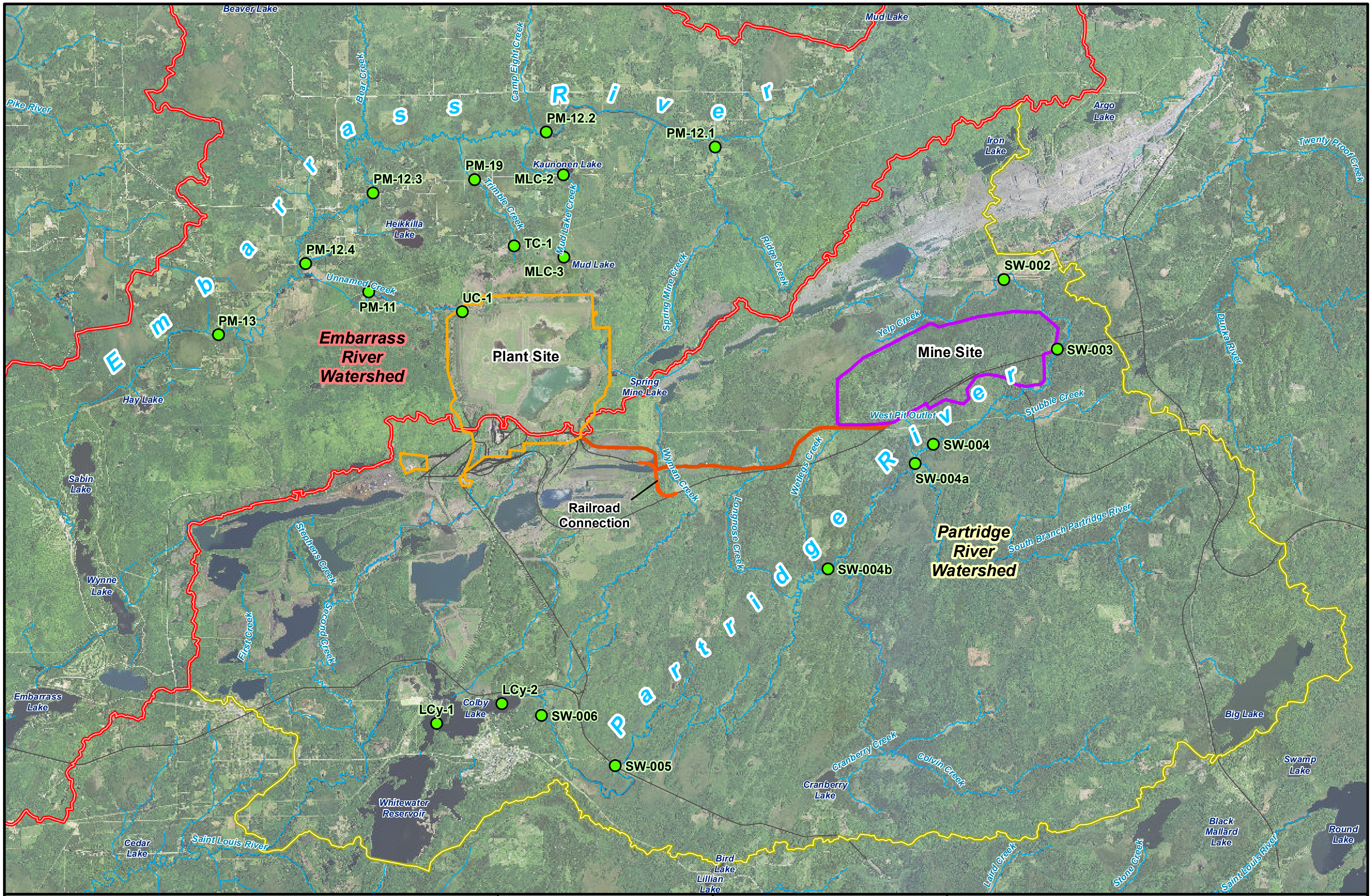
<u>Fish Communities</u>

Abundance and diversity of taxa among the Upper Partridge River sampling sites were indicative of a warmwater stream populated by typical warmwater species, including gamefish such as northern pike, bluegill, northern rock bass, and yellow perch (see Table 4.2.6-4). The IBI, which is a commonly used metric for assessing stream health related to human disturbance, was not available for many of the Partridge River sites closest to the NorthMet Project area. The presence of one or more intolerant or intermediate species in each of these monitoring locations is, however, one indication that quality habitat is present at these sites and chemical and physical stream deterioration is likely negligible. IBI scores were derived from the two MPCA fish surveys conducted at sites 97LS077 and 09LS105. The scores of 61 and 87, respectively, represent average to good habitat quality. A review of aerial photography reveals similar riparian vegetation cover for all Upper Partridge River sites.

Results of recent fish studies conducted in 2014 by the USFS (see Table 4.2.6-5) indicated similar results to the other studies within the Partridge River Watershed and warmwater fish species were common. Species diversity was variable and each sampling reach exhibited at least one pollution intolerant species.

The MPCA collected fish community data during a 2009 sampling event for Wyman Creek, a State of Minnesota-listed trout stream (see Figure 4.2.6-1). MDNR surveys were conducted on Wyman Creek in 1968, 1981, and 2003 (MDNR 1981; MDNR 2003). Based on the latest 2009 survey, a variety of taxa were collected; however, no trout species were collected, which likely contributed to an IBI score of only 33, four points below the minimum threshold for this stream classification (see Table 4.2.6-4). MDNR survey results reference elevated stream temperatures due to warmwater surface runoff from Mine Pit lakes to the east and west of the headwaters, extensive logging in the watershed, and beaver dam and impoundments occurring along the entire length of Wyman Creek. It should be noted that Wyman Creek is not a comparable stream to others in the Upper Partridge River watershed for several reasons. Most notable, Wyman Creek is a designated coldwater trout stream, it is affected by mining activity, and would not be in the direct drainage of the NorthMet Project Proposed Action. It is included in this FEIS because it contributes to watershed water quality.

No aquatic biota studies have been conducted in Longnose Creek, Wetlegs Creek, or Second Creek, and no fish or macroinvertebrate community or habitat characteristics could be documented, although, like Yelp Creek, all are first-order streams within the vicinity of the NorthMet Project area.



Water Sampling Location
Embarrass River Watershed
Partridge River Watershed
Stream/River
Existing Railroad
Mine Site
Plant Site
Transportation and Utility Corridor

Minnesota Department of Natural Resources
US Army Corps of Engineers St. Paul District
Forest Service U.S. Department of Agriculture

This document is a working document. This document may change over time as a result of new information, further deliberation, or other factors not yet known to the Co-lead Agencies.

N W E S

0 0.5 1 2 3 Miles

Figure 4.2.6-2
Water Quality Sampling Locations within the Partridge River and Embarrass River Watersheds
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

222

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Table 4.2.6-4 Fish Species Collected at Nine Sites in the NorthMet Project Area

			Site								
			Upper Partridge River Watershed								Wyman Creek Watershed
Scientific Name	**Common Name**	**Tolerance Designation[1]**	**PR-B2[2]**	**PR-B3**	**PR-east[2]**	**PR-west[2]**	**PR-B1[3]**	**97LS077[3]**	**09LS105**	**USFS_SBPR[5]**	**81LS008**
Ameiurus melas	Black bullhead	Intermediate							X		X
Catostomus commersonii	White sucker	Tolerant	X	X	X	X	X	X	X	X	X
Moxostoma macrolepidotum	Northern shorthead redhorse	Intermediate							X		
Rhinichthys cataractae	Longnose dace	Intolerant	X	X			X	X	X		X
Luxilus cornutus	Common shiner	Intermediate	X		X		X				X
Etheostoma nigrum	Johnny darter	Intermediate	X		X		X	X		X	X
Hybognathus hankinsoni	Brassy minnow	Intermediate	X		X		X				
Lota lota	Burbot	Intermediate					X	X	X	X	X
Percina caprodes	Northern logperch	Intermediate							X		
Percopsis omiscomaycus	Troutperch	Intermediate							X		
Ambloplites rupestris	Northern rock bass	Intermediate							X		
Esox lucius	Northern pike	Intermediate					X	X	X	X	
Lepomis macrochirus	Bluegill	Intermediate							X		
Perca flavens	Yellow perch	Intermediate							X		X
Pomoxis nigromaculatus	Black crappie	Intermediate							X		
Sander vitreus	Walleye	Intermediate							X		
Phoxinus eos	Northern redbelly dace	Tolerant	X		X	X					X
Culaea inconstans	Brook stickleback	Intermediate	X		X	X					
Rhinichthys atratulus	Blacknose dace	Intolerant	X		X						
Semotilus atromaculatus	Creek chub	Tolerant									X
Margariscus margarita	Pearl dace	Intermediate	X		X						X
Noturus gyrinus	Tadpole madtom	Intermediate		X							
Umbra limi	Central mudminnow	Tolerant		X						X	
Pimephales promelas	Fathead minnow	Tolerant			X						
Cottus bairdii	Mottled sculpin	Intolerant						X		X	X
Study Year			2004	2004	2009	2009	2004	2009	2009	2011/2012/2014	2009
Species Observed			9	4	9	3	7	6	13	6	11

			Site								
			Upper Partridge River Watershed								Wyman Creek Watershed
Scientific Name	**Common Name**	**Tolerance Designation[1]**	**PR-B2[2]**	**PR-B3**	**PR-east[2]**	**PR-west[2]**	**PR-B1[3]**	**97LS077[3]**	**09LS105**	**USFS_SBPR[5]**	**81LS008**
# intolerant species			2	1	1	0	1	2	1	1	1
Total Abundance			267	11	1,847	19	36	68	155	12	64
IBI[4]			na	na	na	na	na	61	87	na	33
Predominant Substrate			boulder	silt	silt	silt	boulder	boulder	na	na	na

Sources: Breneman 2005; Barr 2011b; MPCA 2011c; MPCA 2013c; MDNR 1981; MDNR 2003, and USFS 2014.

Notes:
[1] Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates, and Fish - Second Edition EPA 841-B-99-002 (USEPA 2012b). Tolerance values indicate qualitative tolerances of physical and chemical disturbances.
[2] Federal parcel sites.
[3] South Branch Partridge River reference sites PR-B1 and 7LS077 are the same location.
[4] IBI is the sum of study specific metrics, where 0 represents the worst fish assemblage conditions and 100 represents the best fish assemblage conditions (USEPA 2011b).
[5] Results of one-pass electroshocking sampling in years 2011, 2012, and 2014. Summarized data is an average of three surveys combined.
-- = no designation assigned
na = Not available

Table 4.2.6-5 Fish Species Collected at Four Reaches Within the Partridge River Watershed

			Study Reach Fall 2014 MDNR Partridge River Watershed Fish Sampling			
Scientific Name	**Common Name**	**Tolerance Designation[1]**	**Reach 1**	**Reach 2**	**Reach 3**	**Reach 4**
Ameiurus melas	Black bullhead	Intermediate	X	X	X	
Ameiurus natalis	Yellow bullhead	Intermediate	X	X		
Ictalurus punctatus	Channel catfish	Tolerant		X		
Catostomus commersonii	White sucker	Tolerant	X	X	X	X
Rhinichthys atratulus	Blacknose dace	Intolerant				X
Rhinichthys cataractae	Longnose dace	Intolerant	X	X	X	
Moxostoma macrolepidotum	Northern shorthead redhorse	Intermediate		X		
Luxilus cornutus	Common shiner	Intermediate		X		
Etheostoma nigrum	Johnny darter	Intermediate			X	X
Hybognathus hankinsoni	Brassy minnow	Intermediate				
Lota lota	Burbot	Intermediate	X	X	X	
Percina caprodes	Northern logperch	Intermediate	X	X		
Ambloplites rupestris	Northern rock bass	Intermediate	X	X		
Esox Lucius	Northern pike	Intermediate	X	X	X	
Lepomis macrochirus	Bluegill	Intermediate	X	X		
Micropterus salmoides	Largemouth bass	Intermediate		X		
Perca flavens	Yellow perch	Intermediate		X		
Pomoxis nigromaculatus	Black crappie	Intermediate	X	X		
Sander vitreus	Walleye	Intermediate	X	X	X	
Phoxinus eos	Northern redbelly dace	Tolerant				
Culaea inconstans	Brook stickleback	Intermediate				X
Rhinichthys atratulus	Blacknose dace	Intolerant				
Semotilus atromaculatus	Creek chub	Tolerant				X
Margariscus margarita	Pearl dace	Intermediate				X
Noturus gyrinus	Tadpole madtom	Intermediate		X		

Scientific Name	Common Name	Tolerance Designation[1]	Study Reach Fall 2014 MDNR Partridge River Watershed Fish Sampling Reach 1	Reach 2	Reach 3	Reach 4
Umbra limi	Central mudminnow	Tolerant				
Pimephales promelas	Fathead minnow	Tolerant				
Cottus bairdii	Mottled sculpin	Intolerant				
Cottus spp.	Sculpin species	Unknown	X	X	X	
Study Year			2014	2014	2014	2014
Species Observed			12	18	8	6
# intolerant species			1	1	1	1

Source: Varian, MDNR, Pers. Comm., January 12, 2015.

Note:
[1] Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates, and Fish - Second Edition EPA 841-B-99-002 (USEPA 2012b). Tolerance values indicate qualitative tolerances of physical and chemical disturbances.

Macroinvertebrate Communities

Aerial photography review and habitat descriptions found in the various studies indicate the reference site (PR-B1) and the USFS Colvin Creek and South Branch Partridge River sites should have no effects from previous mining and quality habitat should exist for macroinvertebrate assemblages. The results of the 2011 macroinvertebrate studies indicate habitats for macroinvertebrate assemblages are just as good or better at the PR-B2 and PR-B3 Partridge River study sites as the percent Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) (%EPT) exhibited better results at the Partridge River sites and similar %Diptera results. The Hilsenhoff Biotic Index (HBI), which measures the pollution tolerance for various benthic macroinvertebrate families, exhibited a fair ranking for both sites, which indicates habitat degradations from biotic stressors are minimal and fair macroinvertebrate habitat exists. %EPT and %Diptera results are also similar to the 2004 results for sites PR-B2 and B3.

The results of the USFS studies indicate variable %EPT and %Diptera between three study years, but, in general, the results indicate %EPT scores on the high end. This indicates quality macroinvertebrate habitat likely exists at these sites. Comparing the generally high %EPT and low %Diptera results at the USFS sites with the 2011 studies indicates better habitat may be present at the USFS sites; however, the results may be indicative of differing sampling protocols or that the variability in sampling was absent for the one year effort in the 2011 studies.

Table 4.2.6-6 Composition of Macroinvertebrate Assemblages at Six Sites in the Federal Parcel

Name	Study Year	Site	No. of Samples	Total Taxa	Mean Abundance	%EPT[1]	%Diptera[2]	HBI Scale of 0 - 10[3]	HBI Ranking[3]
South Branch Partridge River (Breneman 2005)	2004	PR-B1	7	90	627	6	58	na	na
South Branch Partridge River (USFS 2014)	2011/ 2012/ 2013	USFS-SBPR	1/ 1/ 1	43/ 55/ 62	300/ 300/ 319	11/ 34/ 54	75/ 32/ 33	na	na
Partridge River (Breneman 2005)	2004	PR-B2	6	89	1,261	15	65	na	na
Partridge River (Breneman 2005)	2004	PR-B3	4	82	1,278	16	52	na	na
Partridge River (Barr 2011b)	2009	PR-west	5	27	710	19	66	6.4	Fair
Partridge River (Barr 2011b)	2009	PR-east	5	26	912	22	50.2	6.0	Fair
Partridge River (USFS 2014)	2011/2012/ 2013	USFS-PR	1/ 1/ 1	52/ 61/ 44	329/ 301/ 308	67/ 44/ 58	16/ 17/ 32	na	na
Second Creek	2011	SD026	na	36	2,534	72	47	na	na
Colvin Creek (USFS 2014)	2011/2012/ 2013	USFS-CCk	1/ 1/ 1	50/ 51/ 28	330/ 325/ 134	60/ 31/ 10	28/ 34/ 27	na	na

Sources: Data and functional group assignments from Breneman 2005, Barr 2011b, Barr 2011i, and USFS 2014.

Notes:

[1] %EPT indicates the percent of mayflies, stoneflies, and caddisflies within the macroinvertebrate sample. High EPT percentages of the population typically indicates degraded habitat conditions are not present.

[2] %Diptera indicates the percent of true flies and bloodworms present within the macroinvertebrate sample. High percentages of the population typically indicates low habitat diversity and predominant silty habitats often present within slow-moving, headwater streams.

[3] HBI is the measure of macroinvertebrate assemblages tolerance toward organic (nutrient) enrichment. Not calculated in Breneman 2005.

na = Not available

Freshwater Mussel Communities and Habitats at Survey Sites

Unionid mussels (*Unionidae*) constitute one of the most imperiled major taxa in the United States (Master et al. 2000), and the MCWCS identifies 26 unionid species within Minnesota as species of special concern. Two of these species, creek heelsplitter (*Lasmigona compressa*) and black sandshell (*Ligumia recta*), are known to exist in the St. Louis River Watershed (see Table 4.2.6-6), but were not identified in areas near the Mine Site. Heath (2011) sampled mussels at M1 and M2 in 2004 and at PR-upstream and PR-downstream in 2009 (see Figure 4.2.6-3). Only one mussel species was collected in the Partridge River Watershed, the giant floater (*Pyganodon grandis*) (see Table 4.2.6-7), which is a widely distributed feeding generalist, tolerant of silt-dominated substrate, and often found in lakes, ponds, or slow-moving water pools of small to medium-sized creeks and rivers (Cummins and Mayer 1992; Heath 2011).

Some of the unionid species known to exist in the St. Louis River Watershed were not collected by Heath (2011), including the creeper (*Strophitus undulatus*), plain pocketbook (*Lampsilis cardium*), white heelsplitter (*Lasmigona complanata*), and the black sandshell (see Table 4.2.6-7). The creeper, plain pocketbook, and white heelsplitter are typically found in larger streams (Cummins and Mayer 1992) and may only exist farther downstream in the drainage system. It is unlikely that the SGCN-designated black sandshell occurs in the NorthMet Project area given its absence from the sample sites. Habitat for this species (riffles or raceways in gravel or firm sand; Cummins and Mayer 1992) likely only exists in small reaches within the NorthMet Project area.

Other species known to exist in the St. Louis River Watershed, but also not collected by Heath (2011) at all stations included cylindrical papershell (*Anodontoides ferussacianus*) and creek heelsplitter. The SGCN-designated creek heelsplitter is found in sand and fine gravel substrates (Cummins and Mayer 1992). Sand and gravel were minor substrate type at the sites sampled and is therefore unlikely to exist in the Partridge River Watershed (see Table 4.2.6-8).

Table 4.2.6-7 Mussel Species Identified in the Lake Superior Basin, St. Louis River Watershed, Partridge River, and Embarrass River

		Location			
		Sietman (2003)		Heath (2004 and 2009)	
Scientific Name	**Common Name**	**Lake Superior Basin**	**St. Louis River Watershed**	**Partridge River[2]**	**Embarrass River[3]**
Elliptio complanata	Eastern elliptio	X	X		
Anodontoides ferussacianus	Cylindrical papershell	X	X		
Lasmigona complanata	White heelsplitter	X	X		
L. compressa[1]	Creek heelsplitter	X	X		
Pyganodon grandis	Giant floater	X	X	X	X
Strophitus undulatus	Creeper	X	X		
Utterbackia imbecillis	Paper pondshell	X			
Lampsilis cardium	Plain pocketbook	X	X		
L. siliquoidea	Fat mucket	X	X		X
Ligumia recta[1]	Black sandshell	X	X		

Source: Adapted from Heath 2011.

Notes:
1 Minnesota Species of Special Concern.
2 Partridge River sampling sites include M-1, M-2, PR-upstream, and PR-downstream; only one species was found between four sites.
3 Embarrass River only sampled by Heath as summarized in the Heath 2011 report.

Table 4.2.6-8 Location and Physical Characteristics of Mussel Sample Sites

Name	**Site**	**River Mile[1]**	**Mean Depth (cm)**	**Substrate Composition**
Partridge River	PR-upstream	25.0	250	100% detritus (peat)
Partridge River	PR-downstream	21.6	150	20% clay 80% detritus (peat)
Partridge River	M1	20.5	80	95% silt 5% boulder
Partridge River	M2	16.7	60	40% silt 30% boulder 15% coarse sand 15% fine sand
Trimble Creek	M3	na	20	50% gravel 50% coarse sand
Embarrass River	M4	na	60	20% boulder 20% rubble 20% coarse sand 20% fine sand 20% clay

Source: Modified from Heath 2011.

Notes:
1 River mile indicated is measured from the sample site to the Colby Lake inlet.
na = Not available

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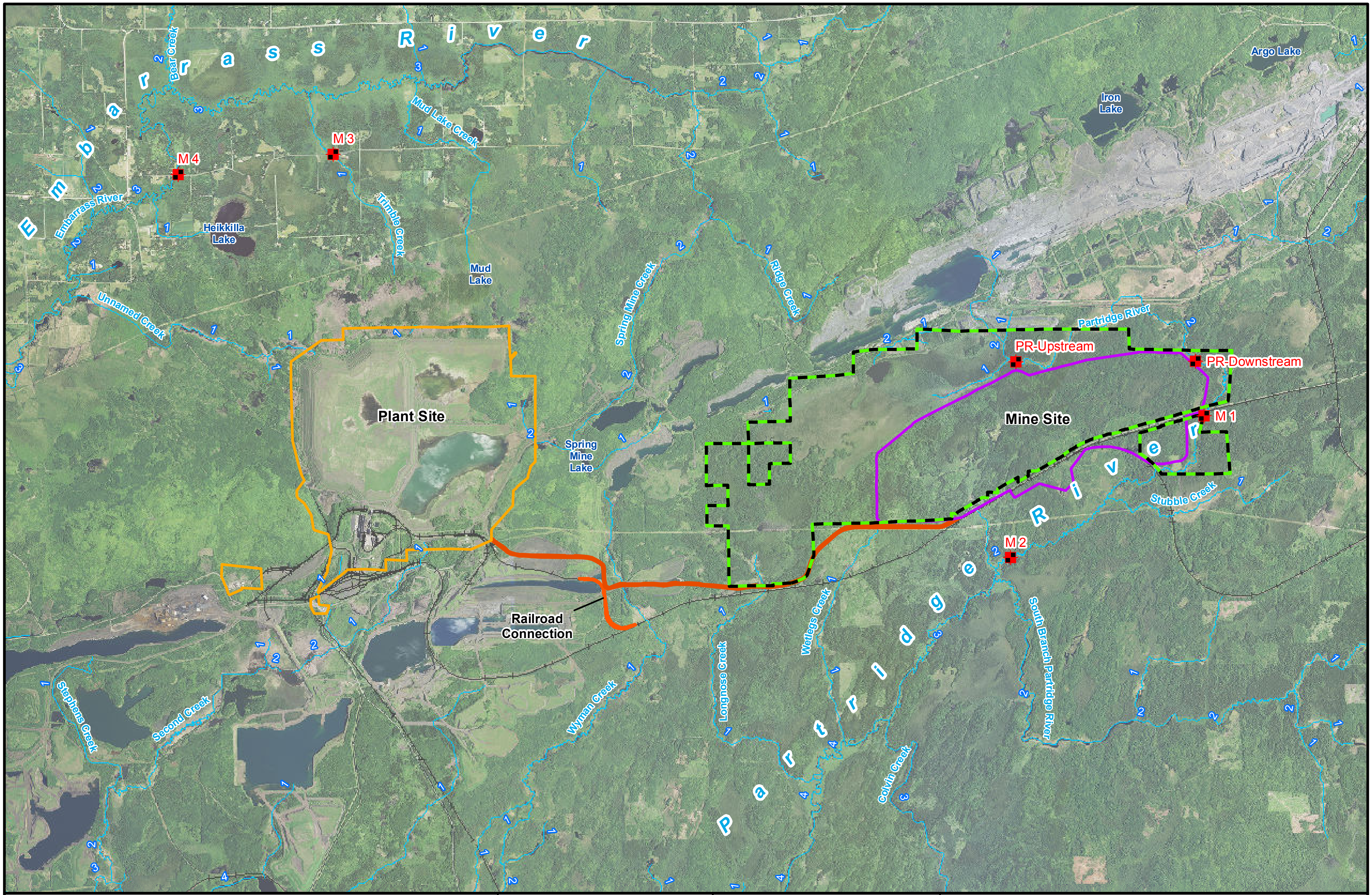

Federal Lands

Freshwater Mussel Sampling Site

Mine Site

Existing Railroad

Plant Site

Streams and Rivers

Trasportation and Utility Corridor

Stream Order Number

US Army Corps of Engineers St. Paul District

This document is a working document. This document may change over time as a result of new information, further deliberation, or other factors not yet known to the Co-lead Agencies.

N W E S

0 0.5 1 2 Miles

Figure 4.2.6-3

Freshwater Mussel Sampling Site Locations

NorthMet Mining Project and Land Exchange PFEIS

Minnesota

June 2015

311 -Page Intentionally Left Blank-

4.2.6.1.4 Special Status Fish and Macroinvertebrates

There are no federally listed or state-listed threatened or endangered fish or macroinvertebrate species known to occur in the Partridge River (USFWS 2011).

As with wildlife resources, assessment of fish and macroinvertebrates included consideration of the MCWCS (MDNR 2006d) and RFSS species. The MCWCS identifies SGCN by ecoregion subsections based on a statewide approach, and the RFSS species are identified for the potential to be found within the Superior National Forest. SGCN species identified in the Laurentian Uplands and Nashwauk Uplands, include two unionid mussel species (i.e., creek heelsplitter and black sandshell) and one species of fish (northern brook lamprey, *Ichthyomyzon fossor*), but these species were not found in the NorthMet Project area, though there is potential habitat for these species. These species also are listed by the state as species of special concern and the USFS as RFSS. In addition to the creek heelsplitter and the black sandshell, USFS also lists seven other species as RFSS for Superior National Forest, including three insects and four fish (see Table 4.2.6-9). Each of these RFSS species are briefly described below. No invasive fish or macroinvertebrate species are known to exist within the federal parcel.

Table 4.2.6-9 SGCN and RFSS Species Identified Within Portions of the Laurentian Uplands – Nashwauk Uplands Ecoregion or Superior National Forest

Scientific Name	Common Name	Laurentian and Nashwauk Uplands Ecoregion SGCN	RFSS
Insects			
Chilostigma itascae	Headwaters chilostigman caddisfly		X
Somatochlora brevicincta	Quebec Emerald		X
Williamsonia flechen	Ebony boghaunter		X
Fish			
Acipenser fulvescens	Lake sturgeon		X
Coregonus nipigon	Nipigon cisco		X
Coregonus zenithicus	Shortjaw cisco		X
Ichthyomyzon fossor	Brook lamprey	X	X
Mussels			
Lasmigona compressa	Creek heelsplitter	X	X
Ligumia recta	Black sandshell	X	X

Sources: MDNR 2006d and USFS 2012f.

<u>Headwaters Chilostigman Caddisfly</u>

This species of caddisfly has only been discovered in two locations within Minnesota where it is also listed as a state endangered species. In 1994, it was documented in a slow-moving, silt-dominated headwater stream in Itasca State Park and in 2005 in rich swamp to poor fen habitats within a large, acid to minerotrophic peatland complex in Finland State Forest (MDNR 2011n). Little is known about the headwaters chilostigman caddisfly. Headwater habitats are present at the Mine Site; however, since the distribution of this caddisfly appears to be very limited, it is unlikely to occur in the NorthMet Project area.

Quebec Emerald

The Quebec emerald dragon fly occurs in lentic habitats typically associated with bogs, fens, and heaths near water-saturated or water-suspended sphagnum (USFS 2007a). This species has been found within the Superior National Forest. Little distribution information is known regarding this species due to lack of completed surveys. The known required habitat is likely present within the federal parcel near the bogs associated with the headwater stream, Yelp Creek; however, this species was not found in the benthic macroinvertebrate surveys. The likelihood of observing Quebec emerald individuals or populations in the vicinity of the federal parcel and Mine Site is low.

Ebony Boghaunter

The ebony boghaunter shares a similar habitat description with the headwaters chilostigman caddisfly described above; however, the distribution is likely more widespread than the caddisfly (MDNR 2011n). Habitat likely exists for this species in the NorthMet Project area in sphagnum dominated bogs; however, this species has not been identified in the benthic macroinvertebrate surveys conducted to date.

Lake Sturgeon

The lake sturgeon is a large fish that is broadly distributed throughout the Mississippi River, Great Lakes, and Hudson Bay drainages (Scott and Crossman 1973a; Wilson and McKinley 2005). Lake sturgeon typically inhabit large lakes and rivers and are usually found in waters that are 15 to 30 ft deep (Wilson and McKinley 2005). Spawning takes place in swift-flowing water 2 to 15 ft in depth, often at the base of a low waterfall that blocks further migration upstream (Scott and Crossman 1973a). The species has been classified as threatened in both Canada and the United States by a special committee of the American Fisheries Society (Williams et al. 1989) and is a species of special concern in Minnesota.

Historically, lake sturgeon migrated approximately 14 miles upriver from Lake Superior in the St. Louis River (Auer 1996). Spawning occurred between the falls near Fond du Lac, which formed a natural barrier to upstream migration, and Bear Island located a few miles downstream (Goodyear et al. 1982; Kaups 1984; Schram et al. 1999). The lake sturgeon was extirpated from the St. Louis River during the early 1900s (Schram et al. 1999).

The St. Louis River currently is one of 17 tributaries to Lake Superior identified by the Great Lakes Fishery Commission as a priority stream where lake sturgeon rehabilitation should be focused, and the St. Louis is one of only six rivers identified by the Great Lakes Fisheries Commission as a priority for lake sturgeon stocking (Auer 2003). A stocking program was initiated in 1983 to reintroduce lake sturgeon to the St. Louis River; however, stocking was reduced in 1995 and discontinued in 2000 (MDNR 1995). The stocking has resulted in an increase in lake sturgeon abundance in the St. Louis River estuary near Duluth (Schram et al. 1999). Two separate observations of juvenile lake sturgeon were observed by Fond du Lac and MDNR biologists near the Fond du Lac dam in 2011 and 2014, respectively, which indicates recruitment from naturally reproducing adult lake sturgeon, since no stocking has occurred below the dam since 2000 (Varian, MDNR, Pers. Comm., November 7, 2014). Fond du Lac has stocked lake sturgeon into the St. Louis River above the Fond du Lac dam near the confluence with the Cloquet River and within the Cloquet River near Independence, Minnesota. Fond du Lac has 2012 through 2014 lake sturgeon telemetry data, which indicates juvenile and adult sturgeon have been located near Floodwood, Minnesota, downstream from the confluence of the Whiteface River and St. Louis River (Varian, MDNR, Pers. Comm., January 12, 2015). No fish have been observed upstream of this location and migration of lake sturgeon from this location would be blocked by the dam at Forbes, Minnesota, approximately 14 miles downstream of the Embarrass River confluence with the St. Louis River.

There are no known occurrences of lake sturgeon and no likely habitat for lake sturgeon within the NorthMet Project area (USFS 2015a).

Nipigon Cisco

The nipigon cisco is found in waters of Lake Nipigon, Black Sturgeon Lake, Saganaga Lake, and other lakes of northwest Ontario and Quebec (Hubbs and Lagler 2007). Saganaga Lake is the only lake in this list shared with Minnesota and Ontario and is a deep, oligotrophic lake covering approximately 13,800 acres (MDNR 2011d). There are no known occurrences or likely habitat for nipigon cisco within the NorthMet Project area.

Shortjaw Cisco

Formerly found in deep waters of several of the Great Lakes (Scott and Crossman 1973c), the shortjaw cisco has been eliminated from Lakes Erie, Huron, and Michigan and is in decline in Lake Superior (COSEWIC 2003). The species is also found in Gunflint and Saganaga lakes (MDNR 2006d), which are two of the deepest natural lakes in Minnesota. Invasive species, habitat degradation, and competition or predation may be factors that are limiting recovery (Pratt and Mandrak 2007). There are no known occurrences or likely habitat for shortjaw cisco within the NorthMet Project area.

Northern Brook Lamprey

The northern brook lamprey is a small, nonparasitic, jawless fish. This species' typical habitat is creeks and small rivers, apparently avoiding small brooks and large rivers (Scott and Crossman 1973b). There are no known occurrences of this species in or near the NorthMet Project area. Cochran and Pettinelli (1987) identified northern brook lamprey at a site south of Cloquet, Minnesota, approximately 75 miles south of the NorthMet Project area. Since 1986, it has been collected from six other sites in the Lake Superior drainage (Hatch et al. 2003). Suitable habitat for northern brook lamprey is likely to exist in the NorthMet Project area; however, the nearest known occurrence of this species is far removed from the NorthMet Project area.

Freshwater Mussels

No special freshwater mussel species were observed during the mussel surveys described in Heath (2011). As discussed above, it is unlikely the habitats required for the black sandshell exist in the vicinity of the NorthMet Project area. The habitat for the creek heelsplitter likely exists in portions of the NorthMet Project area, but no creek heelsplitter mussels have been identified in 2 years of baseline survey efforts.

4.2.6.2 Whitewater Reservoir and Colby Lake

This section describes the aquatic resources found in Colby Lake and Whitewater Reservoir. Colby Lake and Whitewater Reservoir are the two lentic (standing) waterbodies potentially affected by water discharges and withdrawals associated with the NorthMet Project Proposed Action. The Partridge River flows through Colby Lake. Whitewater Reservoir is hydraulically connected to Colby Lake by a diversion works, and water moves between the two waterbodies either by controlled gravity-fed flow or by pumps, depending on the relative water levels in the two lakes (see Section 4.2.2 for more details).

Colby Lake is a Class 11 lake with a surface area of 539 acres and a littoral (water depth up to 15 ft) area of 377 acres. Maximum depth is 30 ft. In the most recent habitat characterization, the dominant littoral substrates were boulders (diameter greater than 10 inches), rubble (diameter 3 to 10 inches), and gravel (size unspecified) (MDNR 2010c). Aquatic plants were moderately abundant, dominated by water lilies (*Nympheadeae*), pondweed (*Potamogeton* sp.), and water shield (*Brasenia schreberi*). Average Secchi depth was 2 ft, and submersed plants grew to a maximum depth of 6 ft. The non-native curly-leaf pondweed (*Potamogeton crispus*) was found in the west end of the lake. During the most recent fisheries survey conducted in July 2010 (MDNR 2010c), surface water temperature was 76^{o}F, and the bottom temperature was 53^{o}F. Oxic water (dissolved oxygen concentration greater than 2 parts per million [ppm]) supporting fish extended to a depth of 15 ft where the temperature was 62^{o}F. A heated water plume (greater than or equal to 100^{o}F at the surface) extended from the Laskin Energy Center power plant discharge.

Fish species collected in Colby Lake through the latest July 2010 survey are listed in Table 4.2.6-10. The latest survey found species typically found in a lake Class 11 fish community assemblage, with one exception. Channel catfish were abundant in Colby Lake, which is unique for Class 11 lakes. Channel catfish, by weight, were the most abundant fish sampled in 2010. There was a low-density, quality-sized population of northern pike and a representative array of panfish species including bluegill, black crappie, and yellow perch. Historically, the walleye population has been highly variable. The 2010 catch was the lowest on record and below the 25^{th} percentile value for lake Class 11. There is an MDH consumption advisory for fish in Colby Lake due to high levels of mercury.

Whitewater Reservoir is a Class 7 lake that encompasses a total surface area of 1,210 acres and a littoral area of 564 acres with a maximum depth of 73 ft. The dominant littoral substrate was gravel, rubble, and sand during the most recent habitat characterization (MDNR 2007c). Aquatic plants were moderately abundant along the shore and in shallow bays. The dominate taxa were cattails (*Typha* sp.), sedges (*Cyperaceae*), northern milfoil (*Myriophyllum sibericum*), and pondweed. Average Secchi depth was 12 ft, and submersed plants grow to a maximum water depth of 8 ft. During the more recent MDNR fisheries survey in mid-August 2012, the surface water temperature was 73^{o}F, and the bottom water temperature was 47^{o}F. Oxic water extended to a depth of 23 ft where the water temperature was 69^{o}F.

Walleye were introduced to the reservoir following impoundment in 1955, and stocking continued through 1984. Fish species collected in the Whitewater Reservoir by the MDNR surveys are listed in Table 4.2.6-10. The fish population in 2012 was dominated by walleye, northern pike, and bluegill and the total gillnet catch for each was above average among similar lake classes in northeast Minnesota that share similar ecological characteristics (MDNR 2012m). As is the case for Colby Lake, Whitewater Reservoir contains a similar MDH consumption advisory for fish due to high levels of mercury. Colby Lake water quality is summarized in Section 4.2.2, which identifies water quality exceedances for aluminum, iron, and manganese, which is believed to be naturally occurring. Both Colby Lake and Whitewater Reservoir are listed on the Minnesota 303(d) TMDL list because of high mercury concentrations in fish tissue.

Table 4.2.6-10 Fish Species Collected in Colby Lake and Whitewater Reservoir by MDNR Fisheries Surveys[1]

Scientific Name	Common Name	Colby Lake[2]	Whitewater Reservoir[3]
Ameiurus melas	Black bullhead		X
Pomoxis nigromaculatus	Black crappie	X	X
Lepomis macrochirus	Bluegill	X	X
Ameiurus nebulosus	Brown bullhead		X
Lota lota	Burbot		X
Ictalurus punctatus	Channel catfish	X	
Luxilus cornutus	Common shiner	X	
Lepomis hybrids	Hybrid sunfish		X
Micropterus salmoides	Largemouth bass	X	X
Esox lucius	Northern pike	X	X
Lepomis gibbosus	Pumpkinseed	X	X
Ambloplites rupestris	Rock bass	X	X
Moxostoma macrolepidotum	Shorthead redhorse	X	X
Notropis hudsonius	Spottail shiner	X	
Sander vitreus	Walleye	X	X
Catostomus commersonii	White sucker	X	X
Ameiurus natalis	Yellow bullhead	X	
Perca flavescens	Yellow perch	X	X

Notes:
[1] Collection methods included gillnets, trapnets, and shoreline seining.
[2] Surveys conducted in 1968, 1985, 2005, 2010, and 2012.
[3] Ten surveys conducted post-impoundment, 1967-2002.

Little information exists on the macroinvertebrate assemblages of Colby Lake and Whitewater Reservoir. Sampling conducted in many lakes in the region (including Colby and Whitewater) as part of the MEQB Regional Copper-Nickel Study (MEQB 1979) found that nearly all of the taxa collected in the littoral zone of lakes were also collected in the streams of the region. The littoral zone of the lakes had a more diverse macroinvertebrate fauna than did the profundal (deep water) zone. Gastropods (snails) were collected from the littoral zone of Colby Lake and pelecypods (clams) were collected from the profundal zone (Johnson and Lieberman 1981). The most frequently collected and most abundant taxa collected from the profundal zone of Colby Lake were the phantom midge (*Chaoborus* sp.), a mayfly species (*Hexagenia limbata*), and two midge taxa (*Procladius* sp. and *Chironomus* sp.), similar to other lakes of the region and are characteristic of good water quality (Johnson and Lieberman 1981).

4.2.6.3 Embarrass River Watershed

This section describes the aquatic resources found within the Embarrass River Watershed portion of the NorthMet Project area.

4.2.6.3.1 Surface Water Features

Surface water features within the Embarrass River Watershed and within the NorthMet Project area include the Embarrass River and several of its tributaries draining the existing LTVSMC

Tailings Basin including the first-order streams Mud Lake Creek, Trimble Creek, and Unnamed Creek. Mud Lake Creek and Trimble Creek originate from the wetlands and bogs to the north and northwest of the existing LTVSMC Tailings Basin, respectively. Unnamed Creek originates from the northwest corner of the existing LTVSMC Tailings Basin.

Aerial photograph review of these streams indicates a mix of disturbed and vegetated riparian buffers with human impact effects on the landscape and stream courses apparent. Major channel habitat and substrate characteristics for these streams are summarized in Table 4.2.6–11. Study locations are included in Figure 4.2.6-1.

Table 4.2.6-11 Major Channel Characteristics at a Biological and Habitat Survey Stations for Streams within the Vicinity of the Plant Site

	Location	Channel Characteristics						
Water Body/ Reference	**Site**	**Stream Order**	**Catchment (mi^2)**	**Dominant Substrate**	**Width (cm)**	**Depth (cm)**	**Velocity (m^3/s)**	**QHEI[1]**
Trimble Creek (Breneman 2005)	B6[2]	1	7.4	Sand and Silt	190	58.70	0.10	65
Trimble Creek (Barr 2011b)	PM-19[2]	1	--	Sand and Silt	250[(3)]	53.3[(3)]	0.09	46
Unnamed Creek (Barr 2011b)	PM-11	1	--	Muck and detritus	183	58	0.08	59
Spring Mine Creek	PM-12.1	1	--	Sand and detritus	213[(3)]	29[(3)]	0.01[(3)]	--

Sources: Adapted from Breneman 2005, Barr 2011b, Barr 2011i, Barr 2011m. Referenced from Figure 4.2.6-1.

Notes:
[1] QHEI (Rankin 1989) is designed to provide an integrated evaluation of physical habitat characteristics important to fish communities and ranges from 0 (low) to 100 (high).
[2] Sample sites B-6 and PM-19 are the same sampling location; however, data was collected in separate years during different studies.
[3] Averaged between two study dates (September 2010 and June 2011).

4.2.6.3.2 Existing Water Quality

Water quality sampling has occurred at PM-12 (upstream of all mining influences); PM-12.1 (on Spring Mine Creek); PM-12.2, PM-12.3, and PM-12.4 (between PM-12 and PM-13), and PM-13 (downstream of all NorthMet Project Proposed Action influences), as well as three tributary streams that drain the existing LTVSMC Tailings Basin (Mud Lake Creek, Trimble Creek, and Unnamed Creek) (see Figure 4.2.6-2 and Section 4.2.2.3.2 for additional sample information). Water quality evaluation criteria exceedances were found for aluminum and mercury at most locations, and elevated concentrations for sulfate, especially at Spring Mine Creek. The Embarrass River, from its headwaters to Embarrass Lake, and Spring Mine Creek, from Ridge Creek to the Embarrass River, are both included on the 2012 TMDL list for aquatic life based on Fishes Bioassessment and, in the case of Spring Mine Creek, also aquatic macroinvertebrate bioassessment. Section 4.2.2 describes the water quality of the Embarrass River in more detail.

Table 4.2.6-12 Average Existing Water Quality Concentrations in the Embarrass River

Parameter	Units	Evaluation Criteria[1]	PM-12	PM-12.1	PM 12.2	PM-12.3	PM-12.4	PM-13
General								
Chloride	µg/L	230	4.7	2.5	3.4	4.7	5.0	5.8[3]
Specific Conductivity	umhos/cm	NA	138	980	490	263	264	258
TDS	mg/L	700	130	521	-	-	-	210
Temperature	ºC	-	10.6	9.1	10.7	10.7	10.6	11.3
Metals								
Aluminum	µg/L	125	99.8	57.4	80.2	**130**	122	**188**
Antimony	µg/L	31	0.51	0.25	-	-	-	0.53
Arsenic	µg/L	53	1.6	0.38	-	-	-	1.2
Boron	µg/L	500	24.0	37.7	-	-	-	32.7
Cadmium	µg/L	2.5[2]	0.094	0.055	-	-	-	0.10
Cobalt	µg/L	5	1.0	0.10	-	-	-	0.46
Copper	µg/L	9.3[2]	1.1	0.61	-	-	-	1.4
Lead	µg/L	3.2[2]	0.26	0.15	-	-	-	0.28
Mercury	ng/L	1.3	**5.1**	**4.8**	-	-	-	**4.3**
Nickel	µg/L	52[2]	1.4	1.2	-	-	-	1.5
Selenium	µg/L	5	0.87	0.10	-	-	-	0.76
Silver	µg/L	1	0.20	0.10	-	-	-	0.21
Sulfate	mg/L	10[4]	7.2	**388**	**131**	**50.2**	**42.8**	**39.4**[5]
Thallium	µg/L	0.56	0.19	0.10	-	-	-	0.20
Vanadium	µg/L	NA	1.5	-	-	-	-	1.5
Zinc	µg/L	120[2]	9.5	3.0	-	-	-	7.9

Source: Barr 2014d.

Notes:
Bold font indicates exceedance of the Class 2B water quality standards evaluation criteria.
2010 data not collected for all parameters. Includes non-detects at half the detection limit.
1 Section 5.2.2 includes a detailed discussion of evaluation criteria.
2 Water quality standard for this metal is hardness-dependent. Listed value assumes a concentration of 100 mg/L.
3 Excludes single outlier value of 94.8 mg/L from November 8, 2006.
4 MPCA has listed the waters within and downstream from Embarrass Lake, the northernmost tip of Wynne Lake, and the segment of the Embarrass River from Sabin Lake to the Highway 135 bridge as waters used for the production of wild rice, so the 10 mg/L sulfate standard is only applicable to that portion of the Embarrass River (PM-13).
5 Excludes 688 mg/L value from November 8, 2006.

4.2.6.3.3 Aquatic Biota Studies

Breneman (2005) collected fish and macroinvertebrate community information at three sites in the Embarrass River Watershed. Fish and macroinvertebrate data were also collected by Barr at Spring Mine Creek, Trimble Creek, and Unnamed Creek. The results of these sampling events are summarized in Tables 4.2.6-13 and 4.2.6-14.

<u>Fish Communities</u>

Sampling location PM-20 (Bear Creek) was used for a reference or control study site to compare results for aquatic biota sampling locations PM-12.1 (Spring Mine Creek), PM-19 (Trimble Creek), and PM-11 (Unnamed Creek). As part of an additional study, aquatic biota data was collected from two additional sites on Unnamed Creek (B-5 and B-7) and a resampling of the Trimble Creek site (B-6). The MPCA also conducted aquatic biota studies for five locations, one of which was also conducted on Bear Creek near PM-20. A limited number of pollution-intolerant fish were identified among the various sample locations, including the Bear Creek control site. One pollution-intolerant species was found at Spring Mine Creek and one was identified at an Embarrass River sampling location. IBI scores ranged from moderate to poor for the various sampling locations, indicating impairment for aquatic life within these study reaches. Aerial photograph review of the B-5, B-6, and B-7 sampling sites exhibits a mix of disturbed and vegetated riparian buffers with human impact effects in the wetland landscape and stream courses, which likely limits the quality and diversity of the fish habitat present at these locations. Muck and silt were listed as dominant substrates within most of sample locations, which is consistent with headwater stream characteristics in the region. Sampling location PM-12.1 was located within a second-order section of Spring Mine Creek where sand and detritus were the dominant substrate.

553 ***Table 4.2.6-13 Fish Species Collected at Sampling Sites within the Vicinity of the Plant Site and Transportation and Utility Corridor***

Scientific Name	Common Name	Tolerance Designation[1]	Bear Creek		Unnamed Creek			Trimble Creek		Spring Mine Creek			Embarrass River				
			PM-20	**09LS098**	**PM-11**	**B-7**	**B-5**	**PM-19[2]**	**B-6[2]**	**09LS101**	**09LS101**	**PM-12.1**	**10EM045**	**10EM045**	**97LS005**	**97LS005**	**09LS100**
Catostomus commersonii	White sucker	Tolerant	X	X	X	X		X	X	X	X	X	X	X	X	X	X
Luxilus cornutus	Common shiner	Intermediate				X				X		X			X	X	
Notemigonus crysoleucas	Golden shiner	Tolerant	X	X											X	X	
Lota lota	Burbot	Intermediate		X				X	X	X	X	X			X	X	X
Margariscus margarita	Pearl dace	Intermediate									X	X					
Phoxinus eos	Northern redbelly dace	Intermediate			X	X	X		X							X	
Phoxinus neogaeus	Finescale dace	Intermediate				X	X										
Pimephales promelas	Fathead minnow	Tolerant				X	X										
Etheostoma nigrum	Johnny darter	Intermediate	X	X				X				X			X	X	
Perca flavens	Yellow perch	Intermediate										X	X		X	X	
Esox lucius	Northern pike	Intermediate	X	X										X	X		X
Culaea inconstans	Brook stickleback	Intermediate			X	X	X		X	X	X					X	
Umbra limi	Central mudminnow	Tolerant	X	X	X	X	X	X	X	X	X	X				X	X
Semotilus atromaculatus	Creek chub	Tolerant			X	X		X	X	X	X	X					
Ambloplites rupestris	Rock Bass	Intermediate		X									X		X	X	
Notropis heterolepis	Blacknose Shiner	Intolerant								X	X				X		
Ameiurus melas	Black Bullhead	Intermediate		X													X
Study year			2010	2009	2010	2004	2004	2010	2004	2009	2009	2010	2009	2010	1997	1997	2009
Species observed			5	8	5	8	5	5	6	7	7	8	3	2	9	10	5
# intolerant species[3]			0	0(1)	0	0	0	0	0	1(2)	1(2)	0	0	0	1(2)	0(1)	0(1)
Total Abundance			20	38	121	441	222	13	67	88	22	21	6	8	35	97	31
IBI[4]			--	43	--	--	--	--	--	37	37	--	0	0	50	54	31
Substrate			Muck and detritus	--	Muck and detritus	--	--	Sand and silt	Silt	--	--	Sand and detritus	--	--	--	--	--

554 Sources: Breneman 2005, Barr 2011b, and MPCA 2011c.

555 Notes:
556 [1] Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates, and Fish - Second Edition EPA 841-B-99-002 (USEPA 2012b). Tolerance values indicate qualitative tolerances of physical and chemical disturbances.
557 [2] Sample sites PM-19 and B-6 are the same sampling location; however, data was collected in separate years during different studies.
558 [3] Number in parentheses represents MPCA classification (MPCA 2011c).
559 [4] IBI is the sum of study specific metrics where 0 represents the worst fish assemblage conditions and 100 represents the best fish assemblage conditions (USEPA 2011b).

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Macroinvertebrate Communities

The assemblages observed in the survey are typical of those sampled elsewhere in the northeast region of Minnesota (Breneman 2005). Total taxa, abundance, %EPT, and %Diptera totals are quite variable among the sites. Most sampling locations exhibited significant percentages of stonefly, mayfly, and caddisfly populations, which, unlike the fish community data, indicate desirable, non-degraded stream characteristics are likely present. Study sites PM-12.1 and PM-19 exhibited 44 and 41 percent EPT, respectively, which indicated some riffle/run habitat was likely present, although this was not reflected from the substrate data provided in Table 4.2.6-13 or at least was not a dominant habitat within the study stretch. The HBI scores exhibited variable results, indicating fair to good macroinvertebrate habitat was present within these study stretches. The exception to these results was the impairment for invertebrate life in Spring Mine Creek, which resulted in the MPCA listing of "Impaired" in 2012.

Table 4.2.6-14 Composition of Macroinvertebrate Assemblages for Sites in the Embarrass River Watershed

Name	Year	Site	Total Taxa	Abundance	%EPT[1]	%Diptera[2]	HBI[3]	IBI[4]
Embarrass River wetland (upstream)	2004	B-5	54	2,529	17	47	--	--
Embarrass River	1997	97LS005	21	--	--	8	2.7	55
Embarrass River	2009	97LS005	31	--	--	25	5.7	69
Embarrass River	2009	10EM045	21	--	--	8	2	39
Embarrass River	2010	10EM045	16	--	--	9	1.3	41
Embarrass River	2009	09LS100	24	--	--	29	3.7	61
Spring Mine Creek	2009	09LS101	20	--	--	23	5.7	46
Spring Mine Creek	2010	PM-12.1	33	2,494	44	20	5.3	--
Trimble Creek	2004	B-6[5]	64	654	0.5	27	--	--
Trimble Creek	2010	PM-19[5]	36	6,998	42	49	5.5	--
Unnamed Creek	2004	B-7	37	1,549	2	65	--	--
Unnamed Creek	2010	PM-11	22	2,484	31	25	6.5	--
Bear Creek	2009	09LS098	25	--	--	21	4.3	67
Bear Creek	2010	PM-20	32	2,787	24	30	6.4	--

Sources: Data and functional group assignments from Breneman 2005, Barr 2011b, Barr 2011i, Barr 2011m, Barr 2011n, and MPCA 2011c.

Notes:
[1] %EPT indicates the percent of mayflies, stoneflies, and caddisflies within the macroinvertebrate sample. High EPT percentages of the population typically indicates degraded habitat conditions are not present.
[2] %Diptera indicates the percent of true flies and bloodworms present within the macroinvertebrate sample. High percentages of the population typically indicates low habitat diversity and predominant silty habitats often present within slow-moving, headwater streams.
[3] HBI is the measure of macroinvertebrate assemblages tolerance toward organic (nutrient) enrichment. Decreasing values indicate improving biotic condition. Higher values indicate fewer biological stressors (scale of 100).
[4] IBI derived by the MPCA (MPCA 2011c).
[5] Sample sites B-6 and PM-19 are the same sampling location; however, data was collected in separate years during different studies.

4.2.6.3.4 Special Status Fish and Macroinvertebrates

No special status fish or macroinvertebrates are known to occur within the Embarrass River Watershed, although the same potential SGCN, federal, and RFSS special status species described for the Partridge River Watershed would also apply to these areas. Suitable habitat is likely present for the same species discussed in Section 4.2.6.1.4.

No invasive fish or macroinvertebrate species are known to occur within the Embarrass River or its tributaries near the Plant Site.

4.2.6.4 Mercury Concentrations in Fish

As discussed in Section 4.2.2, Section 303(d) of the CWA requires states to publish a list of waters that are not meeting one or more water quality standards. The Partridge River is not listed as an impaired water body for mercury on the 303(d) list; however, fish tissue mercury concentrations in the Partridge River were indicative of an impaired waterbody (See Table 4.2.6-15). It should be noted that these data only represent one sampling event and may not be representative of the overall fish tissue mercury concentrations within the Partridge River Watershed.

Most of the St. Louis River is listed for "mercury in fish tissue" impairment. Similarly, the Embarrass River is not on the 303(d) list for mercury; however, several lakes downstream of the NorthMet Project area (within the Chain of Lakes), through which the Embarrass River flows, are listed for "mercury in fish tissue" impairment. It should be noted that portions of the Embarrass River, from the headwaters to Embarrass Lake, are listed on the 303(d) list as impaired for "Fishes Bioassessment," a category not related to mercury. Fish consumption advisories have been issued for "mercury in fish tissue" impaired waters by the MDH to provide site-specific consumption guidance on the quantity and frequency of fish species consumed. For waters not listed on the 303(d) list for "mercury in fish tissue," statewide consumption advisories still apply because these waters have not been tested and it is assumed that fish within these waters could potentially contain mercury in sufficient quantities to warrant a consumption advisory. Table 4.2.2-2 provides a summary of impaired waters within the Embarrass River and Partridge River watersheds.

Table 4.2.6-15 Mercury Concentrations in Fish Species Collected During 2014 MDNR Partridge River Fish Surveys

Sample Size	Scientific Name	Common Name	Mercury (ppm)
6	*Perca flavescens*	Yellow Perch	**0.25**[(1)]
4	*Catostomus commersonii*	White Sucker	0.16
6	*Sander vitreus*	Walleye	**0.63**[(1)]
8	*Esox lucius*	Northern Pike	**0.62**[(1)]

Source: Varian, MDNR, Pers. Comm., January 12, 2015.

Note:
Bold values indicate mercury concentrations in fish that are indicative of impaired waters (MPCA 2014).
[1] Mercury concentrations above 0.2 ppm indicate an impaired water (MPCA 2014).

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4.2.7 Air Quality

The NorthMet Project Proposed Action is subject to various federal and State of Minnesota air quality regulations. These regulations are designed to protect the general climate and air quality within the affected region of the NorthMet Project area. The USEPA has promulgated National Ambient Air Quality Standards (NAAQS) for seven common pollutants found in the ambient air, known as "criteria" pollutants. These standards are designed to ensure human and environmental health criteria are met for the ambient air quality. Minnesota has also promulgated Minnesota Ambient Air Quality Standards (MAAQS) to further protect human health. Minnesota has been granted air permitting authority by the USEPA, so the NorthMet Project Proposed Action would be issued a single permit by the MPCA.

The affected region can vary depending upon the specific regulations and the federal and state jurisdictions. For the purpose of this section, the extent of the affected region would be bounded by the Federal Land Managers' (FLMs') request to assess effects for all USEPA-defined Class I areas within a 300-kilometer (km) radius of the NorthMet Project area. The remainder of this section summarizes the regional climate, local meteorology, and the existing ambient air quality for the affected region.

4.2.7.1 Regional Climate and Meteorology

The climate for the NorthMet Project area and Minnesota, in general, is defined as continental. The region is subject to continental polar air masses throughout most of the year and, during the cold season, is subject to more frequent Arctic air masses. During the summer months, the southern portion of the state gives way to warm air entering northward from the Gulf of Mexico. As Pacific Ocean air masses move across the western United States, relatively mild and dry weather can be observed throughout the year, depending upon the strength of the air mass.

Based upon surface data taken at the Hibbing Monitoring Station (see Figure 4.2.7-1), predominant winds are from the north-northwest through west-northwest, occurring approximately 25 percent of the time. Winds from the south-southeast through southeast show a secondary predominance, occurring approximately 15 percent of the time. Average monthly temperatures range from 4^{o}F in the coldest month (January in northwest Minnesota) to 85^{o}F in the hottest month (July in southwest Minnesota). Mean annual temperatures range from 36^{o}F in the extreme north to 49^{o}F in the southeast along the Mississippi River. Extreme temperatures throughout the state can vary from 114^{o}F in the summer to -60^{o}F in the winter (NCDC 2010). During the three coldest months (December through February), maximum daily temperatures are below 32^{o}F for 24 days per month. Temperatures in the summer months rarely reach maximum temperatures above 90^{o}F (only 5 to 6 days per year).

Approximately two-thirds of the precipitation occurs between May and September, with annual precipitation ranging from 35 inches in the southeast and gradually decreasing to 19 inches in the extreme northwest. Northeastern Minnesota generally receives approximately 70 inches of snow per year, decreasing to 40 inches per year near the south and eastern border states. Snow cover occurs in Minnesota an average of 110 days per year with 1 inch or more on the ground, although there is a marked difference between the northern (where the NorthMet Project area is located) and southern portions of the state, ranging from 140 days per year to 85 days per year of snow cover, respectively.

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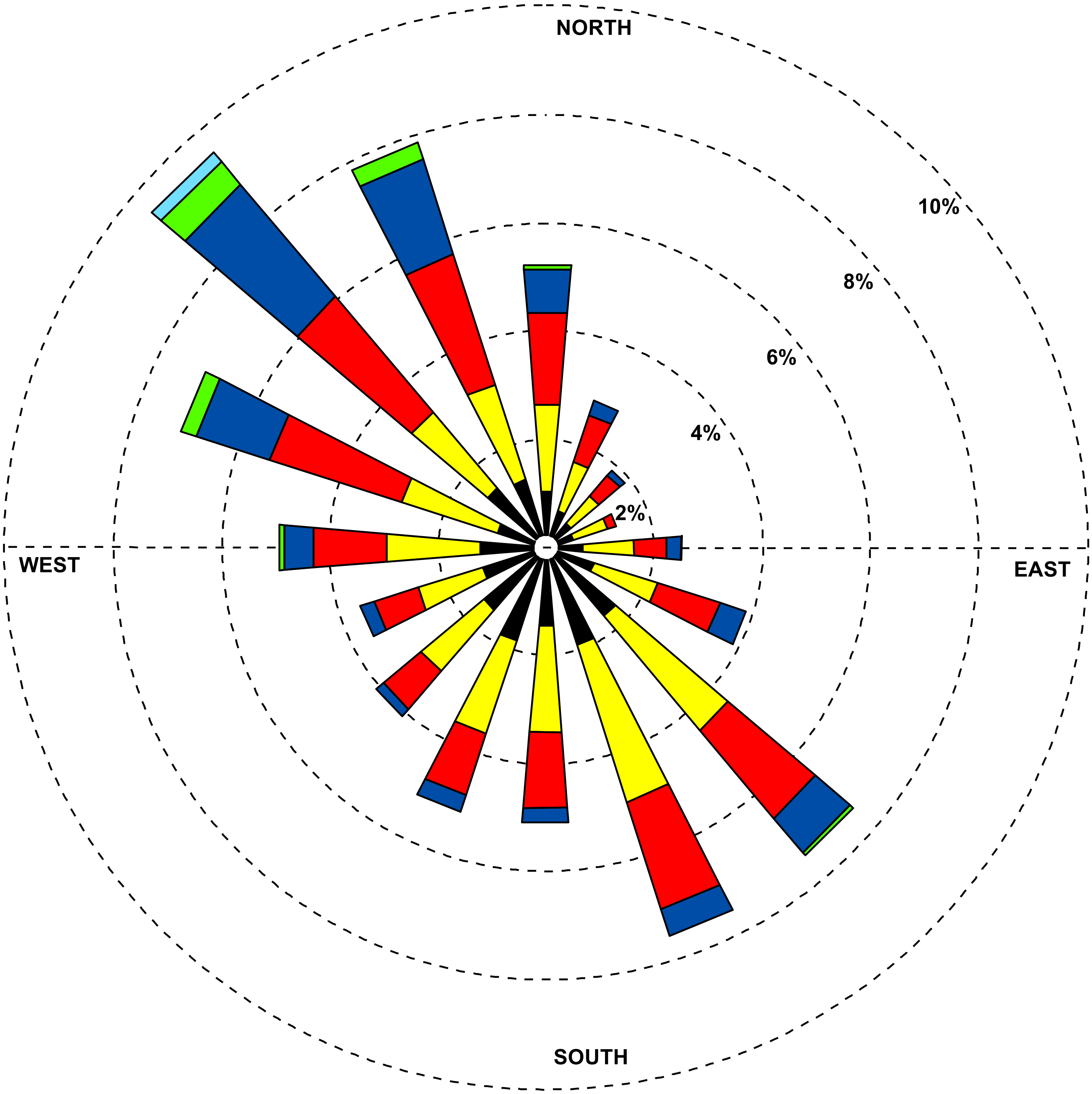

This document is a working document. This document may change over time as a result of new information, further deliberation, or other factors not yet known to the Co-lead Agencies.

Wind Speed (m/s)

- > 11.1
- 8.8 - 11.1
- 5.7 - 8.8
- 3.6 - 5.7
- 2.1 - 3.6
- 0.5 - 2.1

US Army Corps of Engineers
St. Paul District

Figure 4.2.7-1

Wind Frequency Distribution Plot for Hibbing, Minnesota (2001-2005)

NorthMet Mining Project and Land Exchange PFEIS

Minnesota

June 2015

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4.2.7.2 Local and Regional Air Quality

The MPCA monitors air quality at a number of stations throughout the state. The data collected helps the state determine major sources of air pollution as well as assess compliance with NAAQS and MAAQS. Per requirements of the federal CAA, monitoring is done for the criteria pollutants. The MPCA also monitors for a range of chemicals, referred to as air toxics, which, like the criteria pollutants, potentially affect human health.

As of 2012, air quality was monitored at 52 locations throughout Minnesota. Not all locations monitor all pollutants; rather, the selection of monitoring locations and parameters reflects consideration of a number of factors including population, pollutants of concern in the area, and wind direction. Table 4.2.7-1 provides the monitored background concentrations for the period 2008 to 2010 at monitoring stations within or close to the 300-km area of the NorthMet Project Proposed Action. Both the Duluth and Virginia locations are considered urban; the Cloquet site is rural, while the Voyageurs site is within Voyageurs National Park. The Virginia monitoring location has been in operation since 1968. In addition to demonstrating compliance with NAAQS and MAAQS, the monitoring site was also established to characterize metals concentrations and identify emissions sources from mining activities. The Cloquet site is three miles west of the city near several large forest products industries. Land use near the Voyageurs site is managed for recreation, timber, and wilderness. Pulp and paper mills in International Falls and Fort Frances, Ontario are approximately 95 miles northwest of the NorthMet Project area.

As seen from the table, all reported air quality data meet the NAAQS and the MAAQS, indicating that existing ambient air quality concentrations are below levels that are known to cause health-based impacts for these pollutants. These levels demonstrate that the general air quality area is considered in attainment under federal regulations.

Table 4.2.7-1 Monitored Background Concentrations (2008–2010)

Pollutant	Averaging Period	Monitored Background Concentration	Standard Value	Standard Type	Monitoring Station
Carbon Monoxide	8-Hour	1.9 ppm	9 ppm	Primary	Duluth – Torrey Building
	1-Hour	4.1 ppm	35 ppm 30 ppm[1]	Primary Primary and Secondary	Duluth – Torrey Building
Nitrogen Dioxide	Annual	0.002 ppm	0.05 ppm[2]	Primary and Secondary	Cloquet
	1-Hour	0.014	0.10 ppm[2]	Primary	Cloquet
Ozone (O_3)	8-Hour	0.072 ppm	0.08 ppm	Primary and Secondary	Voyageurs National Park
Lead	Quarterly	0.005 $\mu g/m^3$	1.5 $\mu g/m^3$	Primary and Secondary	Virginia
Total Suspended Particulate (TSP)[1]	Annual	30 $\mu g/m^3$	75 $\mu g/m^3$ 60 $\mu g/m^3$	Primary Secondary	Virginia
	24-Hour	83 $\mu g/m^3$	260 $\mu g/m^3$ 150 $\mu g/m^3$	Primary Secondary	Virginia

Pollutant	Averaging Period	Monitored Background Concentration	Standard Value	Standard Type	Monitoring Station
PM_{10}[3]	Annual	14 $\mu g/m^3$	50 $\mu g/m^3$	Primary and Secondary	Virginia
	24-Hour	36 $\mu g/m^3$	150 $\mu g/m^3$	Primary and Secondary	Virginia
$PM_{2.5}$	Annual	5.8 $\mu g/m^3$	12 $\mu g/m^3$	Primary and Secondary[6]	Virginia
	24-Hour	16.5 $\mu g/m^3$	35 $\mu g/m^3$	Primary and Secondary	Virginia
Sulfur Dioxide	Annual	0.001 ppm	0.03 ppm 0.02 ppm[1]	Primary Secondary	Rosemount
	24-Hour	0.007 ppm	0.14 ppm	Primary and Secondary	Rosemount
	3-Hour	0.021 ppm	0.5 ppm 0.35 ppm	Primary and Secondary[4] Secondary[5]	Rosemount
	1-Hour	0.024 ppm	0.075 ppm	Primary	Rosemount

Source: Gavin, MPCA, Pers. Comm., October 28, 2011.

Notes:
[1] Minnesota State Ambient Air Quality Standard only.
[2] Data available for only year 2010.
[3] The USEPA revoked the annual PM_{10} standard (effective December 17, 2006). However, it is still reflected in the State of Minnesota's regulations.
[4] Secondary standard for Air Quality Control Regions 128, 131, and 133.
[5] For Air Quality Control Regions 127, 129, 130, and 132.
[6] Updated to the December 2012 standard.
$\mu g/m^3$ = Micrograms per cubic meter

4.2.8 Noise and Vibration

This section addresses baseline noise and vibration conditions at the Mine Site and Plant Site, including a brief introduction to noise concepts and terms.

Noise is generally defined as unwanted sound. Sound travels in a mechanical wave motion and produces a sound pressure level. This sound pressure level, also referred to as loudness or intensity, is measured in decibels (dB). The dB scale is logarithmic such that each 10 dB increase represents a tenfold increase in noise intensity. For example, if sound energy is doubled, there is a 3 dB increase in noise because the two sound levels are added logarithmically, not linearly or arithmetically (e.g., 70 dB plus 70 dB equals 73 dB, not 140 dB). Sound measurement is further refined by using an A-weighted scale that emphasizes the range between 1,000 and 8,000 cycles per second, which is the range of sound frequencies most audible to the human ear. Unless otherwise noted, all dB measurements presented in this FEIS are A-weighted (dBA) on a logarithmic scale. This measurement is an expression of the relative loudness of sounds in air as perceived by the human ear. In the A-weighted scale, the dB values of sounds at low frequencies are reduced compared with unweighted dB, in which no correction is made for audio frequency. This correction is made because the human ear is less sensitive at low audio frequencies, especially below 1,000 hertz (Hz), than at high audio frequencies. A sound increase of 3 dBA is barely perceptible to the human ear, while a 5 dBA increase is clearly noticeable and a 10 dBA increase is heard as twice as loud (MPCA 2008a; Bies and Hansen 2009; IDOT 2011). Noise emissions diminish or attenuate with distance from the source depending on the nature of the source. When distance from a point source, such as a building, is doubled, the sound level decreases by 6 dB. However, when distance from a line source, such as a busy roadway, is doubled, the sound level decreases by 3 dB (MPCA 2008a).

The dB levels of common noise sources are shown in Table 4.2.8-1.

Table 4.2.8-1 Decibel Levels of Common Noise Sources

Common Noise Source	dB Levels
Jet Engine (at 25 meters)	140
Jet Aircraft (at 100 meters)	130
Rock Concert	120
Pneumatic Chipper	110
Jackhammer (at 1 meter)	100
Chainsaw, Lawn Mower (at 1 meter)	90
Heavy Truck Traffic	80
Business Office, Vacuum Cleaner	70
Conversational Speech, typical TV Volume	60
Library	50
Bedroom	40
Secluded Woods	30
Whisper	20

Source: MPCA 2008a.

A comparison of typical outdoor noise levels by land use category for daytime and nighttime is shown in Table 4.2.8-2.

Table 4.2.8-2 Typical Outdoor Sound Levels by Land Use Category

Land Use Category	L_{dn} (dBA)	L_d (dBA)	L_n (dBA)
Rural and sparsely populated areas	35 - 50	35 - 50	25 - 40
Quiet suburban (630 people/mi^2, remote from large cities and from industrial activity and trucking)	50	50	40
Normal suburban community (2,000 people/mi^2 not located near industrial activity)	55	55	45
Urban residential community (6,300 people/mi^2 not immediately adjacent to heavily traveled roads and industrial areas	60	59	52
Noisy urban residential community (near relatively busy road or industry or 20,000 people/mi^2)	65	62	58
Very noisy urban residential community (63,000 people/mi^2)	70	67	63

Source: USEPA 1974.

Notes:
L_{dn}, or day-night sound level, is the average equivalent A-weighted sound level during a 24-hour time period with a 10-dB weighting applied to equivalent sound level during the nighttime hours of 10 p.m. to 7 a.m.
L_d, or daytime L_{eq}, is the average equivalent sound level for daytime (7 a.m. to 10 p.m.).
L_n, or nighttime L_{eq}, is the average equivalent sound level for nighttime (10 p.m. to 7 a.m.).
L_d and L_n values were determined from the L_{dn} values using methods described in the 1974 USEPA document referenced above (based on data from 63 sets of background measurements conducted at various land-use areas across the United States).

Vibration is defined as regularly repeated movement of a physical object about a fixed point. Blasting is an activity associated with mining that could result in vibration. There are two types of vibration associated with mine blasting: ground vibration and air vibration or airblast overpressure. The magnitude of ground vibration is expressed in terms of peak particle velocity (PPV) and is measured in inches per second (in/s) or millimeters per second (mm/s). Airblast overpressure is measured in linear-weighted decibels (dBL).

4.2.8.1 Types of Noise

Noise may be classified as steady, non-steady, impulsive, or low-frequency depending on the temporal variations in sound pressure level. The various types of noise are described below.

- **Steady noise** is a noise with negligibly small fluctuations of sound pressure level within the period of observation. Steady noise with audible discrete tones is called discrete frequency noise or tonal noise. **Tonal noise** is characterized by one or two single frequencies and is much more annoying than broadband noise, which is characterized by energy at many different frequencies and of the same sound pressure level as the tonal noise. Tonal noise is caused by rotating parts of machines such as fans, internal combustion engines, transformers, and pumps. **Broadband noise** is steady noise without discrete frequency tones. Sounds are of longer duration and vary little over time (e.g., large gas turbines and road traffic).

- **Non-steady noise** is a noise that occurs when its sound pressure levels shift significantly during the period of observation. This type of noise can be divided into **fluctuating noise** (i.e., noise for which the level changes continuously and to a great extent during the period of observation such as surface grinding, welding, and component assembly) and **intermittent**

noise (i.e., noise that returns to the ambient or background level several times during the period of observation such as air compressors and automatic machinery during a work cycle).

- **Impulsive noise** consists of one or more bursts of sound energy, each of a duration less than approximately 1 second (i.e., sounds of short duration with high peak pressures). This type of noise can be divided into **highly impulsive sounds** (i.e., sound from one of the following enumerated categories of sound sources: small-arms gunfire, metal hammering, wood hammering, drop hammering, pile driving, drop forging, pneumatic hammering, pavement breaking, metal impacts during rail-yard shunting operation, and riveting); **high-energy impulsive sound** (i.e., sound from one of the following enumerated categories of sound sources: quarry and mining explosions, sonic booms, demolition and industrial processes that use high explosives, military ordinance, explosive ignition of rockets and missiles, explosive industrial circuit breakers, and any other explosive source where the equivalent mass of dynamite exceeds 25 grams); and **regular impulsive sound** (i.e., impulsive sound that is not highly impulsive sound or high-energy impulsive sound) (ANSI 2005).
- **Low-frequency noise** or sounds with strong low-frequency content produce greater annoyance than is predicted from A-weighted sound levels. Generally, annoyance is minimal when octave-band sound pressure levels are less than 65 dB at 16, 31.5, and 63 Hz midband frequencies. Annoyance to sounds with strong low-frequency content is virtually only an indoor problem (ANSI 2005).

4.2.8.2 Regional Setting

Noise exposure goals for various types of land use reflect the varying noise sensitivities associated with each of these uses. Residences, hospitals, and guest lodging are most sensitive to noise intrusion and therefore have more stringent noise exposure targets than industrial or commercial uses that are not subject to effects such as sleep disturbance. The land use in the Superior National Forest is mostly for forest. The region surrounding the Mine Site has traditionally supported various mining activities, as well as logging, on federal, state, county, and private forest lands. Noise sources associated with logging activities include skidders, feller bunchers, and log loaders. Noise sources associated with mining activities include drills, explosives, dump trucks, excavators, crushers, and power generators. Considering the attenuation effect of the surrounding forest and the fact that most of the mining and logging activities typically occur several thousand ft away from each other, the noise levels are localized (rather than regional) and diminish very quickly with distance due to geometric divergence or spreading losses. In addition to the spreading losses, dense vegetation (foliage) in the Superior National Forest also helps to attenuate noise from the mining and logging activities.

4.2.8.3 Mine Site

The Mine Site is situated mostly on federal land in the Superior National Forest, except for the privately owned land bordering Dunka Road to the south of the Mine Site. As indicated above, the region surrounding the Mine Site has traditionally supported various mining activities, as well as logging, on federal, state, county, and private forest lands. The Northshore Mine and Mesabi Nugget Phase I Plant are located approximately 2 miles north and 8 miles west of the Mine Site, respectively. Dunka Road, which provides access to the Mine Site, is an existing private road located south of the Mine Site, with no public access and little usage. The existing LTVSMC railroad grade is also located south of the Mine Site.

Review of the most up-to-date aerial maps indicates that there are no noise-sensitive areas or receptors (e.g., residences, campgrounds, schools, churches, or wilderness areas) within the Mine Site and surrounding federal lands. However, there are a few receptors outside the Mine Site. The closest noise-sensitive receptor to the Mine Site is the City of Babbitt, located approximately 6 miles to the north. Survey data identified a Boy Scout camp located 5 miles from the Mine Site, but the clerk's office of the City of Hoyt Lakes indicated that the only Boy Scout camp near the Mine Site is located on Colby Lake, approximately 10 miles southwest of the Mine Site. Other noise-sensitive receptors in the general area of the Mine Site include: Skibo (a small residential area), approximately 8 miles to the south; the City of Hoyt Lakes, approximately 9 miles to the southwest; and the City of Aurora, approximately 13 miles to the south. The BWCAW is part of the national wilderness preservation system where sensitivity to human-caused sound and noise effects are important considerations. It is approximately 20 miles (in a northeasterly direction) from the Mine Site to the closest portion of the BWCAW. The cities of Ely and Tower are also located close to the BWCAW and are approximately 21 miles north-northeast and 19 miles northwest of the Mine Site, respectively. The Bois Forte Reservation is located near Tower. In addition to the receptors identified above, other receptors such as recreational sites (family campgrounds, campsites, boating, fishing, swimming, and family picnic areas), wildlife corridors, trails, and MPCA staff-recommended wild rice waters/beds (used by tribal members for harvesting) are also within the Mine Site vicinity. The closest recreational site is a family picnic area located approximately 9 miles south of the Mine Site (near Skibo). The closest wildlife corridor and trail (Stony Spur Snowmobile Trail) are located approximately 1 mile northwest and 6 miles northeast of the Mine Site, respectively. The closest MPCA staff-recommended wild rice waters/beds are located approximately 5.5 miles north (Mud Lake) and 7 miles northeast (Birch Lake) of the Mine Site. Figure 4.2.8-1 shows the locations of the closest receptors to the Mine Site. Though not depicted on Figure 4.2.8-1 due to sensitivity regarding cultural resources and locations, the federal Co-lead Agencies have identified a few archaeological sites in consultation with the SHPO and the Bands. Although barely discernible in some cases, a few well-defined trail segments of the BBLV Trail and two other unnamed trail segments (BBLV Trail Segment #1) represent the trail corridors that cross the Mine Site and Plant Site, as well as the NorthMet Project area (see Section 4.2.9, Cultural Resources).

Since the Mine Site is located in a rural and sparsely populated environment, the existing ambient steady L_{eq} for all nearby sensitive receptors (except the BWCAW), are expected to range from 35 to 50 dBA or approximately 45 dBA (daytime) and 25 to 40 dBA or approximately 35 dBA (nighttime) (see Tables 4.2.8-2 and 4.2.8-3). The ambient L_{eq} assumed for receptors outside the Mine Site area account for existing noise from the Northshore Mine located approximately 2 miles north of the Mine Site. Since the BWCAW is located in a natural environment that is generally quieter than areas outside the wilderness, the existing ambient L_{eq} at the BWCAW area is expected to be lower than the levels for other receptors surrounding the Mine Site area. In February 2011, the USFS Superior National Forest unit conducted an ambient sound level survey at Little Gabbro Lake in the western part of the BWCAW (ambient data provided by USFS staff via email in June 2013). In March 2011, the Superior National Forest unit also conducted an ambient sound level survey at Royal Lake in the eastern part of the BWCAW (USFS 2012e). The ambient data at both sites are comparable, but the data at Royal Lake is slightly lower. For the purpose of the NorthMet Project Proposed Action, the Royal Lake ambient data has been used to provide a conservative natural ambient level at BWCAW (see Table 4.2.8-3). In addition to the fact that the Royal Lake ambient data are more conservative (i.e., lower than Gabbro Lake data), the USFS staff indicated that the measured ambient data at Gabbro Lake has not been reviewed by the National Park Service, but the measured data at Royal Lake has been reviewed and used by the National Park Service soundscape program for some recent work they did to model noise effects on the BWCAW.

Minnesota's noise standards are based on statistical calculations that quantify noise levels according to duration over a 1-hour monitoring period. The L_{10} is the noise level that is exceeded for 10 percent, or 6 minutes, of the hour, and the L_{50} is the noise level exceeded for 50 percent, or 30 minutes, of the hour. There is not a limit on maximum noise (MPCA 2008a). For the purposes of this assessment, the estimated baseline L_{eq} levels for the nearest receptors (except for the BWCAW, where measured percentile data were available) were converted to other noise percentile metrics, such as L_{50} and L_{10} using a USEPA calculation methodology (USEPA 1974). The calculation was based on an assumed standard deviation of 3 dB for the sound level statistical distribution. A summary of the estimated existing daytime and nighttime ambient levels (i.e., L_{eq}, L_{50}, and L_{10}) expected at receptors closest to the NorthMet Project area is presented in Table 4.2.8-3. As indicated above, natural ambient levels for the BWCAW were based on measured L_{50} and L_{10} data taken from Royal Lake in the eastern part of the BWCAW (USFS 2012e).

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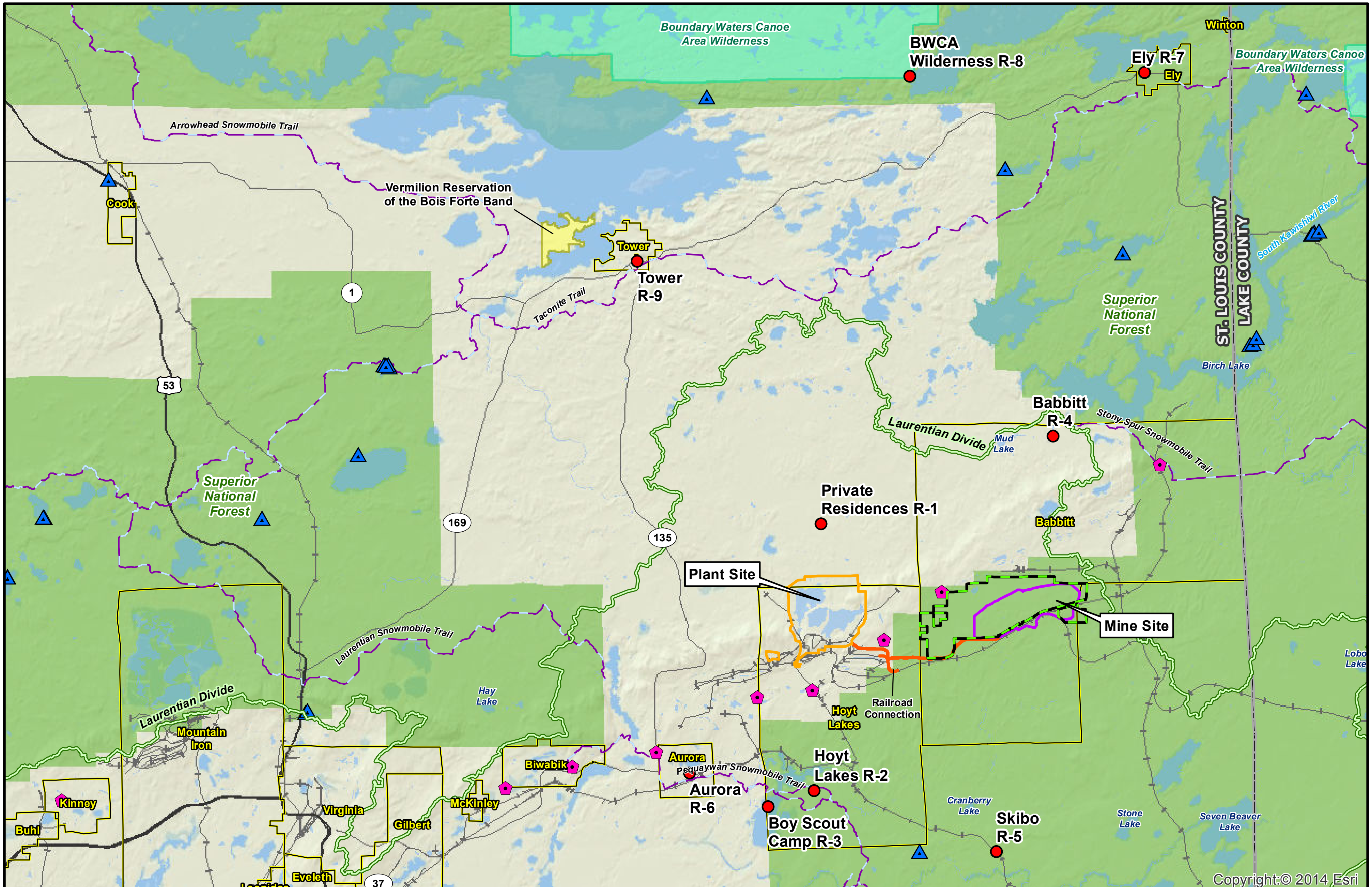

- Noise Sensitive Receptor
- Plant Site
- Mine Site
- Transportation and Utility Corridor
- Recreational Site
- Federal Lands
- Native American Reservation
- Municipality
- Boundary Waters Canoe Area Wilderness
- National Forest
- Wildlife Travel Corridor
- Existing Railroad

US Army Corps of Engineers
St. Paul District

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Figure 4.2.8-1
Nearest Noise Sensitive Receptors to the NorthMet Project Area
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

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Table 4.2.8-3 Summary of Estimated Existing Ambient Noise Levels at the Closest Receptors to the NorthMet Project Area, including the BWCAW

Ambient Noise Levels	Daytime (dBA)	Nighttime (dBA)
All Receptors except the BWCAW[1]:		
L_{eq}	45.0	35.0
L_{50}	44.0	34.0
L_{10}	48.8	37.8
BWCAW[2]:		
L_{eq}	34.0	34.0
L_{50}	23.4	23.4
L_{10}	33.2	33.2

Notes:
[1] Source: USEPA 1974.
[2] Source: USFS 2012e.

Currently, no ground- or air-vibrating sources or activities (e.g., mine blasting, piling, etc.) occur at the Mine Site. The closest vibration-generating activity is blasting at the Northshore Mine. Like noise emissions, ground and air vibration effects diminish with distance from the source. Because of the distance from the operating mine, existing baseline levels of vibration at the Mine Site and nearby receptors are expected to be negligible.

4.2.8.4 Plant Site

The Plant Site is situated on private land located 8 miles west of the Mine Site. The closest noise-sensitive receptors to the Plant Site include a few private residences located approximately 3.5 miles north; the City of Hoyt Lakes, located approximately 5 miles south; and the City of Aurora, located approximately 8 miles southwest. A Boy Scout camp, which is only used occasionally, is located approximately 10 miles south-southwest. In addition to the receptors identified above, other receptors such as recreational sites, wildlife corridors, trails, archaeological sites (used by tribal members for cultural and spiritual purposes), and sites used by tribal members for harvesting of wild rice are also within the Plant Site vicinity. The closest recreational site is a family picnic area located approximately 9 miles south of the Plant Site (near Skibo). The closest wildlife corridor and trail (Pequaywan Snowmobile Trail) are located approximately 2 miles south and 6 miles southeast of the Plant Site, respectively. The closest MPCA staff-recommended wild rice waters/beds are located approximately 6 miles west (Hay Lake) of the Plant Site. Figure 4.2.8-1 shows the locations of the closest receptors to the Plant Site. Though not depicted on Figure 4.2.8-1 due to sensitivity regarding cultural resources and locations, the federal Co-lead Agencies have identified a few archaeological sites in consultation with the SHPO and the Bands. These archaeological sites include the Spring Mine Lake Sugarbush (a natural maple-basswood stand of cultural significance, less than 1 mile east of the Plant Site) and the *Mesabe Widjiu* (a long, linear landform running the length of the Mesabi Iron Range, and intersecting portions of the Laurentian Divide and northeast of the Plant Site near the Tailings Basin), and possess important spiritual and cultural significance to the Ojibwe people. Although barely discernible in some cases, a few well-defined trail segments of the BBLV Trail and two other unnamed trail segments (BBLV Trail Segment #1) represent the trail corridors that cross the Mine Site and Plant Site, as well as the NorthMet Project area (See Section 4.2.9, Cultural Resources).

Like the Mine Site, the Plant Site is also located in a rural and sparsely populated environment; therefore, the daytime and nighttime ambient levels (i.e., L_{eq}, L_{50}, and L_{10}) for all nearby sensitive receptors, such as residential houses, are expected to be similar to the levels shown in Table 4.2.8-3. The closest noise-generating sources are the coal and flux pulverizer, rotary hearth furnace, and cooling towers at Mesabi Phase I Plant in Hoyt Lakes, which is approximately 1 mile west-southwest of the Plant Site. The baseline noise levels of the identified receptors near the Plant Site (see Table 4.2.8-3) already capture or account for noise from the Mesabi Phase I Plant.

Currently, no ground- or air-vibrating sources or activities (e.g., mine blasting or pile driving) occur at the Plant Site. The closest vibration-generating sources are the coal and flux pulverizer and rotary hearth furnace at the Mesabi Phase I Plant in Hoyt Lakes, which is approximately 1 mile west-southwest of the Plant Site. Since ground and air vibration effects diminish with distance from the source, existing baseline levels of vibration at the Plant Site and the nearest sensitive receptors are expected to be negligible.

4.2.9 Cultural Resources

4.2.9.1 Introduction

The MDNR, USACE, and USFS have prepared this joint state-federal FEIS for the proposed NorthMet Project Proposed Action and Land Exchange Proposed Action. USEPA, the Fond du Lac Band of Lake Superior Chippewa, the Bois Forte Band of Chippewa, and the Grand Portage Band of Lake Superior Chippewa (herein referred to as the Bands) participated as cooperating agencies based on regulatory authority and/or subject matter expertise. Cooperating agencies have not participated in production or endorsement of any components of the EIS or the NorthMet Project.

Although not required by NEPA and MEPA, the Co-lead Agencies committed to providing an appendix in this FEIS that contains the Tribal Cooperating Agencies' comments and supporting documentation representing Major Differences of Opinion (MDOs). See Appendix C for comments and supporting documentation from the Bois Forte, Grand Portage, Fond du Lac, GLIFWC, and the 1854 Treaty Authority. These take the form of eight position papers and a Co-lead Agency Preliminary SDEIS comment disposition spreadsheet for the Tribal Cooperating Agencies.

The Tribal Cooperating Agency submittals in Appendix C are provided verbatim and in identical form as they were for the SDEIS. They were considered in the development of this FEIS. Refer to Chapter 8 for more information.

4.2.9.2 Cultural Resources

"Cultural resources" is a very general term that includes a wide range of resources. There is no legal or generally accepted definition of "cultural resources" within the federal government, but it is commonly used in connection with the identification of historic properties in compliance with Section 106 of the National Historic Preservation Act (NHPA). However, historic properties are only a subset of cultural resources, and are but one aspect of the "human environment" defined by the NEPA regulations.

Under NEPA, the human environment includes the natural and the physical (e.g., structures) environment, and the relationships of people to that environment. A NEPA review must address the cultural context in which the project effects would occur. Management policies, and guidance within federal and state agencies, seek to identify and consider all types of cultural resources and balance the need for development with the need to protect cultural resources.

The intent of this section is to describe the affected environment within this cultural context. Cultural resources within this context include historic properties, which are considered under the NHPA, and natural resources of cultural significance to the Bands. A discussion of treaty rights under the 1854 Treaty is also provided as part of this cultural context to understand the significance of the Ceded Territory to the Bands.

4.2.9.2.1 National Historic Preservation Act Overview

The NorthMet Project Proposed Action is considered an undertaking as defined in 36 CFR 800, the regulation implementing Section 106 of the NHPA. A more narrow view of cultural resources is necessary for these regulatory requirements. The intent of Section 106, as set forth in the impending regulations, is for federal agencies to take into account the effects of a proposed undertaking on historic properties and to consult with the Advisory Council on Historic Preservation (ACHP), State Historic Preservation Offices (SHPOs), federally recognized tribes, other federal agencies with concurrent undertakings in connection with the project, applicants for federal assistance, local governments, and any other parties with a demonstrated interest in the proposed undertaking and its potential effects on historic properties.

Section 106 establishes a process for identifying historic properties that may be affected by the proposed undertaking; assessing the undertaking's effects on those resources; and engaging in consultation that seeks ways to avoid, minimize, or mitigate adverse effects on properties that are either listed on, or considered eligible for listing on, the National Register of Historic Places (NRHP). The area in which effects on resources are evaluated is the Area of Potential Effect (APE). The APE is defined as, "… the geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist. The area of potential effects is influenced by the scale and nature of the undertaking and may be different for different kinds of effects caused by the undertaking" (36 CFR § 800.16(d)).

A historic property is defined as any district, site, building, structure, or object that is either listed, or eligible for listing, in the NRHP.

To be eligible for listing in the NRHP, a cultural resource must meet one of the four criteria for eligibility. The criteria (36 CFR 60.4(a–d)) used to evaluate the significance of a cultural resource are as follows:

a) It is associated with events that have made a significant contribution to the broad patterns of history;

b) It is associated with the lives of past significant persons;

c) It embodies the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or

d) It has yielded or may be likely to yield, information important in history or prehistory.

Properties also need to exhibit integrity of location, materials, setting, design, association, workmanship, and feeling and must be at least 50 years old. However, under Criteria Consideration G, a property achieving significance within the past 50 years is eligible if it is of exceptional importance.

Historic properties can include properties of traditional religious and cultural significance to Indian tribes; these properties are commonly referred to as Traditional Cultural Properties (TCPs). Because the cultural practices or beliefs that give a TCP its significance are typically still observed in some form at the time the property is evaluated, it is sometimes perceived that the intangible practices or beliefs themselves, not the tangible property, constitute the subject of evaluation. There is naturally a dynamic relationship between tangible and intangible. The beliefs or practices associated with a TCP are of central importance in defining its significance. However, it should be clearly recognized at the outset that the NRHP does not include intangible resources themselves. The entity evaluated must be a tangible property—i.e., a district, site, building, structure, or object. A property must meet several preconditions in order to meet the federal definition of TCP as articulated in National Register Bulletin 38. These conditions include the ongoing use of a property in spiritual practice or other traditional activities. TCPs are defined in National Register Bulletin 38 as a place "eligible for inclusion in the NRHP because of its association with cultural practices or beliefs of a living community that (a) are rooted in that community's history, and (b) are important in maintaining the continuing cultural identity of the community" (National Register Bulletin 38:1). It is difficult to identify properties of traditional cultural significance, since they are often kept secret. It is through consultation with Native American tribes themselves that historic properties of religious and cultural significance can be properly identified and evaluated (ACHP 2008).

Local, state, tribal, and federal agencies shall be consulted as appropriate in findings and determinations made during the Section 106 process, as specified in 36 CFR 800. This includes any SHPO whose state would physically include any portion of the APE. The SHPO is appointed by each state to protect the interests of its citizens with respect to issues of cultural heritage. In addition to the SHPO, the lead federal agencies have an obligation, as appropriate, to work with state and local governments, and private organizations, applicants, or individuals with a demonstrated interest from initiation to completion of the review under Section 106 of the NHPA.

Once the lead federal agencies have identified the appropriate SHPO, 36 CFR 800.3(f)(2) requires the federal agencies to identify Native American tribes that may attach religious and cultural significance to historic properties within the APE and invite them to be consulting parties.

If a historic property were affected, the federal Co-lead Agencies would follow the provisions of 36 CFR 800.5 to determine whether the effect were adverse. If an effect were adverse, the USACE and the USFS would consult with the parties identified above to resolve the adverse effect either through avoidance of the effect or mitigation of the effect pursuant to 36 CFR 800.6. Prior to the federal agencies taking an action, whether it is the issuance of a USACE CWA permit or a USFS land exchange in connection with the NorthMet Project Proposed Action, the federal agencies must comply with Section 106 of the NHPA. Such compliance can be achieved by, among other things, avoiding an adverse effect on historic properties or developing appropriate mitigation measures and executing a Memorandum of Agreement (MOA) requiring such mitigation.

4.2.9.2.2 Identification of Consulting Parties

The USACE invited 15 federally recognized tribes, as listed in the Native American Consultation Database (maintained by the Department of the Interior, National Park Service) for St. Louis County, Minnesota, and select state and federal agencies by letter to consult on the NorthMet Project Proposed Action and notified the consulting parties that the USACE would be the lead federal agency. Another letter from the USACE sent May 2006 invited Native American tribes that had not responded to the initial invitations. Those federally recognized tribes that did not respond to the first or second written invitations were contacted via phone.

As a result of this initial round of consultation, the Bois Forte Band of Chippewa Indians and Fond du Lac Band of Lake Superior Chippewa had requested to be included as cooperating agencies for the NorthMet Project Proposed Action under NEPA. Following this initial round of consultation, the Grand Portage Band of Chippewa requested to be included as a cooperating agency. The federal Co-lead Agencies continue consultation with the Bands, Minnesota SHPO, and PolyMet as determinations are made concerning NRHP eligibility of identified cultural resources, effects of the NorthMet Project Proposed Action on historic properties, and resolution of any adverse effects, as required under 36 CFR 800. The federal Co-lead Agencies also continue to consult on issues outside of the NHPA, including other issues pertinent to this FEIS.

4.2.9.2.3 Methods for Identifying Historic Properties

The NorthMet Project Proposed Action is considered an *undertaking* as defined in 36 CFR 800.16. The Co-lead Agencies must consider effects on historic properties before an undertaking were to occur. The intent of Section 106 is for federal agencies to take into account the effects of a proposed undertaking on any historic properties situated within the APE and to consult with the ACHP, SHPOs, federally recognized Native American tribes and their Tribal Historic Preservation Officers (THPOs), local governments, applicants, and any other interested parties regarding the proposed undertaking and its potential effects on historic properties.

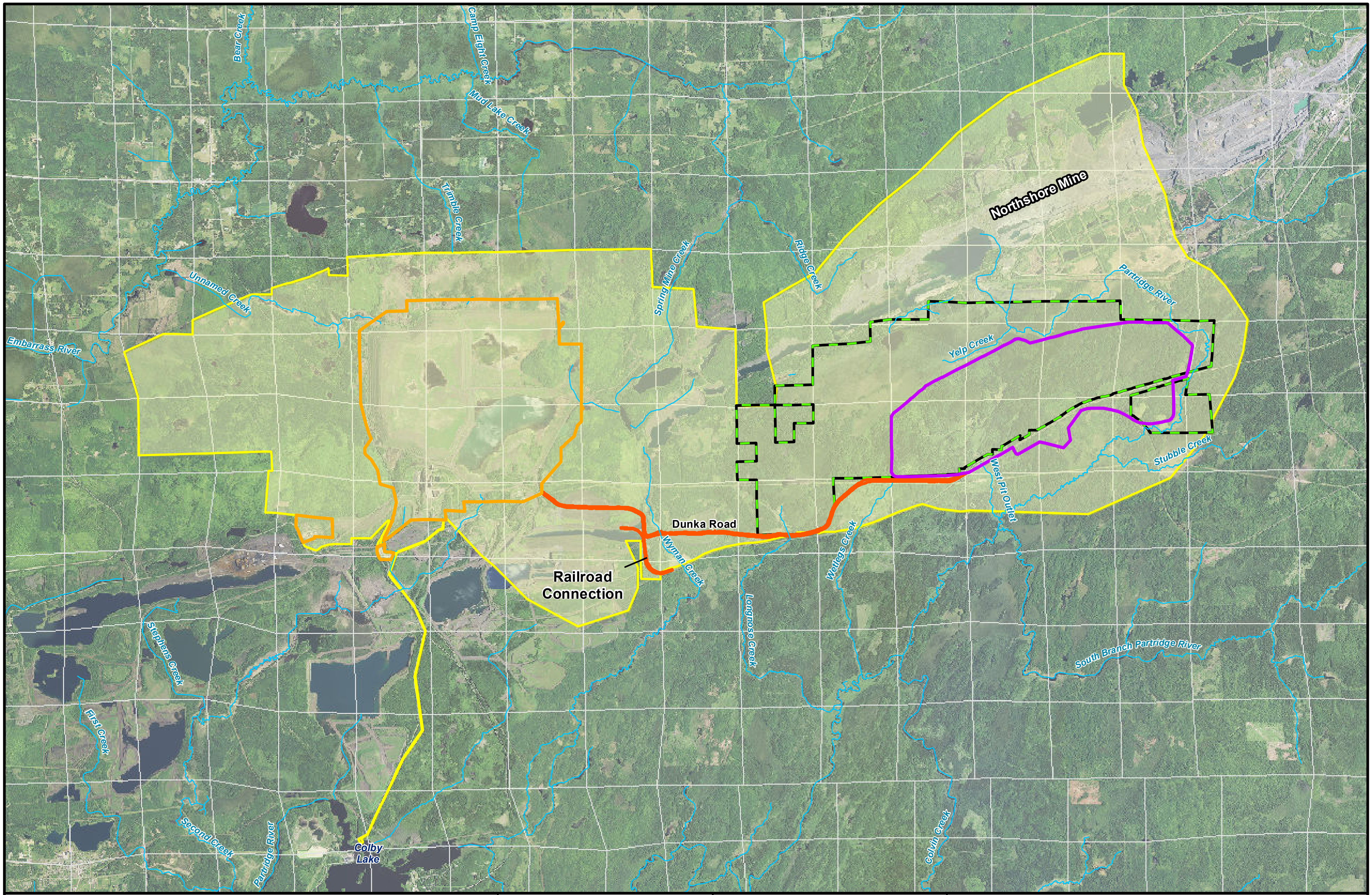
Area of Potential Effect

The APE is the area in which a federal agency has identified historic properties that may be affected by the undertaking. For the purpose of any discussion pertaining to historic properties, direct effects physically alter the historic property in some way and indirect effects are further removed in time or space and diminish some aspect of the historic property, but do not physically alter it. Direct effects on archaeological sites and historic structures would occur in a fairly circumscribed area. Indirect effects could occur within a more geographically expansive area that typically reflects potential effects resulting from visual, audible, or atmospheric changes.

Typically, archaeological surveys are only done within the area where direct effects would occur. However, for the NorthMet Project Proposed Action, the Co-lead Agencies conducted archeological surveys in some areas within the APE where both direct and/or indirect effects could occur.

The APE for the NorthMet Project Proposed Action was developed using the analysis discussed below and in other resource-specific sections of this FEIS. The APE includes potential effects areas for both direct and indirect effects (see Figure 4.2.9-1). The purpose of this summary is to address the APE for the NorthMet Project Proposed Action and discuss the rationale behind the areas that were included in the APE. As discussed in this section, cultural resources may include components that are, in part or entirely, natural resources. Therefore, to address indirect visual, audible, or atmospheric effects on all types of cultural resources, the APE includes aspects related to aesthetics, water, air, and noise. The Co-lead Agencies' consultation concerning the APE is ongoing with the SHPO, Bands, and PolyMet; the APE may be subject to change based on new information vetted through and accepted by the Co-lead Agencies. For the purposes of evaluating effects on cultural resources, the APE discussed in this FEIS is being used.

The DEIS was issued in October 2009. From 2007 to 2009, archaeological and architectural surveys were conducted for the NorthMet Project Proposed Action, as discussed below. Those surveys focused on the existing Plant Site area and the proposed Mine Site area (see Figure 4.2.9-2).



Federal Lands
Mine Site
Plant Site
Transportation and Utility Corridor
Stream/River
Section Boundary
Cultural Resources Area of Potential Effect

US Army Corps of Engineers
St. Paul District

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N W E S

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Figure 4.2.9-1
Cultural Resources Analysis - Area of Potential Effect
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

168

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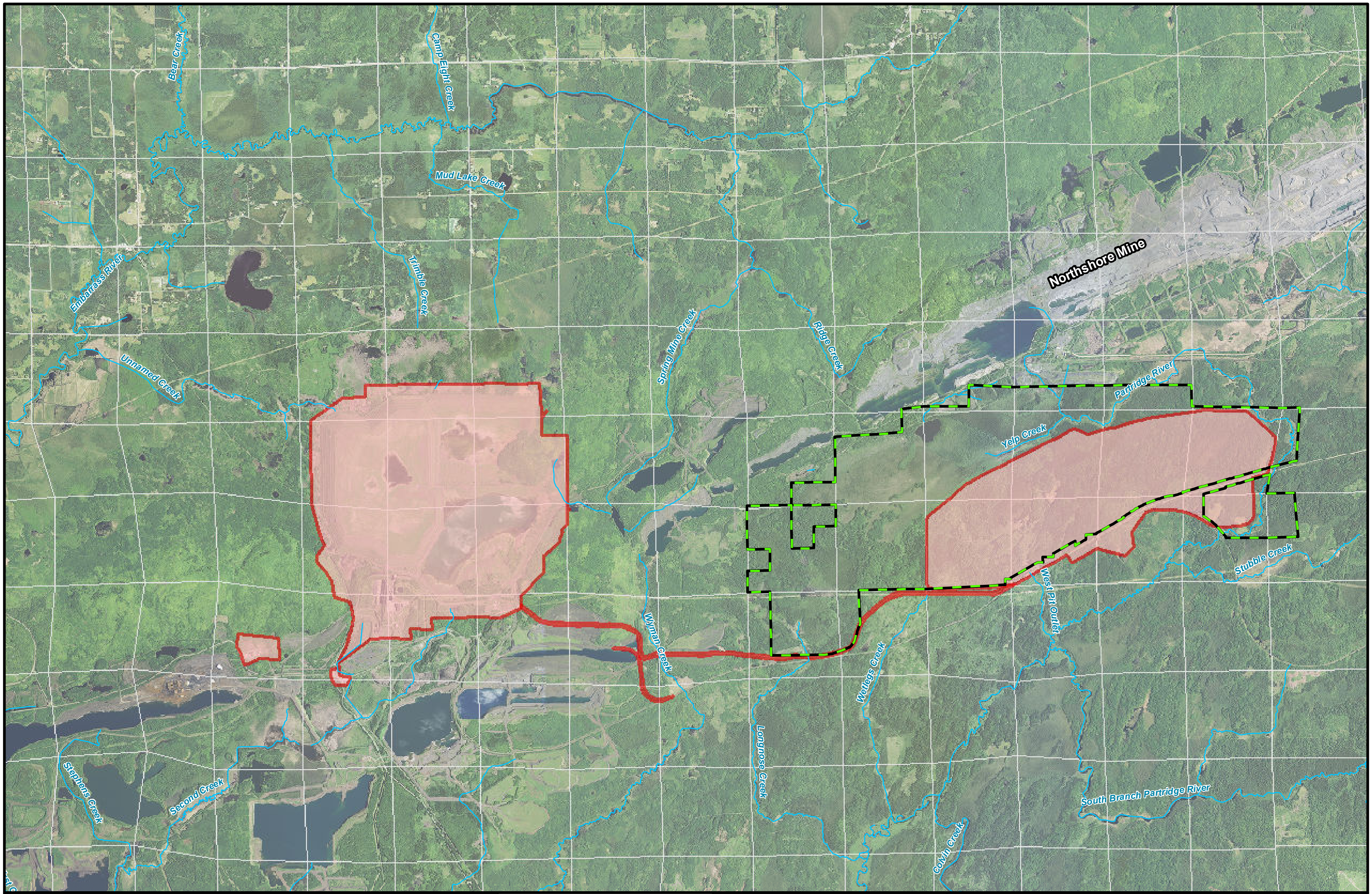

Federal Lands
Stream/River
Area of Direct Effect
Section Boundary

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0 0.5 1 2 Miles

Figure 4.2.9-2
Cultural Resources Analysis - Area of Direct Effect
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

170

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In early 2009, the consulting Bands proposed the 1854 Ceded Territory as a historic property. Prior to that, the Bands reiterated their concerns about effects on water quality and quantity, for both surface water and groundwater. At that point in the NorthMet Project Proposed Action review, data were not available on which to reasonably extrapolate the APE. The result was an APE that included a large area inclusive of portions of the Partridge River and Embarrass River watersheds, extending down the St. Louis River to Lake Superior.

As consultation progressed with the Bands, it became apparent that further identification efforts were warranted. Supplemental field investigations focused on the areas around the proposed Plant Site and Mine Site. Since this initial effort, the Co-lead Agencies have received the results of water quality and quantity modeling. The APE has been revised based on these results.

The NorthMet Project Proposed Action would meet ambient air quality standards at the property boundary. Compliance with ambient air quality standards suggests that there would be no significant effects on vegetation or soils. Therefore, it was suggested that the property boundaries at both the Plant Site and the Mine Site be used to define the maximum extent of NorthMet Project Proposed Action air impacts that would have the potential to affect historic properties (see Section 5.2.7.2.3; Figure 4.2.9-3). In 2013, during analysis for the SDEIS, the Co-lead Agencies refined the NorthMet Project Proposed Action APE to include this larger ambient air boundary. Within the redefined APE, modeling shows where fugitive dust from the Plant Site, Tailings Basin, and Mine Site stockpiles is predicted to settle. Areas of fugitive dust deposition that extend beyond the APE would not exceed the ambient air quality standard (see Section 5.2.7.1.3). The intra-property APE for air is defined by these fugitive dust deposition areas (see Figure 4.2.9-4). Therefore, in 2015, at the request of the consulting Bands and SHPO, the federal Co-lead Agencies conducted additional Phase IA (historic aerial photography) desktop survey for portions of the APE adjacent to the proposed Plant Site. This survey coverage focused on areas outside of the previously disturbed mining district that are within the NorthMet Project Proposed Action’s ambient air boundary.

Water quality modeling (see Section 5.2.2) predicts that the NorthMet Project Proposed Action would meet all Class 2B (aquatic life) water quality standards with the possible exception of aluminum in Embarrass River tributaries draining the Tailings Basin. For aluminum, ambient water quality, at times, already exceeds the Class 2B standard in both the Partridge River and Embarrass River. In the Partridge River, the NorthMet Project Proposed Action would not measurably increase aluminum concentrations relative to the Continuation of Existing Conditions (CEC) Scenario results (Section 5.2.2.3.2). In the Embarrass River, the increase in concentration relative to the CEC Scenario would not be the result of increased aluminum loadings from the NorthMet Project Proposed Action, but rather the result of mass loading from surface runoff and the loading from other minor sources (Section 5.2.2.3.3). Figure 4.2.9-5 shows surficial groundwater flowpaths with the potential to transport mine- and Tailings Basin-affected groundwater from source areas to surface waters. Therefore, these distances around the mine pit and Tailings Basin define the APE for potential changes to groundwater and surface water quality (see Figure 4.2.9-5).

Changes to groundwater quantity due to groundwater drawdown resulting from mine pit dewatering are not predicted to occur beyond 3,200 ft from the mine pit (see Section 5.2.2.3.2). Therefore, this distance around the mine pit defines the APE for changes to groundwater quantity (see Figure 4.2.9-6).

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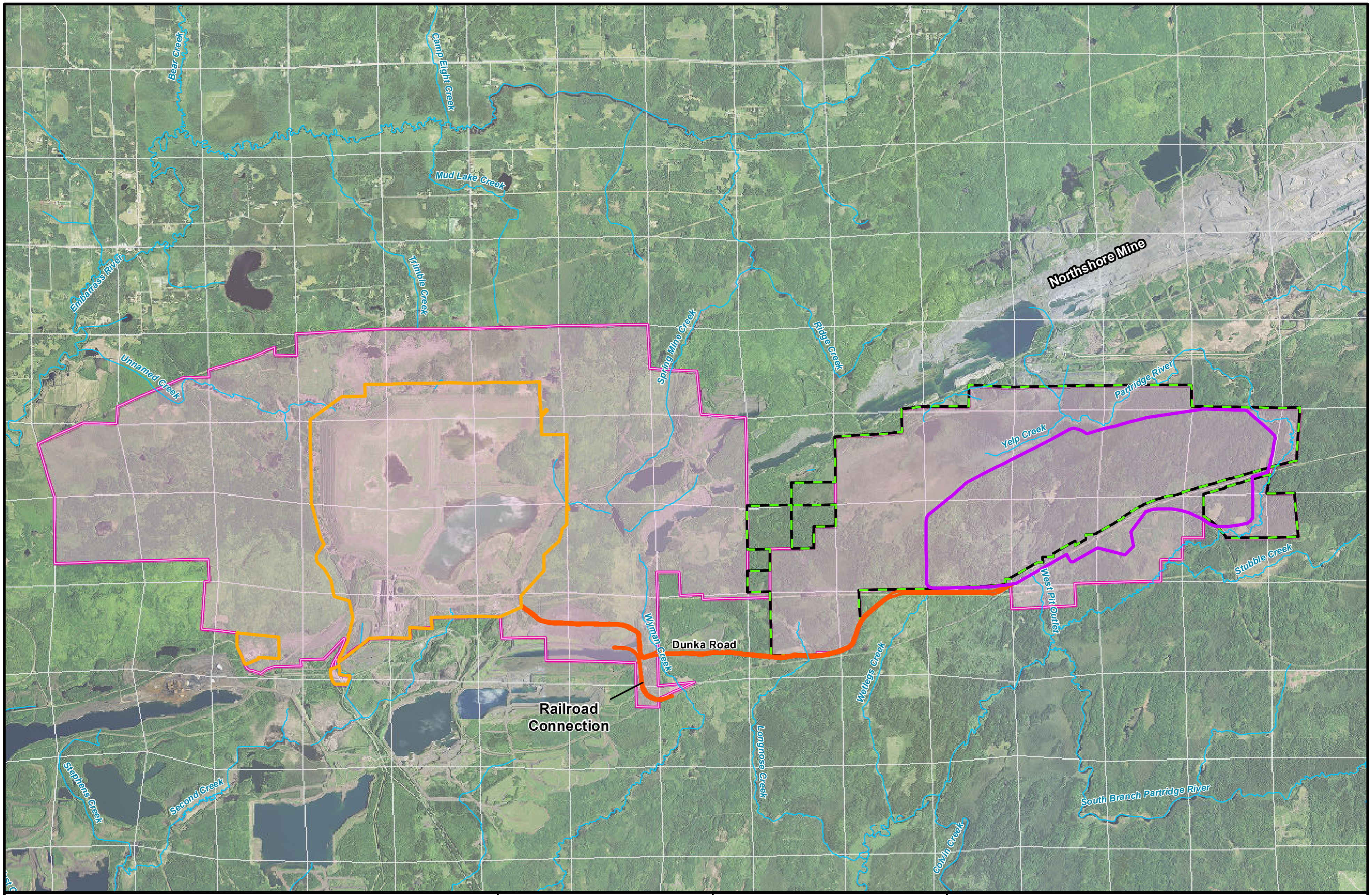

Federal Lands
Mine Site
Plant Site
Transportation and Utility Corridor
Stream/River
Section Boundary
Air Quality Area of Potential Effect

Minnesota Department of Natural Resources
US Army Corps of Engineers St. Paul District
Forest Service U.S. Department of Agriculture

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N W E S

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Figure 4.2.9-3

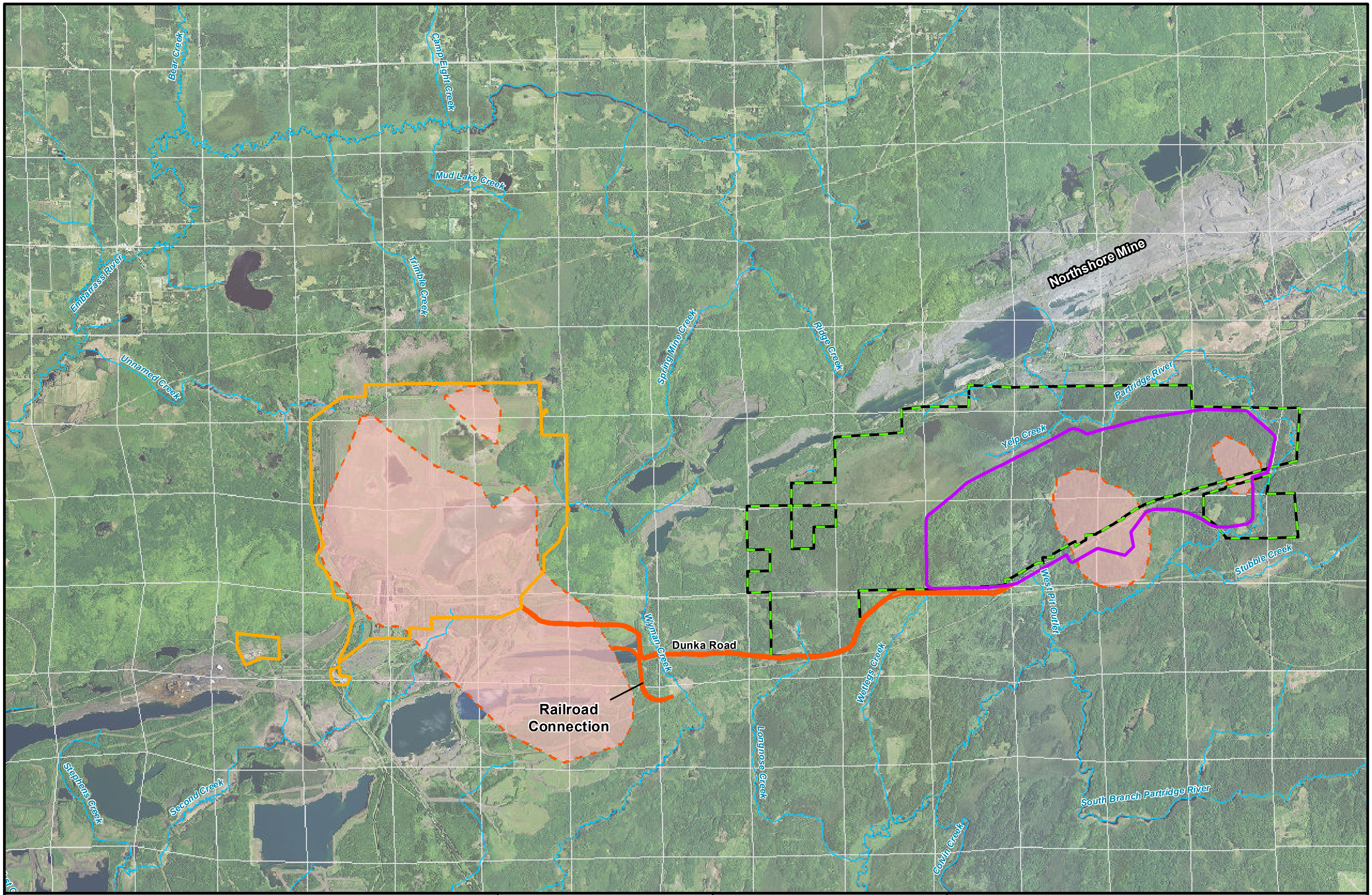
Cultural Resources Analysis - Air Quality Area of Potential Effect

NorthMet Mining Project and Land Exchange PFEIS

Minnesota

June 2015

217 -Page Intentionally Left Blank-



Federal Lands
Mine Site
Plant Site
Transportation and Utility Corridor
Stream/River
Section Boundary
Fugitive Dust Area of Potential Effect

US Army Corps of Engineers
St. Paul District

This document is a working document. This document may change over time as a result of new information, further deliberation, or other factors not yet known to the Co-lead Agencies.

N
W E
S

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Miles

Figure 4.2.9-4
Cultural Resources Analysis - Fugitive Dust Area of Potential Effect
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

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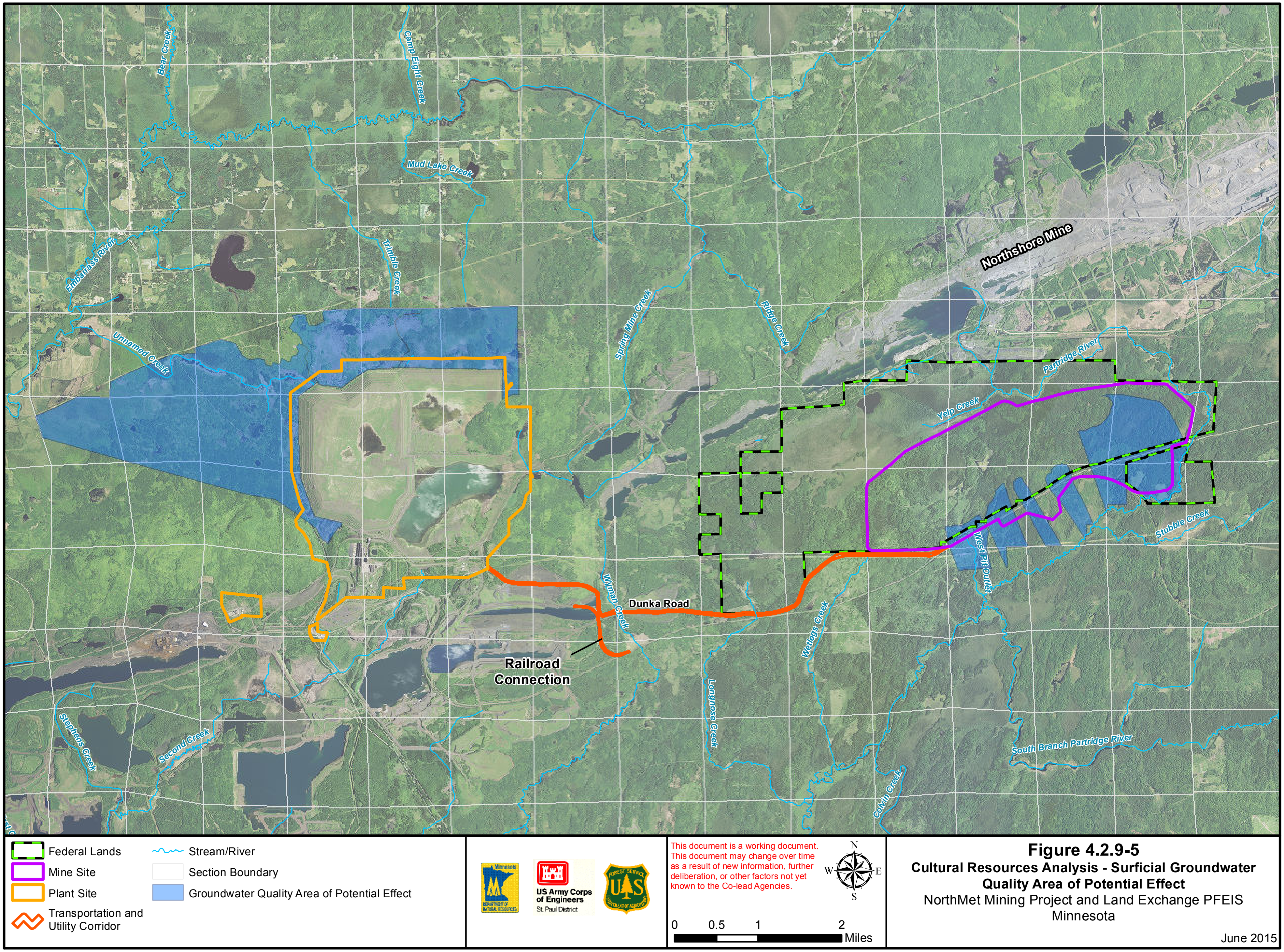

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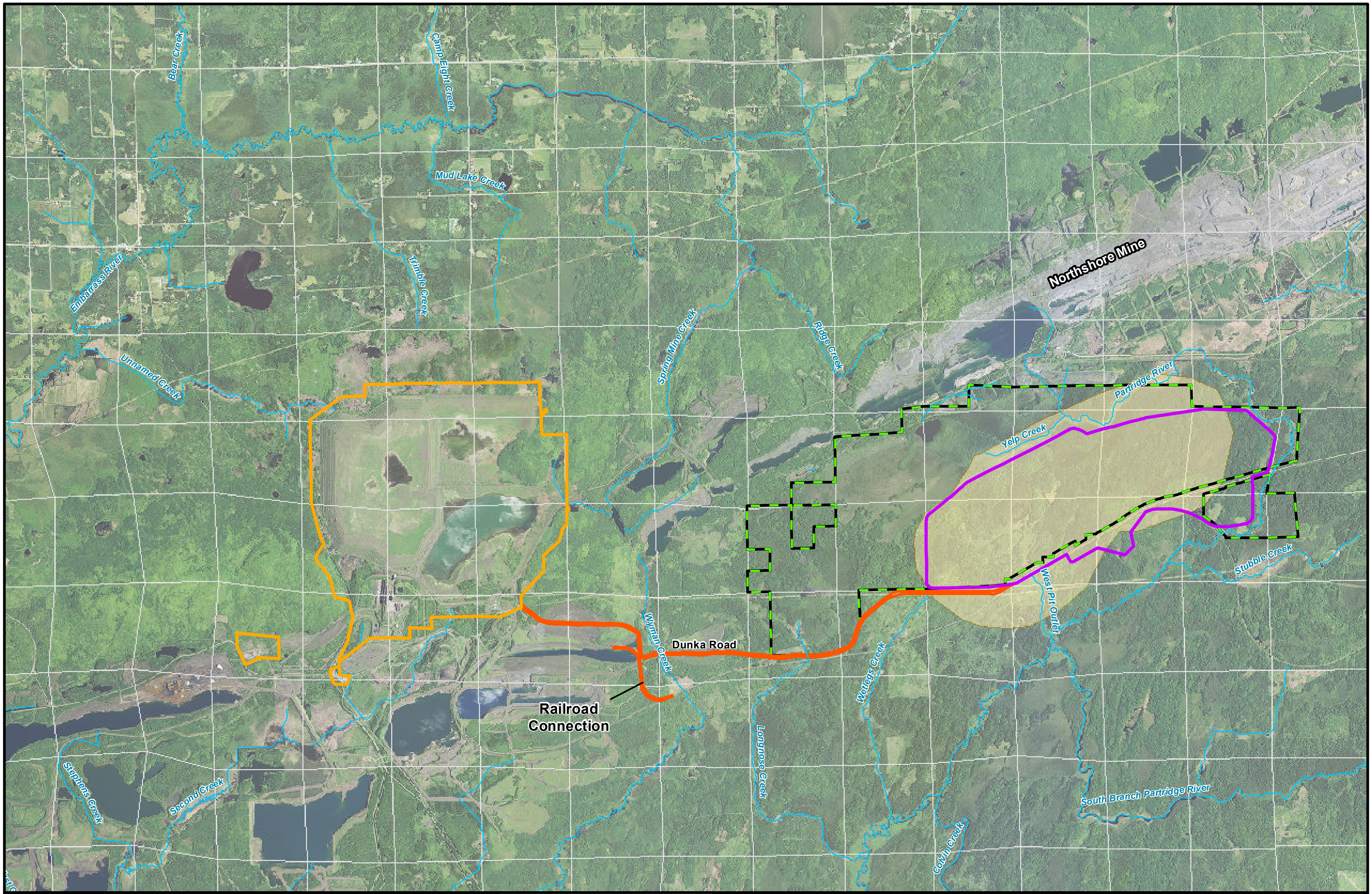
Figure 4.2.9-5
Cultural Resources Analysis - Surficial Groundwater Quality Area of Potential Effect
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

221 -Page Intentionally Left Blank-



Federal Lands
Mine Site
Plant Site
Transportation and Utility Corridor
Stream/River
Section Boundary
Groundwater Drawdown Area of Potential Effect

This document is a working document. This document may change over time as a result of new information, further deliberation, or other factors not yet known to the Co-lead Agencies.

N W E S

0 0.5 1 2 Miles

Figure 4.2.9-6
Cultural Resources Analysis - Groundwater Drawdown Area of Potential Effect
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

223 -Page Intentionally Left Blank-

The APE for visual effects was based on a cultural resource-specific analysis completed for the NorthMet Project Proposed Action by the federal Co-lead Agencies. At a distance of approximately 12 miles on a prominent landform (Skibo Scenic Overlook), the NorthMet Project Proposed Action stockpiles would be visible as a thin line on the horizon. The existing Plant Site buildings are visible from the same location. However, proposed construction at the Plant Site would not result in changes to the existing Plant Site profile visible in the distance. At intermediate distances between Skibo and the Mine Site, the elevations are lower and the Mine Site would not be visible. Therefore, the visual APE for the Mine Site is bounded by the crest of the Laurentian Divide (*Mesabe Widjiu*) and an area about 1 mile from the Mine Site on the eastern, western, and southern sides (see Section 5.2.11.2.2). The visual APE for the existing LTVSMC Tailings Basin at the Plant Site is not considered to be expansive, because the proposed Tailings Basin would be, for the most part, coincident with the existing basin and would not extend to an elevation higher than the existing LTVSMC Tailings Basin (see Figure 4.2.9-7).

To determine the combined noise effect of the NorthMet Project Proposed Action, the total noise generated from operations at both the Mine Site and Plant Site was added to the existing ambient daytime and nighttime baseline levels. Noise effects from rail transport were also assessed, but qualitatively. Blasting at the Mine Site would be a source of intermittent or non-continuous noise and vibration. Blasting noise is not included in the noise level estimates shown in the noise analysis because mine-blasting is typically an instantaneous event (not continuous or steady), and would occur only during daytime periods.

Operations at the Mine Site and Plant Site would occur 24 hours per day. The analysis showed total noise that would be experienced at any receptor location during the daytime (7 a.m. to 10 p.m.) and nighttime (10 p.m. to 7 a.m.) would be well below the Minnesota daytime and nighttime noise standards. In all cases, the NorthMet Project Proposed Action, when mining, hauling, and ore-crushing operations occur, would comply with the applicable Minnesota noise standards.

More specific information on noise-related effects is included in Section 5.2.8, for effects on humans, and Section 5.2.5, for effects on wildlife.

Lastly, the Co-lead Agencies recognized that several refinements were needed in order to finalize the APE. These refinements included the addition of the Dunka Road corridor, inclusion of 206.96 acres of federal parcels included in the Land Exchange Proposed Action that were omitted from the APE in the SDEIS, and inclusion of the Colby Lake Pumphouse and pipeline refurbishment.

Identification of Historic Properties

The SHPO maintains the official inventory of historic properties in Minnesota, as specified in the NHPA and *Minnesota Statutes* 138.081. This inventory is physically housed in two separate sets of files: the History/Architecture files contain records of buildings, structures, and landscapes, and the Archaeological Site files contain records of archaeological sites. A review of SHPO and USFS files and all previous cultural resources studies was conducted for the area covered by the APEs.

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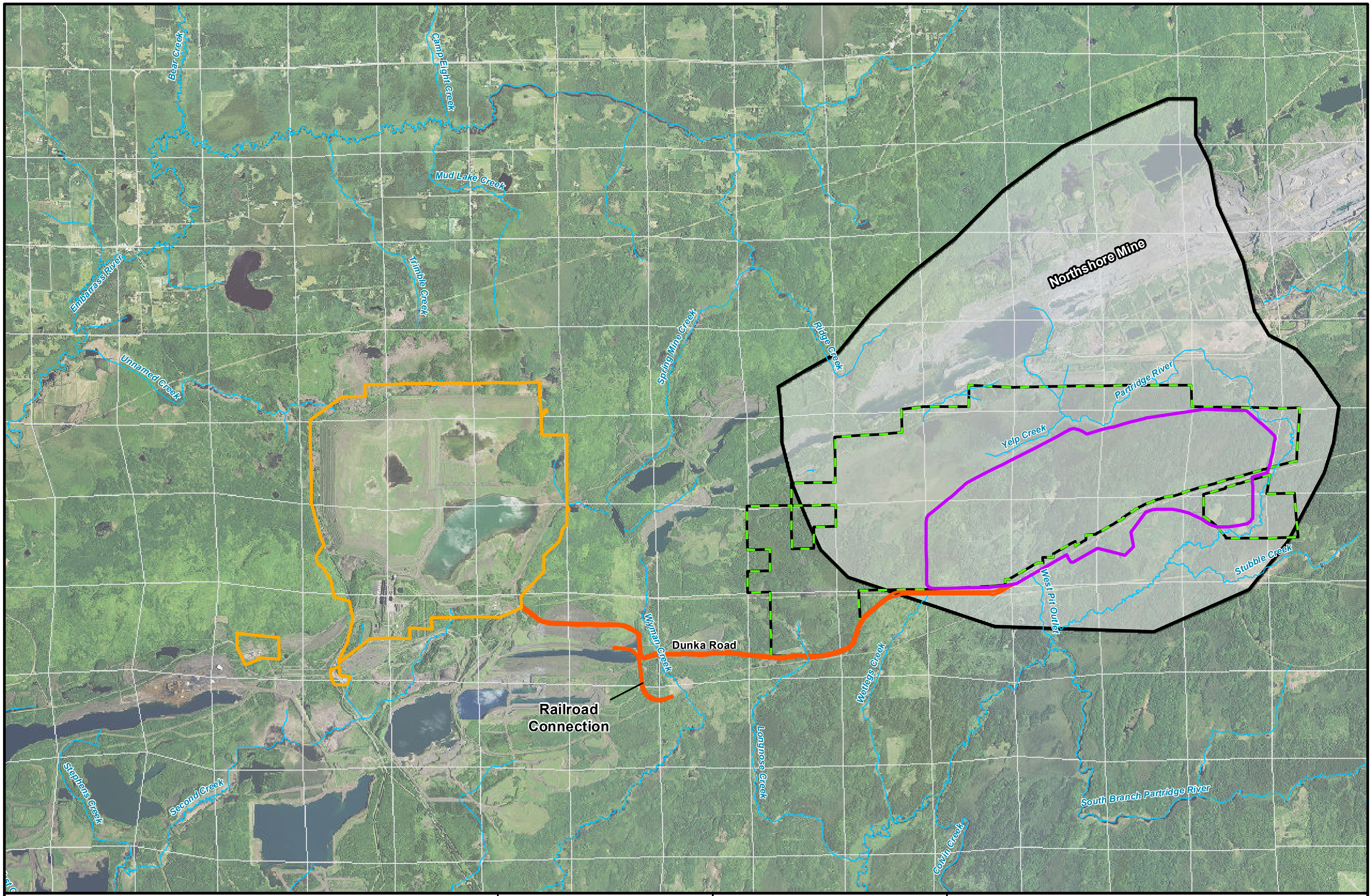

Federal Lands
Mine Site
Plant Site
Transportation and Utility Corridor
Stream/River
Section Boundary
Visual Area of Potential Effect

US Army Corps of Engineers
St. Paul District

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N W E S

0 0.5 1 2 Miles

Figure 4.2.9-7

Cultural Resources Analysis - Visual Area of Potential Effect

NorthMet Mining Project and Land Exchange PFEIS

Minnesota

June 2015

267

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Cultural Context

This section provides a basis for understanding the identification and evaluation of historic properties as it relates to existing conditions. An emphasis is also placed on understanding Ojibwe history and traditions because of a greater emphasis on environmental effects and their potential to affect resources of importance to the Bands. This section provides sufficient context to understand the process of identification and evaluation of historic properties of religious and cultural significance to the Bands.

Paleoindian (Circa 13,300 to 9,000 Before Present)

The earliest evidence for human occupation in North America is referred to as the Paleoindian Period. The beginning of this period largely coincides with the transition from the Pleistocene to the Holocene about 11,700 years before present (BP), which marks the transition out of the last glaciation. The Paleoindian Period spans from about 13,300 to 9,500 BP and is generally associated with finely made fluted, lanceolate-shaped projectile points.

This was a period of rapid environmental change as the climate was warming. The ice probably began to retreat about 17,000 BP and, by 9,000 BP, had largely retreated to the Hudson Bay Lowland. Thinning of the ice allowed changes in atmospheric circulation patterns, further affecting climate change (Teller 1987).

Proglacial lakes formed from the meltwater of the ice sheets as its flow was blocked by vast amounts of glacially deposited sediment at the terminal positions of the ice. As the ice continued its retreat, the outlets to the glacial lakes down-cut, lowering lake levels and developing well-defined drainage ways, leading to rapid hydrologic change. Areas where stagnant blocks of ice were buried in glacial sediment developed spruce forests on them and persisted for thousands of years.

The people during this time lived in a subarctic environment that has no direct analogue in the world today. The animals of this environment included mammoths, giant bison, and other now-extinct species. In ice-free areas during this early period, there were variations of fluted, lanceolate-shaped projectile points, as found on archaeological sites. The first published discovery of these projectiles in association with mammoth and an extinct form of bison occurred at archaeological sites in New Mexico.

These early people are thought of as highly mobile big-game hunters who traveled in small bands. Tools were light, efficient, and remarkably similar across great distances (Mason 1981), which suggests that there was a rapid spread of people across the continent at that time.

Radiocarbon dates on mammoth bone collagen and wood associated with stone tools place people in the southeast Lake Michigan Basin by at least 12,500 BP. In Minnesota, the lack of excavated or recorded early Paleoindian sites makes it difficult to identify site types or assess their distribution across the landscape. The known sites appear to be oriented toward the current waterbodies, but that may reflect survey coverage as opposed to actual site distribution. The small number of sites suggests there was a small population in Minnesota or that a large number of sites were destroyed or were deeply buried as the landscape evolved (Mather and Lindbeck 2011).

The late Paleoindian Period is better represented in Minnesota and adjacent parts of Canada. Sites on paleo-shoreline features of proglacial lakes in the Great Lakes region are a well-documented aspect of early settlement patterns such as at the Lakehead Complex sites at Thunder Bay, Ontario dating to roughly 9,500 BP; sites on the Campbell beaches of Lake Agassiz in the Quetico Provincial Park and Boundary Waters Canoe Area Wilderness (Julig et al. 1990); and on a beach ridge of Glacial Lake Aitkin in Aitkin County (Allan 1993). Julig suggests that the beach ridges may have been used for travel routes around the large glacial lake basins (Julig 1988; Julig et al. 1990).

The Reservoir Lakes northwest of Duluth are well-known for extensive surface collections that include Late Paleoindian and Archaic Points (Harrison et al. 1995). Dates from the Bradbury Brook site in Mille Lacs County place the site occupation at about 10,000 to 9,000 BP (Malik and Bakken 1993).

The Bradbury Brook investigation and analysis of other late Paleoindian assemblages suggest a preference for the use of Knife Lake Siltstone, which is a preference that may extend to much of northeast Minnesota and is reflected in the collections from the Reservoir Lakes.

Archaic (Circa 9,000 to 2,500 Before Present)

By 9,000 BP, climatic conditions were probably similar to that of present day, as inferred from the pollen record (Wright 1974). Around 9,400 BP, Lake Superior was dropping rapidly from its Minong levels (Julig et al. 1990) and by 9,000 BP, Lake Agassiz was retreating northward.

At the beginning of this period, lakes covered substantially larger areas and open water would have occupied areas of present day peatland (Hohman Caine and Goltz 1995). Water levels in the larger pro-glacial lakes receded as streams developed and down cut their outlets. As post-glacial warming continued, hydrology and vegetation changed. About 7,000 years ago, much of Minnesota was dominated by prairie and lakes may have periodically dried up during summer droughts (Wright 1974; Watts and Winter 1966; Webb et al. 1983). With changes to the composition of plant communities and shifts in the ranges and varieties of animal species, human adaptations to the environment changed, as well. Moose and caribou were probably replaced by bison in many locations.

Less predictable resources during the mid-Holocene may have resulted in populations concentrating in areas around the largest lakes and streams (Mason 1981) and a shift from a foraging to a collector strategy, with greater use of local environments as task groups ranged from camps located near predictable resources (Hohman Caine and Goltz 1995; Dobbs 1989).

The Itasca Bison Kill Site is an Early Archaic site located at the headwaters of the Mississippi River. It is the only archaeological site in Minnesota where the remains of extinct bison (*Bison occidentalis)* were found in association with cultural material. The bison were killed on the shore of a now-extinct lake. Radiocarbon dates suggest the site dates to about 8,000 years ago. Pollen and macrofossils preserved at the site indicate that the surrounding countryside was an open, pine-dominated woodland giving way to expanding prairie (Shay 1971).

Early Archaic sites in the Canadian-Shield/boreal forest areas are somewhat rare when compared to areas south of the Great Lakes (Mason 1981). The lack of Archaic sites was striking in the results of an archaeological survey on Rainy Lake (Gibbon and Woolworth 1977). In general, the Shield Archaic assemblages lack the complexity found in other regions. Assemblages do include some woodworking tools such as trihedral adzes.

The Shield Archaic is a cultural tradition showing in place continuity over thousands of years with late Paleoindian antecedents as opposed to an intrusion of new people. It appears to be a gradual succession of individual small-scale adaptations to new conditions (Mason 1981; Dobbs 1989).

Population levels during the mid-Holocene may have been lower than those during the late Paleoindian period, because the closed, coniferous forests would have been relatively resource poor (Mason 1981). The lack of recorded sites may be the result of large portions of the archaeological record for this period being submerged as lake levels rose to modern levels, being deeply buried under alluvial sediment, or eroded as stream flows changed (Michlovic 1982; Bettis and Thompson 1981; Overstreet and Kolb 2003).

Woodland Tradition (Circa 2,500 Before Present to European Contact)

This stage in prehistory is characterized by the initial appearance of earthen mounds and ceramics, although it is not certain if mound-building and the adoption of ceramics are related and occur at the same time. The most important cultural trends during this time are increasing population growth, intensification of regional identity, increasingly efficient use of local raw materials and food resources, and the intrusion of ideas and technologies. Dobbs (1989) suggested that, in northern Minnesota, ceramic use seems like more of a “veneer” that overlays a basic Archaic hunting and gathering lifestyle.

Initial Woodland populations in northern Minnesota are represented by a net-impressed ceramic type known as Brainerd Ware, which spans a period of from about 3,000 BP to 1,600 BP. The distribution of Brainerd Ware is well-known in the Mississippi River headwaters, extending west onto the plains. Brainerd Ware is also represented on some sites in St. Louis County (Hamilton 2009; Hohman Caine and Goltz 1995). Mather and Lindbeck (2011) suggest that this development occurred roughly at the same time wild rice was migrating from the lakes of southern and central Minnesota into the lakes of northern Minnesota. Residue from Brainerd vessels has produced rice phytoliths and radiocarbon dates of 2,000 years ago (Justin and Thompson 1995) and 2,700 BP to 2,800 years ago.

Many of the Brainerd sites are found on beach ridges associated with higher lake levels of this period. The remains of elk, bison, deer, and possibly caribou from a site near Leech Lake suggest the people who made Brainerd Ware were highly adapted to the prairie-forest ecotone (Hohman Caine and Goltz 1995).

The first burial mounds in northern Minnesota are associated with the Laurel Culture (Arizigian 2008). While the cultural relationship between Brainerd and Laurel is poorly understood, radiocarbon dates suggest that Brainerd precedes Laurel. Laurel dates range from 2,000 to 1,000 years ago. At the Big Rice site north of Virginia, Minnesota, wild rice grains were recovered from three pit features containing only Laurel ceramics and produced radiocarbon dates of about 2,035 to 1,700 years ago (Valppu and Rapp 2000).

In stylistic terms, Laurel is comparable to other woodland manifestations to the south and east. Laurel distribution is extremely broad, extending from west-central Quebec to east-central Saskatchewan, including northern Minnesota, where it is common in the Superior National Forest (Hamilton 2009). The best-known concentrations of Laurel occur in the Rainy River, Rainy Lake, and Vermillion River drainages and the Mississippi headwaters (Arizigian 2008).

Extensive surveys in Voyageurs National Park and the Superior National Forest have identified numerous Laurel sites, with 94 percent of those sites in the MDNR Laurentian Mixed Forest province and concentrated in the Border Lakes subsection of the Northern Superior Uplands. Most sites are in lacustrine settings (lakeshore, islands, and peninsulas), less than 20 percent are in riverine settings, and only 3 percent are in uplands.

During the Terminal Woodland, there are increases in site size and density, suggesting a population increase. The period begins in northern Minnesota, with the Blackduck-Kathio-Clam River cultures comprising stylistically similar ceramics. Kathio ceramics are primarily from the central lakes area of Minnesota, and Clam River ceramics are found mostly on tributaries to the St. Croix River in western Wisconsin. Early Blackduck begins about 1,400 years ago in the Mississippi headwaters and on the Rainy River, ending about 900 to 1,000 years ago.

The stratigraphic relationship of Blackduck ceramics to Laurel and the later Sandy Lake Ware is fairly well-known. Laurel and Blackduck may have coexisted for several hundred years. There have been no well-stratified sites excavated with components transitional between Laurel and Blackduck (Shaaf and Johnson 1978) and it is unclear whether Blackduck represents in situ evolution of Laurel (Thomas and Mather 1996) or the replacement of Laurel by a separate group of people (Stoltman 1973).

The most recent pre-contact archaeological culture in northern and central Minnesota is the Psinomani, dating from 900 to 360 years ago. It is associated with Sandy Lake and Ogechie ceramics. Sandy Lake ceramics are similar to other woodland ceramic types throughout North America, but Ogechie ceramics are most similar to Oneota ceramic types produced by the agricultural communities to the south. These groups were north of areas where corn agriculture was practiced successfully, particularly on major lakes and waterways of the Mississippi River headwaters: the Rainy River – Rainy Lake, and Boundary Waters systems and eastward to Lake Superior, with some sites in the prairie region to the west. The larger site size and greater population density is often attributed to the use of wild rice, but evidence also suggests use of the prairie forest ecotone and prairie, which includes seasonal bison hunts. The differences in the archaeological assemblages in the prairie region versus the central lakes area may represent the seasonal round, as opposed to different subsistence strategies.

Psinomani archaeological sites in the Mille Lacs area have been linked to the historic Mdewakanton Dakota through early historic records and artifact assemblages that include French trade goods.

In the Mille Lacs area, the end date for the Psinomani is based on the historic record for the displacement of Dakota people by the Ojibwe in 1750 AD. In the Rainy River area at the Long Sault Site, Sandy Lake pottery was found in association with historic trade goods, overlying a Blackduck component that dated to 1750 AD. At the Creech site on Leech Lake, there were levels with both Sandy Lake and Blackduck stratigraphically above levels containing only Blackduck ceramics (Johnson 1991) and at Mitchell Dam, Sandy Lake was described as associated with Blackduck (Cooper and Johnson 1964).

The practice of these Eastern Woodland lifeways was disrupted during the mid-17th century as European explorers and trade goods began to enter the region.

Ojibwe Context

The Ojibwe people were living in the upper Great Lakes region when European explorers first entered the area. Some archaeologists associate Blackduck ceramics with the Algonkian-speaking groups, including the Cree and Ojibwe (Johnson 1969; Steinbring 1980), while others have suggested association with Siouan-speaking Assiniboine. More recently, archaeologists believe that the makers of Blackduck ceramics were most likely Algonkian speakers, but the ethnic divisions of Cree and Ojibwe are historical constructions with little validity in prehistory (Greenberg and Morrison 1982).

The ancestral Ojibwe were part of a large clan-based group of people that referred to themselves as Anishinabe (original people). This Algonquian-speaking group was spread over a vast area of the subarctic region of southern Canada and the northern United States, a territory much larger than that of any other Native American tribe in North America (Tanner 1986).

Subsistence patterns depended, to some extent, on the location any one particular group inhabited and varied greatly across the territory occupied. The groups were not connected by a uniform subsistence base, but by a clan network. These clan groups were seasonally mobile, autonomous groups for centuries prior to the arrival of Europeans in North America. The earliest accounts talk of a number of distinct, but related groups, such as the Saulteur, the Outchibou, or Marameg (Tanner 1994). These people became known as “Ojibway” after the publication in 1885 of William Warren’s *History of the Ojibway People* (Warren 1984).

Their story starts prior to arrival of Europeans in North American, when the Anishinabe were living along the eastern seaboard. It was during that time, according to the Anishinabe sacred migration story, that a man beheld a vision from the Creator that foretold of the destruction of the Anishinabe and called on them to move west until they found the place “where food grows on the water:”

> While we were on the east coast, a man had a dream or a vision if you will. In this dream, he was told a number of things. The first was, he was to leave the area and take as many people as would go with him. The second was, if people did not leave many would perish. The third was, to travel towards the west and to follow the great megis shell when it rose out of the water, or sand, and to stop when it lowered back into the water, or sand, or if something reminded them of a turtle. The fourth was that their journey would end when they found the food that grows on water.
>
> He left with many following him, and went down the St. Lawrence River and waterways that led to the Great Lakes area. While in the central part of the Great Lakes area, two peoples split off from us. They are the Potawatomi and the Ottawa, who went into Canada, Michigan, and Wisconsin. The Anishinabe continued on to the edge of Lake Superior. Once we came inland, we never saw the megis shell again. This journey took over five hundred years and the prophecy that was told while we were on the east coast was kept alive orally from generation to generation by traditional storytelling. On our journey, we stopped seven times, sometimes for five days, sometimes for five years, it all depended on the megis shell. (Berens and Raske, Pers. Comm., August 14, 2012)

Pressures from European trade and from their Iroquois neighbors are often cited as motivation for this move (Risjord 2005). However, this explanation for westward migration is a Euro-

American perspective and contrary to oral history (Berens and Raske, Pers. Comm., August 14, 2012).

Anishinabe oral tradition relates a 500-year journey, beginning in about 900 AD on the east coast. Near the end of this journey, the fifth of the seven stopping places was in the area that is now the location of Sault Ste. Marie, Michigan, where a group stayed because of the rich fisheries. From Sault Ste. Marie, the Ojibwe split into two groups. One traveled north around Lake Superior and the other south around the lake. They met at Spirit Island in the St. Louis River Estuary, the sixth stopping place, where they found wild rice.

From Spirit Island, some moved east along the southern shore of Lake Superior to find the seventh stopping place, which was at Madeline Island—the last point on the migration.

Perhaps because the last part of the migration occurred during the time of European explorations, early accounts of settlement locations and how they relate to the migration and first arrival in the western Great Lakes are difficult to interpret. Oral tradition places the Ojibwe in the Lake Superior region as early as 1400 AD (Benton-Banai 1988:102). Other sources place the Ojibwe on the north shores of Lake Superior and the Upper Peninsula of Michigan by 1500 AD (Clifton et al. 1986).

The first known encounter with Europeans was at Sault Ste. Marie in 1609, when Samuel Champlain, founder of New France, established relations, intending to set up trading partnerships. As the Ojibwe began to focus on trapping for furs to trade, the once-autonomous bands reorganized into village-centered sociopolitical entities. This was an important demographic consequence of French influence and endemic native wars. Villages were established along the southern shore of Lake Superior in Keweenaw Bay, La Point, and Sault Ste. Marie, and probably represented only a fraction of the population dispersed across the Western Great Lakes and interior waters (Zedeño et al. 2001).

As the fur trade gained momentum in the east, increased conflict resulted as the beaver supply was being exhausted. In the mid-1600s, the British-allied Iroquois pushed the Huron out of their land and into the Tionontati, Erie, and Ottawa regions, which also affected the Ojibwe presence at Sault Ste. Marie. Subsequently, throughout the early 1700s, many groups moved into areas previously vacated because of the Iroquois threat. The Fox began an aggressive campaign against the French in the Detroit area, who were thought to prevent the Fox from carrying on trade with the Dakota. The Fox and the Dakota were allied in their interests in Plains resources. The Ojibwe went to the aid of the French as a sign of their loyalty. The final battle between the Fox and the Ojibwe was fought at St. Croix Falls in 1755. The Ojibwe conflict with the Fox had affected Dakota-Ojibwe relations.

After the second Treaty of Paris in 1783 sealed the victory of the American Revolution, the new Americans felt that the land ceded to them in the treaty included the land where the Ojibwe and other Great Lakes tribes lived (Tanner 1986). Warfare between the Ojibwe and the Dakota made merchants extremely cautious of moving to land west of Michigan (Hickerson 1970). In order to end continuing land disputes between the Ojibwe and the Dakota, and secure a peaceful frontier for settlers, the United States encouraged the signing of the 1825 Treaty. The treaty defined boundaries of land owned by the Ojibwe (Kappler 1904).

As more settlers pushed into the Lake Superior region in search of timber and minerals, the United States government bought land from the Ojibwe through cession treaties. The Treaty of

1836 ceded land in Michigan's Upper and Lower Peninsulas and parts of the Great Lakes, and the Treaty of 1837 ceded land in north-central Wisconsin and east-central Minnesota. The Treaty of 1842 ceded land in northern Michigan and Wisconsin and the western part of Lake Superior; and the 1854 Treaty ceded land in northeastern Minnesota, and created reservations for many Ojibwe bands. These treaties reserved the rights of the Ojibwe to hunt, fish, and gather on lands they sold to the United States (Kappler 1904).

History of the Iron Range

Minnesota became the thirty-second state in 1858, which spurred an ever-increasing flow of European-American settlement and the establishment of towns, cities, and enterprises other than fur trade (Mason 1981). Wheat surpassed corn as the principal crop in 1860, with much of it being exported out of state. White pine and red pine were sought after by loggers, and were harvested in the Fort Snelling area as early as 1820. By 1870, there were 207 saw mills in Minnesota. In 1877, a law allowing sale of timber off state lands further opened the state for logging. The logging boom had tapered off by the early 1900s (Risjord 2005).

In 1865, the newly appointed Minnesota state geologist, Augustus Hanchett, with the help of his assistant, Thomas Clark, issued a report generally describing copper ore deposits in the Lake Superior area and iron ore deposits at Lake Vermilion (Hanchett and Clark 1865). The following year, Henry H. Eames replaced Hanchett as state geologist and issued a report confirming the presence of gold ore around Lake Vermilion, creating a short-lived Minnesota gold rush during which other Minnesota ores were ignored (Lamppa 2004). Discovery of iron ore in the Vermilion Range led the Pennsylvania industrialist Charlemagne Tower to buy large tracts of land on the Vermilion Range. In 1882, Tower organized the Minnesota Iron Company and, by 1884, shipped the first ore from the Soudan Mine by rail on the company's Duluth and Iron Range Railroad to Lake Superior (Risjord 2005).

The Merritt Brothers of Duluth laid groundwork for their Mountain Iron Mine through their explorations during the 1890s (Minnesota Historical Society 2008). Up to that point, only the far-eastern portion of the Mesabi Range had been mined for iron, and not on a large commercial scale, with mostly hand tools being employed (Walker 1979; Atkins 2007). They opened their second mine in 1891 near Biwabik. By 1892, they shipped their first carload of ore on their Duluth, Missabe, and North Railroad to dock in Superior, Wisconsin (Minnesota Historical Society 2008). A loan from John D. Rockefeller to the Merritts to expand the railroad ultimately led to the transfer of all of their mining and rail properties to Rockefeller. Shortly thereafter, all of the mining interests in Minnesota were owned by eastern interests, with J.P. Morgan consolidating the Rockefeller and Carnegie holdings in 1901 under U.S. Steel (Risjord 2005).

By 1890, when the Mesabi Iron Range deposits were discovered, nearly 300 iron mining companies had been incorporated in Minnesota. By 1900, the Mesabi Range was the most extensive iron ore mining area in the world, supplying increasing demand by steel mills throughout the Great Lakes states (Hall 1987). Early mining ventures in the Mesabi Iron Range focused on hematite, a soft granular rock rich in iron that could be mined with steam shovels and required limited processing. More than 95 percent of the iron deposits in the Mesabi Range consist of taconite, a hard iron-bearing rock that must be pulverized and processed for mineral extraction (Risjord 2005).

In the late 1920s, increased mechanization reduced the number of workers needed and increased productivity. However, due to the Great Depression, iron ore production in the Iron Ranges dropped dramatically by the early 1930s (Lamppa 2004). A cost-effective technology for taconite processing was developed by the late 1930s. Taconite mining was made even more economically feasible by two factors: 1) legislation passed in 1941, replacing property taxes within the Iron Range with taxes on actual ore mined, and 2) increased demand due to World War II. The Reserve Mining Company was formed in 1942 (Risjord 2005). In 1964, when interest in taconite pellet use in steel manufacture prompted interest in increasing taconite pellet production, an amendment was passed that guaranteed that the tax advantages of the 1941 taconite legislation would be maintained (Lamppa 2004).

In 1957, the Erie Mining Company opened its concentration plant at Hoyt Lakes. This plant was Minnesota's second large-scale taconite plant, and it remained in operation through 2001, with a change in ownership to LTVSMC in the 1980s, and then to Cleveland Cliffs in 2001 (Zellie 2007). While six new taconite plants were built on the Iron Range in the 1960s and '70s, inexpensive imports changed the industry and decreased demand by two-thirds (Risjord 2005).

Cultural Resources Investigations

Several cultural resources studies have been completed within or adjacent to the NorthMet Project and Land Exchange areas (see Figure 4.2.9-8). This section presents previous investigations that have been conducted prior to the development of the NorthMet Project Proposed Action, as well as investigations conducted specifically for the NorthMet Project Proposed Action.

Previous Investigations

In 1985, the USFS conducted a Phase I cultural resources survey as part of the Yelp Lake Timber Sale (USFS 1985). The survey consisted of a desktop review of historical aerial photographs and pedestrian reconnaissance survey of manmade features such as clearings, roadways, and trails, as well as landforms exhibiting the potential for containing archaeological sites. Overall, the area was considered to have low potential for containing prehistoric and historic archaeological sites, as well as architectural structures. During the Phase I cultural resources survey, one historic period resource (SHPO ID 09-09-01-115) was identified. The resource was only described as being related to the historical railroad and logging context and does not fall within the current NorthMet Project or Land Exchange areas.

In 1990, the USFS conducted a Phase I cultural resources survey as part of the Stubble Creek Timber Sale (USFS 1990). The survey consisted of a desktop review of historical aerial photographs, helicopter flyover, and pedestrian reconnaissance survey of manmade features such as clearings, roadways, trails, and structures, as well as landforms exhibiting the potential for containing archaeological sites. Overall, the area was considered to have moderate potential for containing historic archaeological sites and architectural structures and a low potential for containing pre-contact archaeological sites, with the exception of areas adjacent to the Partridge River. During the Phase I cultural resources survey, no previously recorded cultural resources were noted within the NorthMet Project area; however, three new cultural resources were identified (SHPO IDs 09-09-01-362, 09-09-01-363, and 09-09-01-364). All three resources are associated with the historic period, though the report is unclear as to whether these resources are archaeological sites, standing architectural structures, or both. The North Partridge Camp

(SHPO ID 09-09-01-362) and the Stubble Creek Mill (SHPO ID 09-09-01-364) were not evaluated and the South Branch Bridge (SHPO ID 09-09-01-363) was recommended not eligible. None of these resources fall within the current NorthMet Project or Land Exchange areas.

In 1997, the USFS conducted a Phase I cultural resources survey as part of the Laird/LTV II Project (USFS 1997). The survey consisted of a desktop review of historical aerial photographs, helicopter flyover, and pedestrian reconnaissance survey of manmade features such as clearings, roadways, and trails, as well as landforms exhibiting the potential for containing archaeological sites. During the Phase I cultural resources survey, no new cultural resources were identified; however, five previously identified cultural resources were noted. None of these five previously identified resources fall within the current NorthMet Project or Land Exchange areas.

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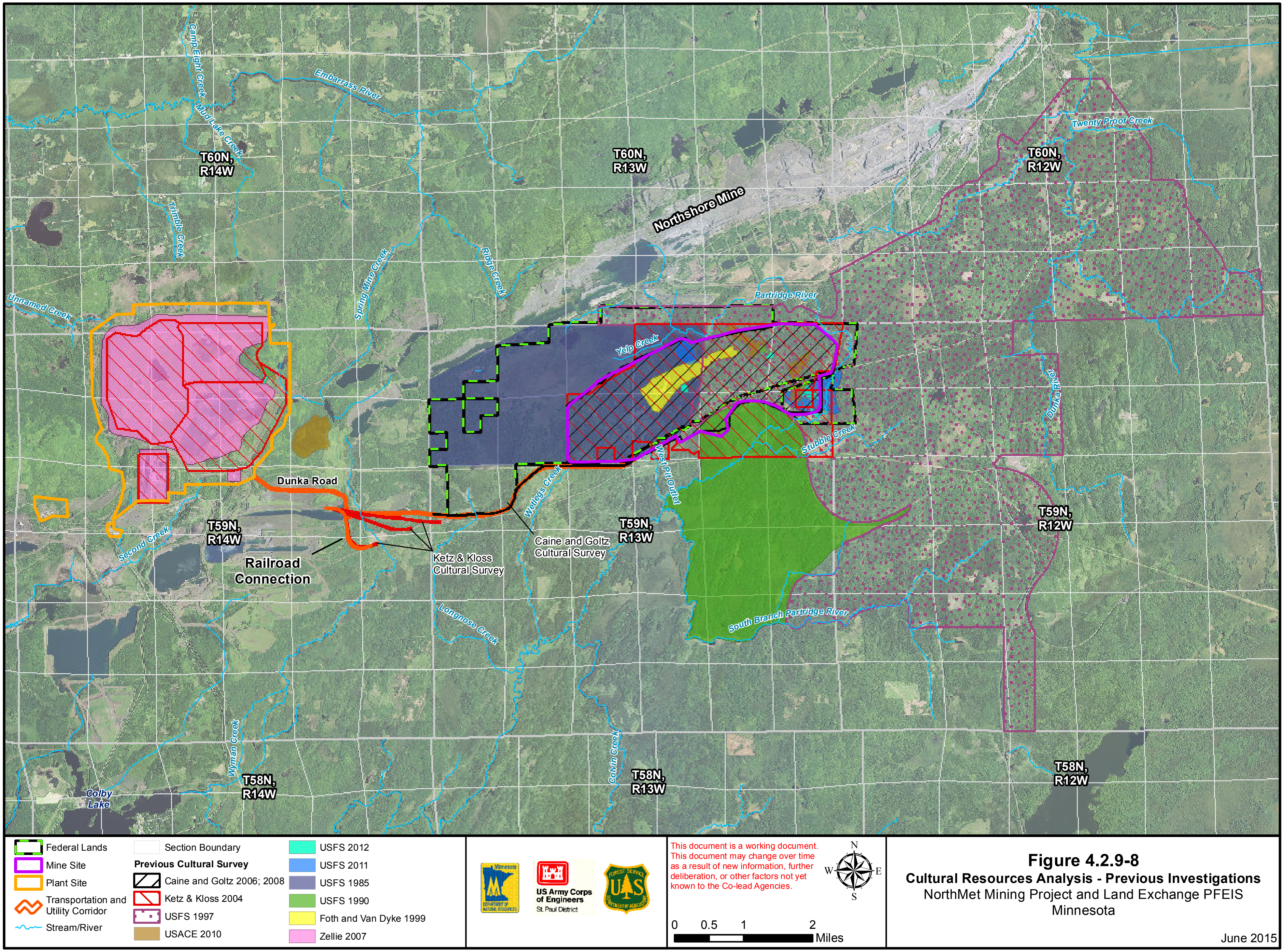


Figure 4.2.9-8
Cultural Resources Analysis - Previous Investigations
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

617 -Page Intentionally Left Blank-

Investigations Conducted for the NorthMet Project Proposed Action

In 1999, Foth and Van Dyke completed a Phase I archaeological survey within the proposed Mine Site where exploratory drilling was to take place (Foth and Van Dyke 1999). The survey area covered approximately 20 acres. The Phase I archaeological survey involved the excavation of 166 shovel tests placed at 15-meter intervals along the proposed drilling transects with exception to areas exhibiting standing water or exposed bedrock. No new or previously identified archaeological resources were identified within the survey area; however, the literature review portion of the investigation indicated that three historic logging camps (including the Knot Camp Site) and a mill were located to the south and east of the proposed Mine Site.

In 2004, The 106 Group Ltd (106 Group) conducted a cultural resources assessment for the NorthMet Project Proposed Action (Ketz and Kloss 2004). The assessment included the lease area (an area approximating the Mine Site), the former LTVSMC processing plant, the Tailings Basin, and three proposed railroad interconnection alternatives. The 106 Group found that no pre-contact archaeological sites had been previously identified within the 2004 study area. It was also concluded that the pre-contact archaeological potential for most of the study area is poorly understood, but likely of low potential. However, several upland areas located adjacent to the Partridge River and large wetland complexes were considered to have high potential for pre-contact archaeological resources. The 106 Group noted the presence of one previously reported (not field-verified) historic archeological site, the Knot Logging Camp (21SLmn), as well as the potential for two early historic Native American trails as noted on historical maps (Ketz and Kloss 2004; Trygg 1966). The 2004 study also identified several architectural history resources associated with the former LTVSMC processing plant. These resources include the former Erie Mining Company Taconite facility and associated mining features including an associated rail line. The 106 Group recommended that a Phase II architectural history evaluation be completed for the LTVSMC site (Ketz and Kloss 2004).

In 2005, Soils Consulting conducted a Phase I archaeological survey for the NorthMet Project Proposed Action (Hohman Caine and Goltz 2006). The investigation entailed the archaeological survey of select landscape features determined by Hohman Caine and Goltz to have the highest potential for pre-contact archaeological sites. Additionally, a survey was also carried out in areas noted on historical maps and/or in previously identified archaeological site files as containing historical features, such as Native American trails or logging camps. During the investigation, one new archaeological site (NorthMet Archaeological Site) was identified and one previously identified archaeological site (Knot Logging Camp [21SLmn]) was revisited. The NorthMet Archaeological Site was found to contain four lithic artifacts. This newly identified site was recommended as potentially eligible for listing on the NRHP under Criterion D for its potential to yield important information regarding the pre-contact use of the region's landscape (Hohman Caine and Goltz 2006). The Knot Logging Camp was reported to have been affected by recent logging activities and was recommended as not eligible for listing on the NRHP due to its lack of integrity.

Additionally, a deeply worn trail was identified during the 2005 investigation (Hohman Caine and Goltz 2006). Soils Consulting suggested that the worn trail may represent a section of a historical Native American trail as noted on a map compiled by John W. Trygg from the original GLO surveys (Trygg 1966). There is the potential that this trail could represent a historical Native American trail connecting Lake Vermilion to Beaver Bay. Shovel testing was completed along the potential historical trail; however, no archaeological resources were identified (Hohman Caine and Goltz 2006).

In 2007, Soils Consulting conducted a Phase I archaeological survey for the NorthMet Project Proposed Action focusing on the Dunka Road Expansion and Substation areas, as well as a Phase II archaeological evaluation of the previously identified NorthMet Archaeological Site (Hohman Caine and Goltz 2008). The Phase I archaeological survey consisted of a pedestrian reconnaissance survey of areas considered to have potential for containing archaeological sites. No areas were designated as requiring subsurface testing. No archaeological resources were identified during the Phase I archaeological survey of the Dunka Road Expansion and Substation areas (Hohman Caine and Goltz 2008). The Phase II archaeological evaluation of the NorthMet Archaeological Site consisted of the placement of three shovel tests and four 1-meter by 1-meter excavation units and one ¼-meter by ¼-meter excavation unit. The Phase II investigation rendered three potential lithic artifacts consisting of one possible basalt core, one possible siltstone flake, and one fragment of quartz. No features or concentrations, such as fire-cracked rock or discolored soils, were noted and the site area was documented as having been previously disturbed by a 10-meter-wide road cut. Upon completion of the Phase II archaeological evaluation of the NorthMet Archaeological Site, Soils Consulting found that the site was unlikely to yield additional information important to the understanding of the past. Therefore, Soils Consulting recommended that the NorthMet Archaeological Site be considered not eligible for listing in the NRHP (Hohman Caine and Goltz 2008). The USACE and SHPO subsequently concurred with this recommendation.

In 2007, Landscape Research LLC (Landscape Research) conducted a Phase I architectural history survey and developed a historic context to evaluate the architectural resources at the former LTVSMC processing plant that could be affected by the NorthMet Project Proposed Action (Zellie 2007). Through consultation with the USACE and SHPO, it was determined that these were the appropriate steps for evaluating the architectural resources that could be affected. The Phase I architectural history survey identified 17 properties, two of which (the Erie Mining Company Concentrator Building [SL-HLC-008/046] and segments of the Erie Mining Company Railroad mine and track [SL-HLC-015/053]) were recommended eligible for listing in the NRHP. The former LTVSMC processing plant as a whole, however, was not recommended as eligible for listing as an NRHP historic district due to the previous demolition of the pelletizing building. The pelletizing building was a critical component of taconite production and its demolition significantly altered the historic integrity of the plant complex. Landscape Research also recommended that the Erie Mining Company Concentrator Building (SL-HLC-008/046), as well as other key plant buildings and structures, be appropriately recorded prior to their mandated (Rule 6132-1300 E 4 c) post-mining demolition. The SHPO concurred with these recommendations in 2009, but an MOA that includes these properties has yet to be finalized.

In 2014, Landscape Research on behalf of PolyMet examined areas that had been added to the APE based on further air and water quality studies presented in the SDEIS (Zellie 2014). The supplemental Phase I architectural survey work was conducted to ensure there were no survey gaps as a result of the change from the original APE to the refined APE published in the SDEIS. The supplemental Phase I architectural survey analyzed 12 properties, three of which (Duluth, Missabe, and Iron Range [DM&IR] Segment [SL-HLC-pending], three segments of the Erie Mining Company Railroad [SL-HLC-015/053], and the Erie Mining Company Administration Building [SL-HLC-pending]) were recommended eligible for listing in the NRHP. The findings of the investigation indicated that potential effects from the NorthMet Project Proposed Action on the three additional segments of the Erie Mining Company Railroad (SL-HLC-015/053) would consist of refurbishment for reuse during operations and, per state law, demolition upon Project completion. At the time of the investigation, the potential effects on the DM&IR Segment (SL-HLC-pending) were not known; however, the reuse of segment portions was thought likely. No potential effects were identified for the Erie Mining Company Administration Building (SL-HLC-pending) as a result of the NorthMet Project Proposed Action.

In 2015, the Co-lead Agencies carried out historical document research and Phase IA desktop survey to further assess a location identified as an “Indian Encampment” on the Trygg Maps (Trygg Land Office-GLO composites Map, Sheet 17, 1966). The Bands expressed concern that the location, which they often referred to as a “rice camp,” might be impacted by the NorthMet Project Proposed Action. The Co-lead Agencies plotted the precise location of the reported site by using the running notes from the 1873 survey of Township 60 North, Range 14 West (Ketola, Pers. Comm., January 26, 2015). Based on this analysis, the Co-lead Agencies confirmed that the site was buried during the construction of Erie’s tailings basin. The Phase IA desktop survey, which utilized the 1937 (partial coverage), 1948, and 1961 aerial images, did not identify any standing structures or historic features in the analysis area.

Efforts to Identify Properties of Religious and Cultural Significance

At a consultation meeting in July 2008 to discuss the results of the surveys conducted by Soils Consulting as referenced above, the Bands voiced general concerns about archaeological survey coverage and specific concerns with the Indian trails shown on the Trygg Maps.

The Bands and USACE worked together to develop a plan for the identification of properties of religious and cultural significance (Plan). In April 2010, the USACE consulted with the Bands and PolyMet concerning the implementation of the Plan. The Plan consisted of four components:

1. Interviews to be conducted by the Bands with Band elders to gather information concerning past use of the NorthMet Project area.
2. Baseline ethno-historical research pertaining to Ojibwe use of the APEs would be used in a cultural landscape assessment of the NorthMet Project area and surrounding vicinity. Background research to identify cultural and natural landscape features would include, at a minimum, the original GLO survey notes and maps developed by Trygg, along with other historic maps of the NorthMet Project area and surrounding vicinity, relevant historic documents and literature.
3. Classification of plant communities by the identification of canopy species using aerial infrared photography and the identification of understory, shrub, and herbaceous layers using existing plant lists of specific community types, based on the MDNR’s ECS. This also included ground-truthing to determine accuracy for classification and gathering of additional information on AOCs to the Bands.
4. A field survey to locate and assess the cultural and natural features identified as a result of the background research, elder interviews, and plant classification.

The intent of the Plan was to use plant community classification to identify plant resource areas of interest to the Bands and facilitate identification of historic properties. The archival research was to provide historic documentation and context for the historic Native American trail system and possibly identify other places important to the Bands. The elder interviews then would be used to further identify and understand tribal use areas and places of importance. The field investigation component was to be informed by the results of those efforts.

The field review primarily focused on a reconnaissance-level investigation of the trail corridors as mapped by Trygg (1966) and specific trail locations recorded during the Land Office surveys. Reconnaissance of the trail corridors was conducted by the federal Co-lead Agencies with participation from the Bands. Barr participated in a portion of this fieldwork to gather information for completing the classification of plant communities. Barr also continued their effort to gather plant data aside from the trail reconnaissance.

During 2010 and 2011, PolyMet contracted the Bois Forte, Fond du Lac, and Grand Portage to conduct interviews with Band elders. The Fond du Lac and Grand Portage bands have not made the results of the interviews available for use, though the Bois Forte interviews have been considered during this identification process. The Bois Forte interviews did not provide any specific locations, but some general information was provided. Elders recalled that some Band members had utilized the general NorthMet Project area for hunting, fishing, and plant gathering of wild rice, maple-sugar, berries, and birch bark; however, they could not provide specific locations or uses within the NorthMet Project area.

The federal Co-lead Agencies recognize the importance of natural resources such as wild rice beds as both ecological communities and as important traditional cultural resources for the Ojibwe people. However, those resources must meet NRHP criteria to be considered historic properties and receive further consideration under Section 106. The federal Co-lead Agencies have considered effects on wild rice and other natural resources, as discussed in other resource-specific sections of this FEIS and below in Sections 4.2.9.2.4 and 5.2.9.

The results of the elder interviews, archival research, and plant surveys are discussed in a report titled *NorthMet Project Cultural Landscape Study for PolyMet* (Zellie 2012). The report has been reviewed and coordinated with the USACE, USFS, and Bands. The USFS conducted a historic context study of the Beaver Bay to Lake Vermilion (BBLV) overland trail, which was provided as an appendix to the final report. Additional fieldwork completed by the USACE, USFS, and Bands may be added to the above-referenced report or provided as a standalone report, based on future consultation with the Bands. As a result of the field reconnaissance, archival research, and elder interviews, a number of properties of religious and cultural significance have been identified within the APE. These properties include the Spring Mine Lake Sugarbush, the *Mesabe Widjiu* (Laurentian Divide), the Overlook location, and the BBLV Trail Segment.

4.2.9.2.4 Identified Cultural Resources

Cultural resources investigated within the NorthMet Project area—such as architectural history properties, archaeological sites, and properties of religious and cultural significance to the Bands—are discussed in this subsection. The investigations completed to date in the NorthMet Project area have identified cultural resources as summarized in Table 4.2.9-1.

Table 4.2.9-1 Cultural Resources Identified in the NorthMet Project Area

Resource ID	Resource Name	Resource Type	NRHP Determination by Co-lead Agencies	SHPO Concurrence with Co-lead Agencies' Findings
SL-HLC-002/040	Erie Mining Company Coarse Crusher	Architectural Property	Not Eligible	Concur
SL-HLC-003/041	Erie Mining Company Fine Crusher	Architectural Property	Not Eligible	Concur
SL-HLC-004/042	Erie Mining Company Conveyor and Drive House	Architectural Property	Not Eligible	Concur
SL-HLC-005/043	Erie Mining Company General Shops	Architectural Property	Not Eligible	Concur
SL-HLC-006/044	Erie Mining Company Reservoir	Architectural Property	Not Eligible	Concur
SL-HLC-007/045	Erie Mining Company Water Tower	Architectural Property	Not Eligible	Concur
SL-HLC-008/046	Erie Mining Company Concentrator Building	Architectural Property	Eligible	Concur
SL-HLC-009/047	Erie Mining Company Tailings Thickener Tanks	Architectural Property	Not Eligible	Concur
SL-HLC-010/048	Erie Mining Company Pelletizing Building (razed)	Architectural Property	Not Eligible	Concur
SL-HLC-011/049	Erie Mining Company Central Heating Plant	Architectural Property	Not Eligible	Concur
SL-HLC-012/050	Erie Mining Company Fuel Oil Tanks	Architectural Property	Not Eligible	Concur
SL-HLC-013/051	Erie Mining Company Pellet Stockpile and Stacker	Architectural Property	Not Eligible	Concur
SL-HLC-014/052	Erie Mining Company Mine Area No. 2 Shops	Architectural Property	Not Eligible	Concur
SL-HLC-015/053	Erie Mining Company Railroad Mine and Plant Track, Main Line Segment, and Dunka Railroad Segment	Architectural Property	Eligible	Concur
SL-HLC-016/054	Erie Mining Company Tailings	Architectural Property	Not Eligible	Concur

Resource ID	Resource Name	Resource Type	NRHP Determination by Co-lead Agencies	SHPO Concurrence with Co-lead Agencies' Findings
	Basin			
SL-HLC-017/055	Erie Mining Company Mine Area No. 1 Shops	Architectural Property	Not Eligible	Concur
SL-HLC-018/056	Erie Mining Company Concentration Plant Complex	Historic District	Not Eligible	Concur
SL-HLC-pending	DM&IR Segment	Architectural Property	Eligible	Concur
SL-HLC-pending	Erie Mining Company Colby Lake Pumping Station and Pipeline	Architectural Property	Not Eligible	Concur
SL-HLC-pending	Erie Mining Company Administration Building	Architectural Property	Eligible	Concur
SL-HLC-pending	Spring Mine and Stockpiles	Architectural Property	Not Eligible	Concur
SL-HLC-pending	Erie Mining Company Mine Area No. 2	Architectural Property	Not Eligible	Concur
SL-HLC-pending	Erie Mining Company Mine Area No. 3	Architectural Property	Not Eligible	Concur
SL-HLC-pending	Erie Mining Company Mine Area No. 5	Architectural Property	Not Eligible	Concur
SL-HLC-pending	Erie Mining Company Dunka Road Segment	Architectural Property	Not Eligible	Concur
SL-HLC-pending	Erie Mining Company High Voltage Transmission Line Segment	Architectural Property	Not Eligible	Concur
SL-HLC-pending	Reserve Crusher No. 2 (Northshore Mining)	Architectural Property	Not Eligible	Concur
SL-HLC-pending	Erie Mining Company Railroad Corridor Historic District	Historic District	Eligible	Concur
SL-HLC-pending	Erie Mining Company Landscape Historic District	Historic District	Eligible	Concur
21SLpending	Spring Mine Lake Sugarbush	Archaeological Site	Eligible	Concur
SL-HLC-pending	*Mesabe Widjiu* (Laurentian Divide)	Archaeological Site	Eligible	Concur

Resource ID	Resource Name	Resource Type	NRHP Determination by Co-lead Agencies	SHPO Concurrence with Co-lead Agencies' Findings
SL-HLC-pending	Overlook	Archaeological Site	Not Eligible	Concur
SL-HLC-pending	BBLV Trail Segment[1]	Archaeological Site	Eligible	Concur
21SLpending	NorthMet Archaeological Site	Archaeological Site	Not Eligible	Concur
21SLmn	Knot Logging Camp	Archaeological Site	Not Eligible	Concur

Note:
[1] USFS designation BBLV Trail Segment #1 (USFS #01-569).

Erie Mining Company Concentration Plant Complex

The historic site SL-HLC-018/056 consists of the primary Erie Mining Company Concentration Plant buildings, such as the coarse and fine crushers and the concentrator; mine and plant track segments of the Erie Mining Company railroad; a Tailings Basin; pellet stockpile area; and mine areas. Treated as a mining complex or district, the property's integrity is diminished by the loss of the pelletizing plant (SL-HLC-010/048), a central component. Its qualities of association, design, and related aspects of feeling and setting are lost without this key component (Zellie 2007). Although some components of the property may be determined eligible individually, the Erie Mining Company Concentration Plant Complex (SL-HLC-018), as a complex/district, was determined not eligible for inclusion in the NRHP.

The Concentrator Building (SL-HLC-008/046) is a key property and reflects Erie Mining Company's decades of experimentation in production and engineering design (Zellie 2007). The Concentrator Building is recommended as being individually eligible for inclusion in the NRHP under Criterion A in the areas of Industry and Engineering, and also under Criterion C in the area of Engineering. The building retains a good level of historic integrity, including qualities of location, design, setting, materials, workmanship, and feeling. The quality of association is fair due to the removal of the pelletizer. At the interior, much of the layout and equipment dates to original construction (Zellie 2007).

The Administration Building (SL-HLC-pending) remains a well-preserved component of the original taconite plant design. It is significant under NRHP Criterion A in the areas of Industry and Engineering and is associated with the statewide historic context: *Minnesota's Iron Ore Industry, 1880s-1945*. The period of significance is 1954 to 1969.

The Erie Mining Company railroad (SL-HLC-015/053) is a 74-mile railroad system created solely for the transportation of ore for shipment to Taconite Harbor. The railroad was in operation during the plant's period of significance (1954 to 1969) and directly linked pellet production with shipping facilities. The period of significance spans from the start of railroad construction, circa 1954 to 1957, through 1964, the date of Dunka Railroad construction. Identified segments of the Erie Main Line Railroad and Mine and Plant Track, as well as Dunka Railroad within the APE, are recommended as eligible for inclusion in the NRHP under Criterion A in the areas of Commerce, Industry, and Transportation.

The following buildings, all of which are associated with the plant complex, have been determined individually not eligible for inclusion in the NRHP:

- Coarse Crusher (SL-HLC-002/040);
- Fine Crusher (SL-HLC-003/041);
- Conveyor and Drive House (SL-HLC-004/042);
- General Shops (SL-HLC-005/043);
- Reservoir (SL-HLC-006/044);
- Water Tower (SL-HLC-007/045);
- Tailings Thickener Tanks (SL-HLC-009/047);
- Pelletizing Building (SL-HLC-010/048);
- Central Heating Plant (SL-HLC-011/049);
- Fuel Oil Tanks (SL-HLC-012/050);
- Pellet Stockpile and Stacker (SL-HLC-013/051);
- Mine Area No. 2 Shops (SL-HLC-014/052);
- Tailings Basin (SL-HLC-016/054);
- Mine Area No. 1 Shops (SL-HLC-017/055);
- Colby Lake Pumping Station and Pipeline (SL-HLC-pending);
- Mine Area Nos. 2, 3, and 5 (SL-HLC-pending);
- Dunka Road Segment (SL-HLC-pending); and
- High Voltage Transmission Line Segment (SL-HLC-pending).

Erie Mining Company Railroad Corridor Historic District

The Erie Mining Company Railroad segments within the APE are eligible for inclusion in the NRHP as a standalone railroad corridor historic district. The Erie railroad corridor historic district includes the mine and plant track, the Erie mainline segment within the APE, and a segment of the Dunka rail spur servicing Mine Area No. 8. This district also includes several buildings in the vicinity of the Plant Site that were serviced by rail: the pellet loader, the mine areas that used rail to move ore to the concentration plant, and other buildings associated with rail transportation during the period of significance. The integrity and significance of the Erie Railroad itself supports inclusion of many of the Erie Mining Company buildings, structures, and objects as contributing resources that would otherwise not be individually eligible. Additionally, it provides a significant contribution to the integrity of the larger Erie Mining Company Landscape Historic District.

Erie Mining Company Landscape Historic District

The portion of the Erie Hoyt Lakes operation located within the APE, including the Erie Concentration Plant Complex, retains the necessary elements to contribute to a larger NRHP-eligible Erie Mining Company Landscape Historic District. The APE for the NorthMet Project Proposed Action includes structures, topographic features, small-scale features, vegetation patterns, and patterns of circulation that are associated with incipient taconite production and shipment on Minnesota's Mesabi Range, circa 1954 to 1969. The features within the APE associated with Erie taconite operations are also emblematic of a purposefully modified and developed landscape that retains integrity and is associated with a significant historic event. In addition, these features retain the ability to inform about the post-World War II industrial process of low-grade iron ore extraction and refinement, and the ultimate shipment of finished taconite pellets to Great Lakes steel mills.

Given the dynamic nature of markets and evolving technologies, mining landscapes often contain complex arrangements of features that may date to several distinct mining periods. The scope of this evaluation is the portion of the Erie Hoyt Lakes taconite operations located within the APE for the NorthMet Project Proposed Action that are associated with the period of significance from 1954 to 1969. This includes a subsidiary rail system serving the Mine Site and Plant Site, as well as a segment of the Erie main line (Dunka segment), the Concentration Plant Complex, expansive mine pits and stock piles representative of large-scale taconite extraction, and many other still extant buildings, structures, and objects associated with power generation, water supply, maintenance, administration, traffic control for both rail and vehicle, and security, all of which are associated with the industrial process of taconite production on the Mesaba Range from the period of 1954 to 1969.

The overall Erie Hoyt Lakes taconite operation conveys significance through the components (Hoyt Lakes, concentration Plant Site/Mine Site, railroad system, and Taconite Harbor shipping facility) that represent implementation of the comprehensive planning effort for one of the largest mining operations of its time. The loss of the pelletizer does not compromise the overall integrity of the larger property. The portion of the Erie Mining Company within the APE retains a high degree of integrity and an ability to convey significance through the composite effects of location, design, setting, materials, workmanship, feeling, and association and contributes to a potentially larger Erie Mining Company Mining Landscape Historic District. The identified landscape components, transportation features, and structures associated with the 1954 to 1969 period of significance contribute to the Erie Mining Company Landscape Historic District and are eligible to the NRHP under Criterion A at a state level for their association with Mining Development on the Mesaba Iron Range.

With respect to the integrity of the contributing historic properties identified in Erie Mining Company Landscape Historic District, the structures and features associated with Erie operations during the period of significance retain integrity of location, association, setting, workmanship, feeling, and materials and individually contribute to an historic mining landscape. Several structures, features, and transportation corridors associated with post-1969 taconite development that have been identified within the NorthMet APE do not, however, contribute to this historic landscape and are not considered as contributing elements for the purposes of this review. The monumental scale of the concentrator building, the considerable number of buildings remaining at the concentration Plant Site, and the mine pits, transportation infrastructure, stockpiles, and Tailings Basin that define the landscape convey the significance of the Erie Mining Company taconite operation from the 1954 to 1969 period of significance. The numerous other buildings and objects associated with the Erie Mining Company within the APE, including the railroad system that defines circulation patterns and provides a linkage between many of these resources, also contribute.

Table 4.2.9-2 provides a list of historic resources from the investigations completed to date that are contributing/non-contributing components of the larger Erie Mining Company Landscape Historic District.

Table 4.2.9-2 Historic Resources Associated with the Erie Mining Company Historic District

Resource ID	Resource Name	Individual Eligibility	Landscape District	Railroad District
SL-HLC-002/040	Erie Mining Company Coarse Crusher	Not Eligible	Contributing	Contributing
SL-HLC-003/041	Erie Mining Company Fine Crusher	Not Eligible	Contributing	Contributing
SL-HLC-004/042	Erie Mining Company Conveyor and Drive House	Not Eligible	Contributing	Contributing
SL-HLC-005/043	Erie Mining Company General Shops	Not Eligible	Contributing	Non-Contributing
SL-HLC-006/044	Erie Mining Company Reservoir	Not Eligible	Contributing	Non-Contributing
SL-HLC-007/045	Erie Mining Company Water Tower	Not Eligible	Contributing	Non-Contributing
SL-HLC-008/046	Erie Mining Company Concentrator Building	Eligible	Contributing	Non-Contributing
SL-HLC-009/047	Erie Mining Company Tailings Thickener Tanks	Not Eligible	Contributing	Non-Contributing
SL-HLC-010/048	Erie Mining Company Pelletizing Building (razed)	Demolished	N/A	N/A
SL-HLC-011/049	Erie Mining Company Central Heating Plant	Not Eligible	Contributing	Non-Contributing
SL-HLC-012/050	Erie Mining Company Fuel Oil Tanks	Not Eligible	Contributing	Non-Contributing
SL-HLC-013/051	Erie Mining Company Pellet Stockpile and Stacker	Not Eligible	Contributing	Non-Contributing
SL-HLC-014/052	Erie Mining Company Mine Area No. 2 Shops	Not Eligible	Contributing	Contributing
SL-HLC-015/053	Erie Mining Company Railroad Mine and Plant Track, Main Line Segment, and Dunka Railroad Segment	Eligible	Contributing	Contributing

Resource ID	Resource Name	Individual Eligibility	Landscape District	Railroad District
SL-HLC-016/054	Erie Mining Company Tailings Basin	Not Eligible	Contributing	Non-Contributing
SL-HLC-017/055	Erie Mining Company Mine Area No. 1 Shops	Not Eligible	Contributing	Non-Contributing
SL-HLC-018/056	Erie Mining Company Concentration Plant Complex	Not Eligible	Contributing	Contributing
SL-HLC-pending	Erie Mining Company Colby Lake Pumping Station and Pipeline	Not Eligible	Contributing	Non-Contributing
SL-HLC-pending	Erie Mining Company Administration Building	Eligible	Contributing	Non-Contributing
SL-HLC-pending	Erie Mining Company Mine Area No. 2	Not Eligible	Contributing	Contributing
SL-HLC-pending	Erie Mining Company Mine Area No. 3	Not Eligible	Non-Contributing	Non-Contributing
SL-HLC-pending	Erie Mining Company Mine Area No. 5	Not Eligible	Non-Contributing	Non-Contributing
SL-HLC-pending	Erie Mining Company Dunka Road Segment	Not Eligible	Non-Contributing	Non-Contributing
SL-HLC-pending	Erie Mining Company High Voltage Transmission Line Segment	Not Eligible	Non-Contributing	Non-Contributing

Duluth, Missabe, and Iron Range Segment

This approximately 3.5-mile-long DM&IR (previously D&IR and now CN) segment within the NorthMet Project Proposed Action APE is a portion of the former 97-mile-long, primarily single-track roadbed constructed in 1884 between Two Harbors and the Soudan Mine east of Tower, Minnesota. The evaluated DM&IR segment predates the Erie Mining Company Plant at Hoyt Lakes (1957) by more than 80 years. The D&IR (and its successor line, the DM&IR) was built as a shipping line for the Vermilion iron range to the northeast. Beginning in the early 1950s, it also provided Erie and its successor, LTVSMC, with construction and mining supplies and raw materials used in the Erie plant. The approximately 3.5-mile-long DM&IR segment is significant under NRHP Criterion A for its association with the development of Vermilion iron range mining and lumber industries and the development of Tower, Soudan, and Ely from 1884 to 1964. The segment retains integrity of location, design, and, in some places, integrity of materials.

Spring Mine and Stockpiles

The Spring Mine is located northeast of the Erie Mining Company Plant Site. The Spring Mine is a natural ore mine. It was opened as an underground mine in 1906, possibly by the Kingston Mining Company, and it produced a soft, gray Bessemer hematite. This small, open pit natural ore mine and its stockpiles appear to be typical of those on the Mesabi Iron Range and do not represent advancements in mining technology. This mine does not appear to possess significance as an important example of an early 20th-century natural ore mine under Criterion A in the area of Industry and Engineering. The mine is not known to be associated with persons significant in local, state, or national history and is not significant under Criterion B. It is not significant under Criterion C in the area of Engineering. It has not yielded, nor is it likely to yield, information important in prehistory or history and is significant under Criterion D. Therefore, the Co-lead Agencies have determined that the Spring Mine and stockpiles are ineligible for the NRHP.

Reserve Mining Company's Crusher #2

Reserve Mine, originally known as Peter Mitchell Mine, is currently operated by the Northshore Mining Company, which actively mines taconite adjacent to the proposed NorthMet Mine Site. In relation to the APE, a waste rock stockpile from the Mine Site is within the viewshed of the adjacent Northshore Mine associated with Reserve Mining Company activities circa 1956 to 1965. Crusher #2, built by Reserve Mining Company in 1963, appears to have served in a supplemental role to Reserve Mining Company's primary crusher (Crusher #1) constructed in 1956. The structure is not significant under Criterion A in the areas of Industry and Engineering. The federal Co-lead Agencies have determined that the structure does not possess significance under Criterion B, C, or D. Therefore, the agencies have determined that Crusher #2 is ineligible for the NRHP. The Co-lead Agencies believe that the inventory conducted in the visual effects APE is adequate and commensurate with the anticipated effects.

Spring Mine Lake Sugarbush Site

Although not located within the Plant Site, the Spring Mine Lake Sugarbush Site (SL-HLC-pending) is located within the APE to the west of the Mine Site. Field investigations as early as 1969 (Loftus 1977) had identified a "Late Historic Period Chippewa Sugar Maple Camp," south of the intersection of the BBLV Trail Segment and east of the New Indian Trail (Trygg 1966). This sloping, approximately 80-acre site appears to be a natural maple-basswood stand of cultural use and significance. The site was reported to have a structure in the interior of a maple grove that was constructed of pine logs secured with round iron nails. Stockpiled birchbark baskets and basswood wedges[sic] or paddles and "various other containers" were interspersed with metal pots and pans within the structure, (Loftus 1977:73). The report concluded that the site was culturally significant because it allowed "for a comparison of Late Historic Chippewa sugaring practices with those of the Early Historic Period." Recent visits to the site by USACE staff and Band members identified it as a large multi-component site with evidence of maple sugaring activity from a range of time periods. Various types of historic artifacts and features demonstrated the continued use of the site into the middle part of the 20th century. The stand itself contains trees that may be up to 200 years old, according to the Erie Mining Company forester (Loftus 1977). During the 2010 survey, many large maple trees were observed that exhibited scaring from repeated tapping. The trunks on these trees were flattened at about 4 to 8 ft above the ground, with visible interior decay on many trees that was most likely the result of the long-term effect of repeated tapping for sap collection. Also, the site has more than 75 percent sugar maple, less than 5 percent basswood, and less than 1 percent yellow birch. This community type in its natural state would have about 35 percent sugar maple, 10 to 25 percent basswood, and some yellow birch (Zellie 2012). This difference may be the result of the relationship between the maple tree and the Ojibwe. The traditional practice of sugaring includes an emphasis on the use of basswood for paddles and troughs.

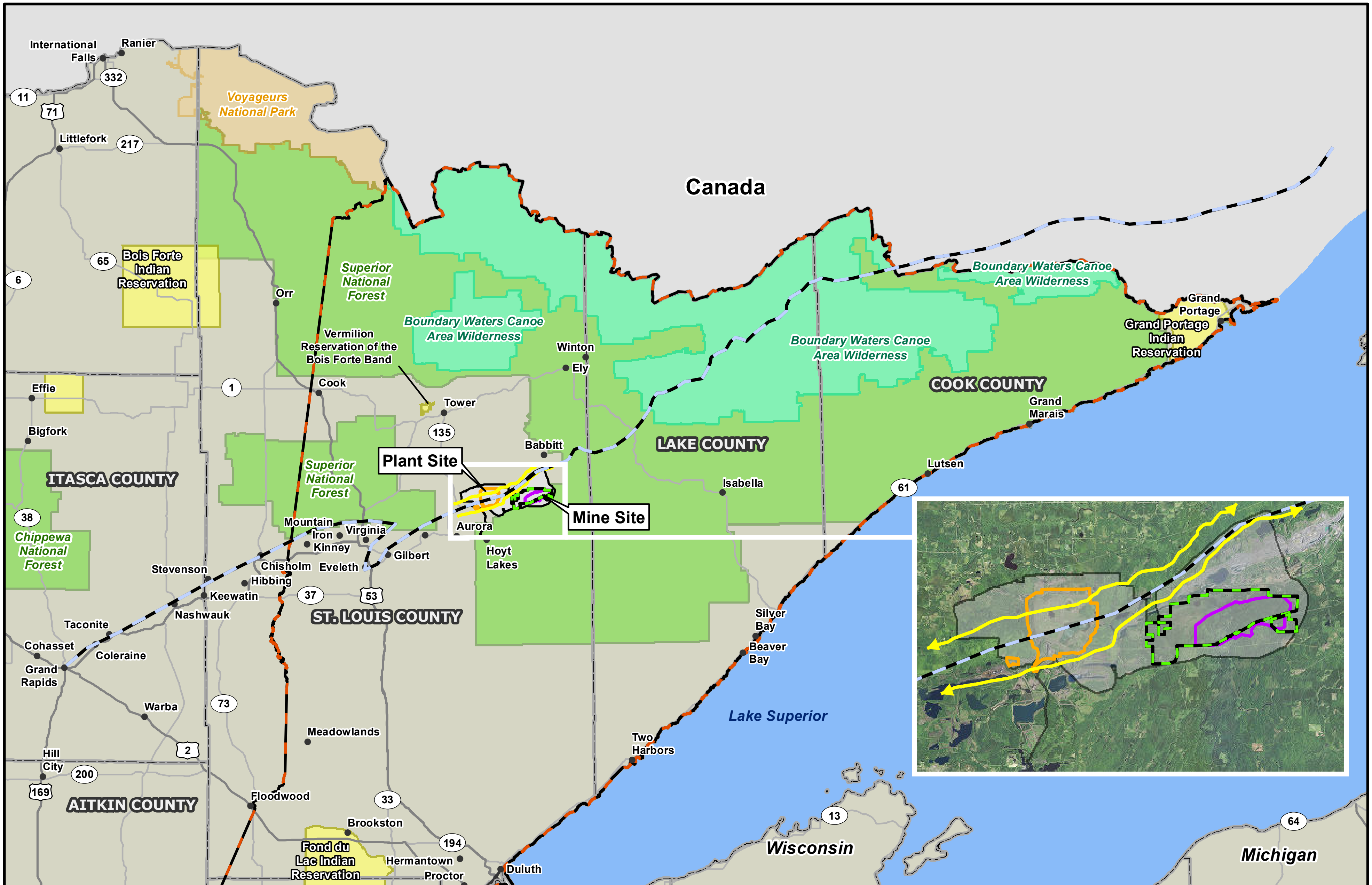
The Spring Mine Lake Sugarbush Site possesses good historic integrity, notably an integral relationship to traditional cultural practices or beliefs, and retains artifactual evidence of prior use as a sugarbush. Based on the site's tie to recent oral histories by Ojibwe elders, its location near the BBLV and New Indian trails mapped by Trygg (1966), photographic evidence of use by Ojibwe families as early as 1941 (Latady and Isham 2011), and its potential role as part of a once-extensive system of sugarbush locations in St. Louis County, the Spring Mine Lake Sugarbush is determined eligible for inclusion in the NRHP under Criterion A. It functioned as a place for sharing and maintaining traditional Ojibwe knowledge of and spiritual connections to the world, which were fundamental to the cultural identity of the Bois Forte Band. Under Criterion D, the site is significant for its potential to answer important questions about possible 19th and 20th century Ojibwe maple sugaring practices.

Mesabe Widjiu

Mesabe Widjiu, or the Laurentian Divide (SL-HLC-pending), is regarded as a sacred place to the Bands, possessing cultural significance for the Ojibwe. Often referred to by various names, such as the Giant's Range or Mesabi Heights, the *Mesabe Widjiu* is a long linear landform running the length of the Mesabi Iron Range and into the area of Thunder Bay, Ontario. Figure 4.2.9-9 depicts the location of the *Mesabe Widjiu*. It should be noted that the depiction of the culturally significant landform from the eastern end of the Iron Range to Thunder Bay is only a representation based on topographic features and was not informed by historical and/or ethnographic information. This portion of the Mesabi Range and Laurentian Divide, parts of which intersect the Plant Site, occupies the crest of a line of low, rugged, Precambrian rock hills where the divide separates the watershed of streams that flow north to the Arctic Ocean from the watershed of streams that flow south through the Great Lakes to the Atlantic Ocean (Ojakangas and Matsch 1982). Based on the elder interviews, the *Mesabe Widjiu* is part of the Band's oral history and cosmology explaining the origin of the hills and the separation of waters along the divide. The *Mesabe Widjiu* is also the path that the Thunderbirds follow. The various granite-capped outcrops and ledges are used for traditional practices because of the *Widjiu*'s spiritual significance. Despite distant views of mining features to the east that include the skyline of the Erie Mining Company plant, the *Mesabe Widjiu* viewshed possesses good historic integrity, notably an integral relationship to traditional cultural practices or beliefs. *Mesabe Widjiu* is determined eligible for inclusion in the NRHP under Criterion A for its association with important Ojibwe spiritual and cultural practices.

In connection with *Mesabe Widjiu*, a granite bedrock outcrop (SL-HLC-pending) providing an east-facing Overlook is located at the site of the proposed Tailings Basin within the Plant Site. Recent visits to the Overlook by USACE staff and Band members identified the presence of oak trees and a number of potentially important natural features, including a spring. In addition, the Overlook is situated at the junction of two trails. Although this trail feature is identified on Trygg maps, the location is not corroborated by the GLO land survey notebooks from that township.

Band elders have noted the cultural significance of both oak trees and east-facing overlooks in the Ojibwe tradition. An outcrop such as this might have been used by Ojibwe for spiritual reasons. Because there is no documented use of this location, the Overlook is determined not individually eligible for inclusion in the NRHP, but included as part of the *Mesabe Widjiu*.



- Mine Site
- Plant Site
- Federal Lands
- Approximate Site Boundary of Mesabe Widjiu, Partridge River Section
- Mesabe Widjiu, Preliminary Full Extent *
- Cultural Resources Area of Potential Effect
- 1854 Ceded Territory
- Native American Reservation
- National Park
- Boundary Waters Canoe Area Wilderness
- National Forest
- City/Town

* Preliminary depiction of full extent based on topographic analysis and not cultural/historical information.

US Army Corps of Engineers St. Paul District

This document is a working document. This document may change over time as a result of new information, further deliberation, or other factors not yet known to the Co-lead Agencies.

0 5 10 20 30 Miles

Figure 4.2.9-9
Cultural Resources Analysis - Mesabe Widjiu
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

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BBLV Trail Segment

Overland trail systems, such as the 75-mile-long BBLV Trail Segment, were frequently referenced during late 19th century GLO surveys in the western Superior Basin (Trygg 1966). Despite mention in the historic record, the trails themselves, and the role they played as transportation systems prior to development of railroad transportation in the region, are underrepresented in the literature. The available literature would suggest, however, that overland trails played a prominent role within a regional transportation system that included interior waterways, short-haul portages, and overland portages leading from Lake Superior to points inland. While the vast majority of the transportation networks in the Western Superior Basin are recognized as routes that maximized waterborne transportation, the BBLV Trail Segment represents one of the few overland trail corridors where lakes and rivers were not utilized. Within this context, it would appear that the route functioned as a winter transportation corridor, or perhaps an expedient summer route from the Lake Superior Watershed into Lake Vermilion. Support for the BBLV Trail Segment's function as a winter route comes from several sources, both primary and anecdotal in nature. Christian Wieland, who conducted the GLO survey of T59N, R13W in the winter of 1872 noted crossing the "Trail from Beaver Bay to Lake Vermilion" at three locations while conducting the survey (GLO 1873).

Historic records also suggest that overland trails were utilized by both local Ojibwe and mineral prospectors from at least the mid-19th century through the early 20th century (Skillings 1972; Lancaster 2009). Historic overland trails are best viewed as a component of an interrelated transportation system where trails and water routes interconnect to form a large and intricate system of communication and transportation (Burns 1985). The southeastern head of the overland trail is situated at Beaver Bay, which had a significant Ojibwe population from at least 1854 to 1930 (Davis 1968; Skillings 1972; Lancaster 2009). Beaver Bay provided access from a mid-point on Lake Superior, located about halfway between Grand Portage and Fond du Lac, the two primary, historic ingress points to the interior portions of Northeastern Minnesota.

The significance of the BBLV Trail Segment to the Ojibwe of Northeastern Minnesota is perhaps more nuanced than the significance ascribed by archaeologists, whose focus remains on attaching significance to physical manifestations of historic events. Consultation with the Bands elicited the importance of both how the trails connected past Ojibwe community in a physical sense and the ability for trails to also connect communities in a contemporary sense. Statements of significance were predicated on the fact that in the late 19th century, Ojibwe residence in the newly ceded territory was highly mobile, and families enrolled at locations at which they happened to be when the rolls were being populated. "In a sense, Ojibwe from scattered locations throughout the ceded territory may have enrolled at a location that was far away from their place of primary residence … at the time, social organization was very fluid, and marriages, disagreements, and the opportunities for wage labor caused folks to move around a lot." There is a general agreement among tribal consultation partners that the trails, or in the case of some, the trail corridors themselves, function as "physical manifestations of the social fluidity that existed among northeastern Minnesota's Ojibwe communities at that time." Consulting partners stated that the trails are "like a lifeline that permeates all aspects of history. That the overland trails are something entirely different than functional trails that are present today, trails that some would refer to as coming and going trails, in that you use them for a purpose and then you return home. The Beaver Bay to Lake Vermilion Trail is viewed as something different … it is viewed as a trail that connects you to who you are, in that they are important signature of cultural identity and reconnection to past ways" (Berens and Raske, Pers. Comm., August 14, 2012).

Although barely discernible in some cases, a few well-defined segments of the BBLV Trail Segment and two other unnamed trail segments represent the trail corridors that cross the Mine Site and Plant Site, as well as the NorthMet Project area (Zellie 2012). Although interrupted by Euro-American agriculture, logging, and mining, as well as road and townsite development, the trails remain an important cultural and spiritual connection for the Bands. Recent oral histories by Band elders substantiate this significance. These segments are potentially part of a once-extensive system of overland trails that were in use during hundreds of years of Ojibwe occupation. Therefore, the BBLV Trail Segment is significant for the role it played in the broad patterns of Ojibwe land use and early mineral exploration. It is eligible for inclusion in the NRHP under Criteria for Evaluation A and D.

NorthMet Archaeological Site

The NorthMet Archaeological Site (21SL pending) is located at the Mine Site. The site was identified through subsurface testing and consisted of pre-contact lithic artifacts. Due to the sparse nature of the artifacts and lack of features, it was believed that the site was unlikely to yield any further information significant to the understanding of past cultural history, and therefore was determined to be not eligible under Criterion D. As a result, the site was determined to be not eligible for inclusion in the NRHP.

Knot Logging Camp

The Knot Logging Camp (21SLmn) is located outside the NorthMet Project area, although within the APE of the NorthMet Project Proposed Action. The historic site was originally identified by USFS staff through historic aerial photography analysis. Field investigations at the site identified pit features and historic debris typical of a logging camp, including stove parts, cans, and other metal materials. The site had been reported to be severely affected by recent and historic logging activities. No obvious remnants of previously identified berms were evident. Historic research failed to uncover anything regarding the individual camp itself other than its affiliation with a brief period in the logging industry in northeastern Minnesota. Thus, the site was determined to be not eligible under Criterion A. Due to the sparse nature of the artifacts and lack of significant features, it was believed that the site was unlikely to yield any further information significant to the understanding of past cultural history, and therefore was determined to be not eligible under Criterion D.

Effect determinations have been drafted by the federal Co-lead Agencies for review and comment by the Bands, SHPO, and PolyMet. The federal Co-lead Agencies have determined that the above properties would be eligible for inclusion in the NRHP. The agencies are working on final boundary determinations for those properties in consultation with the SHPO and the Bands.

Summary of Results Coordination

The USACE has coordinated the results of the archaeological surveys discussed above with the SHPO (USACE 2007; USACE 2009; SHPO 2007; Co-lead Agencies 2014a, 2014b, 2015) and, based on strategic sampling of the NorthMet Project area, the SHPO and USACE concurred that no further efforts were required to identify archaeological resources within the APE. However, the Bands had concerns about the survey coverage (see section above for additional detail).

Through consultation with the USACE and SHPO, it was determined that Phase I architectural history surveys, coupled with the development of a historic context, were appropriate steps for evaluating the architectural resources that may be affected by the NorthMet Project Proposed Action. The initial Phase I architectural history survey identified two properties that were recommended eligible for listing in the NRHP: the Erie Mining Company Concentrator Building (SL-HLC-008/046) and segments of the Erie Mining Company Railroad mine and track (SL-HLC-015/053). Within the refined APE, additional sections of the Erie Mining Company Railroad Mine and Plant Track, Main Line Segment, and Dunka Railroad Segment were identified. The federal Co-lead Agencies consulted with SHPO concerning properties identified as part of additional Phase I architectural history survey. The federal Co-lead Agencies have determined four properties eligible for listing in the NRHP: the Erie Mining Company Administration Building (SL-HLC-pending), Erie Mining Company Landscape Historic District (SL-HLC-pending), Erie Mining Company Railroad Corridor Historic District (SL-HLC-pending), and DM&IR Segment (SL-HLC-pending).

The federal Co-lead Agencies have consulted with the Bands and the SHPO concerning the results of identification efforts for properties of religious and cultural significance to the Bands. Consultation focused on applying NRHP criteria to the properties identified, discussion of property boundaries for those meeting the criteria, as well as discussions to further understand the traditional religious and cultural significance of those properties. As a result, the Spring Mine Lake Sugarbush, the BBLV Trail Segment, and *Mesabe Widjiu* were determined eligible. The Overlook location was not considered by the Co-leads to be eligible in itself, but eligible as part of the *Mesabe Widjiu*.

At various times during consultation for the NorthMet Project Proposed Action, the Bands have proposed a historic district that includes the above properties as well as others that have been reported outside of the APEs. The historic district, proposed by the Grand Portage Band in a June 27, 2013 letter, consists of an approximately 216,000-acre area, extends from Lake Vermilion south to Duluth by way of the St. Louis River, and is bounded on the northeast by an arbitrary line extending southeast from Lake Vermilion to Beaver Bay. The Co-lead Agencies, at this time, believe that additional identification and evaluation efforts within this area would be outside of the scope of the NorthMet Project Proposed Action.

To summarize, the federal Co-lead Agencies have followed the initiation and identification processes outlined in 36 CFR 800.3 and 36 CFR 800.4, respectively, and have involved consulting parties in the finding and determination process completed to date. Multiple historic property identification efforts have occurred over a 15-year period within the proposed NorthMet Project area. These identification efforts have included both standard field inventory and assessment and identification of properties of cultural and religious significance to consulting Bands.

4.2.9.3 Cultural Identity: Natural Resources as Cultural Resources

For most Native American tribes, subsistence is synonymous with culture and identity. Subsistence activities generally constitute a way of being and relating to the world, and thus comprise an essential component of Native American identity and culture. Because Native Americans consider subsistence activities such as obtaining, processing, and distributing natural resources as essential components of maintaining their cultural customs and traditions, one cannot be arbitrarily removed from the other. Therefore, Native Americans generally consider an effect on subsistence resources and/or the ability to hunt, fish, or gather these resources as an effect on associated and perhaps fundamental aspects of cultures and traditions.

The spiritual connection to subsistence resources, and the manner in which these resources are harvested, is an essential part of Ojibwe culture. Potential effects on subsistence resources could therefore impact the culture and tradition of the Ojibwe. For instance, subsistence practices in a particular area could be affected by a loss of hunting, fishing, or gathering opportunities, thereby affecting the traditional or cultural practice that takes place in that area. Effects on subsistence resources in areas where traditions are practiced may have an effect on the ability of individuals or families to pass those traditional practices, knowledge, and beliefs to future generations. The identity of Ojibwe as a people is dependent on the transmission of that knowledge and belief system to the next generation.

4.2.9.3.1 Federal Tribal Trust Responsibility

The federal government has a unique legal relationship with the federally recognized Native American tribes, which has been set forth in the U.S. Constitution, treaties, statutes, court decisions, and EOs. This legal relationship is often referred to as the "Federal Trust Doctrine" or "Federal Tribal Trust Responsibility," which is a body of law defining the relationship of federal government with federally recognized Native American tribes.

Beginning in the mid-19th century, the government of the United States made treaties with the Ojibwe that ceded areas of land in northern Minnesota to the federal government. In return, specific reservations were created for the tribes' use and other considerations specified. The treaties also preserved the right of the Ojibwe bands to hunt, fish, and gather off the reservations within these ceded territories. The federal trust responsibility requires that federal agencies consider their actions with respect to tribal rights, particularly reserve rights, where they exist.

In 1854, the Chippewa of Lake Superior entered into a treaty (1854 Treaty of La Pointe or 1854 Treaty; Kappler 1904) with the United States whereby the Chippewa ceded to the United States ownership of their lands in northeastern Minnesota. These lands are generally known as the 1854 Ceded Territory. Article 11 of the 1854 Treaty provides, *"...and such of them as reside in the territory hereby ceded, shall have the right to hunt and fish therein, until otherwise ordered by the President."* The Chippewa of Lake Superior who reside in the 1854 Ceded Territory are the Fond du Lac, Grand Portage, and Bois Forte Bands. The NorthMet Project area is within the 1854 Ceded Territory, and thus federal agencies must consult on a government-to-government basis with interested signatories to the 1854 Treaty to understand how the proposed federal actions may impinge on or abrogate treaty rights.

Natural resources and the lands on which they are gathered are important to the Bands for a number of reasons, including cultural, spiritual, and/or historical meanings, and will be considered under federal agency tribal trust responsibilities as outlined above and also as cultural resources under NEPA.

4.2.9.3.2 Perspectives on the Environment

This FEIS uses different criteria and methods to describe how the NorthMet Project Proposed Action would affect the environment. These systems are used to identify, describe, and map progressively smaller areas of land with increasingly uniform ecological features. The systems primarily use associations of biotic and environmental factors, including climate, geology, topography, soils, hydrology, and vegetation.

The integration of ecosystems models with greater emphasis on the relationship of people to the land has become popular with Tribal natural resource and landscape planning. The integration of Native American traditional values regarding the natural world as a whole landscape system encompasses both visible physical aspects of the land along with less apparent values such as cultural relationships and spirituality.

The wildlife and vegetation sections describe the natural environment by using the MDNR's ECS, which follows the NHFEU. The NorthMet Project area is within the Laurentian Mixed Forest province, covering northern Minnesota, Wisconsin, and Michigan, as well as southern Ontario and portions of New England. More specifically, the NorthMet Project area is located along the border of the Laurentian Uplands and Nashwauk Uplands subsections.

The Laurentian Uplands and Nashwauk Uplands subsections are characterized by till plains, moraines, peatlands, and flat outwash plains (MDNR 2011g; MDNR 2011i). The Continental Divide separates the Nashwauk Uplands subsection, with waters flowing north to Hudson Bay, west to the Mississippi River, or south to Lake Superior. Land cover within these subsections is described in Table 4.2.9-3 below.

Table 4.2.9-3 Laurentian Uplands and Nashwauk Uplands Subsections

Subsection/Land Cover	Total Acres	Percent of Total Area in Subsection
Nashwauk Uplands	810,028	
Aquatic Environments	283,510	35
Disturbed	40,501	5
Forest	437,415	54
Cropland/Grassland	48,602	6
Laurentian Uplands	567,280	
Aquatic Environments	113,456	20
Disturbed	5,673	1
Forest	448,151	79
Cropland/Grassland	0	0

Sources: MDNR 2011g; MDNR 2011i.

Both subsections are dominated by forest habitat (e.g., upland and lowland deciduous and coniferous forests) and aquatic environments (e.g., open water, wetlands), with a smaller amount of disturbed and cropland/grassland. 1854 Treaty resources—including vegetation, wildlife, and fish— are discussed below within the context of these land cover types.

4.2.9.3.3 1854 Treaty Resources

Another perspective on natural resources of cultural importance can be viewed through the relationship of the federal government with the Bands. The Land Exchange Proposed Action represents an exchange of private and federal land, but it is also represents an exchange of access to natural resources expressed in treaties made between the United States and Bands of Ojibwe Indians in the 19th century. The 1854 Treaty was signed by Henry C. Gilbert and David B. Herriman for the United States and representatives of the Lake Superior Chippewa on September 30, 1854, and proclaimed on January 29, 1855. The 1854 Treaty ceded all of the Lake Superior

Chippewa lands in the Arrowhead Region of Northeastern Minnesota to the United States, in exchange for reservations for the Lake Superior Chippewa in Wisconsin, Michigan, and Minnesota. The signatory tribes retain hunting, fishing, and gathering rights within this region.

The rights to capture or gather (or take) subsistence resources within the 1854 Ceded Territory are provided to the Bands on a usufruct basis. The concept of individuals not owning specific land, but using the resources on land controlled by larger cultural groups, represented this usufruct basis that was so important to the survival of the Ojibwe everywhere in Minnesota prior to arrival of Europeans. As a usufructuary created by the 1854 Treaty, the Bands are allowed to use resources from land owned by others. The NorthMet Project area and Land Exchange area fall within the territory ceded as part of the 1854 Treaty between the U.S. government and the Chippewa of Lake Superior. Rights for hunting and fishing under the 1854 Treaty are exercised on lands within this territory. It is therefore important to address what these resources are and what cultural importance they have to the Bands.

Interpretations of the 1854 Treaty resources range from an emphasis on hunting and fishing to efforts by the courts to determine Ojibwe land use prior to the treaties that lists virtually every resource in the 1854 Ceded Territory that was utilized by the Ojibwe (Lac Courte Oreilles III, 653 F. Supp. 1420, 1424). While this provided an extensive list of possible resources, the emphasis on certain natural resources such as wild rice, moose, white-tailed deer, maple sugar, certain fish and aquatic species, and certain well-known medicinal plants heightens their level of cultural importance. Table 4.2.9-4 shows other animal and plant species that have historically been, and/or could potentially be, harvested in the 1854 Ceded Territory.

Table 4.2.9-4 Species Potentially Harvested in 1854 Ceded Territory

Mammal/Reptile					
white-tailed deer	beaver	snowshoe hare	moose	otter	elk
	marten	cottontail rabbit	woodchuck	lynx	bison
black bear	mink	badger	squirrel	fox	turtles
muskrat	fisher	porcupine	raccoon	wolf	turtle eggs
Bird					
ducks	songbirds	turkeys	eagles	owls	partridges
geese	grouse (various)	hawks			
Fish					
whitefish	chubs	turbot	walleye	sturgeon	perch
herring	lake trout	in-shore suckers	pike	muskie	
Plant/Plant Materials					
adder's mouth	choke cherry	ground pine	mountain holly	shield fern	Virginia waterleaf
agrimony	climbing bitter-sweet	harebell	mountain maple	shin leaf	
alternate-leaved dogwood		hare's tail	mullein	shining willow	white campion
	cocklebur	hawthorn	musquash root	slender ladies' tresses	white lettuce
American dog violet	common burdock	hazelnut	nannyberry		white oak
		heal-all	navy bean	slippery elm	white pine
arbor vitae (white cedar)	common milkweed	heart-leaved umbrella-wort	northern clintonia	small bedstraw	white sage
				small cleaver	white spruce
arum-leaved arrow-head	common plantain	hemlock	Norway pine	small Solomon's seal	white sweet clover
		highbush blackberry	Ojibwe potato		
balsam fir	common thistle		Ojibwe squash	smooth gooseberry	wild balsam-apple
balsam poplar	corn	highbush cranberry	ox-eye daisy		
basswood	cow parsnip		panicled dogwood	smooth juneberry	wild bergamot
beaked hazelnut	cow wheat	hog peanut			wild black

beech	crack willow	hop	paper birch	smooth rose	currant
black ash	cranberry	horseweed	pearly	smooth sumac	wild cherry
black oak	cranberry pole	hound's tongue	everlasting	snowberry	wild columbine
black snakeroot	bean	Indian cup plant	Philadelphia	speckled alder	wild geranium
black spruce	creamy	Indian turnip	fleabane	speckled elder	wild ginger
black-eyed	vetchling	jack pine	pin cherry	sphagnum moss	wild leek
Susan	cucumber	Joe-Pye weed	pitcher-plant	spotted touch-	wild mint
bloodroot	curled dock	Labrador tea	poison ivy	me-not	wild onion
blue cohosh	cursed crowfoot	large-flowered	prickly ash	spreading dog-	wild parsnip
blue flag	daisy fleabane	bellwort	prickly	bane	wild plum
blueberry	dandelion	large pie	gooseberry	squash	wild red currant
bluewood aster	downy	pumpkin	prince's pine	stag-horn sumac	wild rice
bog rosemary	arrowwood	large-toothed	purple meadow	starflower	wild sarsaparilla
bog willow	Dudley’s rush	aspen	rue	star-flowered	wild strawberry
box elder	entire-leaved	large toothwort	quaking aspen	Solomon’s	winterberry
brake	groundsel	large-leaved	rattlesnake grass	seal	wintergreen
bristly crowfoot	esser cat's foot	aster	red ash	steeple bush	wood betony
bunch berry	evening	large-leaved	red baneberry	sugar maple	wood horsetail
bur oak	primrose	aven	red elderberry	swamp	wood nettle
bush	false spikenard	leather leaf	red haw apple	persicaria	wool grass
honeysuckle	female fern	lichens	red maple	sweet cicely	woolly yarrow
butternut	field horsetail	lima bean	red oak	sweet fern	yarrow
Canada	flowering	low birch	red raspberry	sweet flag	yellow birch
anemone	spurge	Lyall’s nettle	rein orchis	sweet gale	yellow ladies’
Canada	fragrant	marsh	reindeer moss	sweet grass	slipper
hawkweed	goldenrod	bellflower	river-bank grape	sweet white	yellow lotus
		marsh cress	rough cinquefoil	water lily	
Canada	fragrant golden-	marsh five-	sand cherry	tall blue lettuce	yellow water
mayflower	rod	finger	scouring rush	tamarack	lily
Canada	giant puffball	marsh marigold	sensitive fern	tansy	
moonseed	ginseng	marsh skullcap	sessile-leaved	tansy-mustard	
Canada thistle	golden corydalis	marsh vetchling	bellwort	thimble-weed	
Canada violet	golden ragwort	meadow-sweet	shell bark	tower mustard	
Carey’s	goldthread	moosewood	hickory	twisted stalk	
persicaria	goose grass			Virginia creeper	
carrion flower	gourds			Virginia grape	
catnip	great bulrush			fern	
cat-tail	great willow-				
	herb				

Source: Appendix C.

The 1854 Treaty resources can be more accurately characterized by examining how they are being currently regulated by the Bands. Governance of hunting, fishing, trapping, management, and gathering of natural resources by the Fond du Lac Band of Lake Superior Chippewa within the 1854 Ceded Territory is demonstrated in the Fond du Lac Ceded Territory Conservation Code (Fond du Lac 1992). The purpose of the Code is to provide a system for tribal control and regulation of hunting, fishing, and gathering within the Ceded Territory, provide a means to promote public health and safety through the conservation and management of natural resources within the Ceded Territory, and to promote and protect the rights of the Fond du Lac retained under the 1854 Treaty.

The 1854 Treaty Authority is an Inter-tribal Natural Resources Management Organization that manages the off-reservation hunting, fishing, and gathering rights of the Grand Portage and Bois Forte Bands of Lake Superior Chippewa in the territory under legal agreement with the State of

Minnesota. The 1854 Treaty Authority's mission statement is to "provide an Inter-Tribal natural resource program to ensure that the rights secured to member Native American tribes by treaties of the United States to hunt, fish, and gather within the 1854 Ceded Territory shall be protected, preserved and enhanced for the benefit of present and future member Native American tribes in a manner consistent with the character of such rights, through provisions of services." The 1854 Treaty Authority's management of natural resources generally focuses on some of the most commonly hunted, fished, or gathered natural resources; therefore, an analysis of subsistence use by the Bands cannot be all-encompassing. The 1854 Treaty Authority and the natural resources which they manage and regularly report on are being used merely as a way to better quantify an analysis of potential natural resource use by the Bands within the NorthMet Project area.

As discussed above, Fond du Lac has its own regulations applicable to the 1854 Ceded Territory. The discussion of 1854 Treaty Authority-regulated species or resources presented in the sections below is not inclusive of all species important to the Bands. Instead, the lists serve as the most updated and best available data for the most common game species or tribally harvested resources within the 1854 Ceded Territory.

Vegetation

The 1854 Treaty Authority developed a Code for Treaty Gathering (2007) to facilitate Treaty-related gathering of wild plants or forest products on lands and waters open to the public within the 1854 Ceded Territory (see Table 4.2.9-5). The gathering activities conducted under this code are for subsistence use only. Subsistence levels are identified for each resource, and any gathering beyond those levels is considered commercial harvesting. Band members may gather other plant species not listed in the table below, but may not gather threatened or endangered species. If the state, county, or federal government prohibits gathering in a forest campground, wildlife management area, SNA, State of Minnesota-designated old growth stand, state park, wayside, beach, water access, plantation, or other specially designated area such as the BWCAW, then gathering by Band members is also prohibited (1854 Treaty Authority 2007).

Plant species or resources discussed in this code were grouped according to their habitat or cover types, and presented along with the area (in acres) of each habitat type located in the NorthMet Project area (see Table 4.2.9-5 and Section 4.2.4). This provides an estimate of how much of each 1854 Treaty Authority-regulated resource or species could be present in the NorthMet Project area based on predominant cover types.

Table 4.2.9-5 Cover Types of Associated Species and Resources Regulated by the 1854 Treaty Authority in the NorthMet Project Area

Cover Types	**Associated Plant Species or Resource**	**Mine Site (Acres)**[1]	**Transportation and Utility Corridor (Acres)**[1]	**Plant Site (Acres)**[1]
Upland coniferous forest	Conifer boughs, princess pine, birch bark, firewood, other plants or forest products	1,195.5	2.6	99.8
Lowland coniferous forest	Conifer boughs, princess pine, firewood, other plants or forest products	781.2	0.2	41.9
Upland deciduous forest	Princess pine, ginseng, birch bark, firewood, other plants or forest products	648.0	2.7	647
Shrubland	Firewood, other plants or forest products	241.7	7.7	333.8
Disturbed	NA	128.0	94.4	2,755.5
Aquatic environments	Wild rice, other plants or forest products	12.7	2.7	636.8
Cropland/Grassland	NA	4.9	9.8	0.0
Upland conifer-deciduous mixed forest	Conifer boughs, princess pine, ginseng, birch bark, firewood, other plants or forest products	2.4	0.0	0.0
Lowland deciduous forest	Princess pine, birch bark, firewood, other plants or forest products	0.1	0.0	0.0
Total	**NA**	**3,014.5**	**120.2**	**4,514.4**

Source: 1854 Treaty Authority 2007.

Note:
[1] Acres from Section 4.2.4.

Specific plant surveys were also completed to assess "the degree to which the [NorthMet Project area] provides opportunities to gather a variety of plant species for use in traditional Ojibwe cultural practices" (Zellie 2012). More than 152 plant species were identified during these surveys; the five most common plant species were identified in at least half of the 43 sample plots, while another 21 plant species were identified in at least one-quarter of the plots. Balsam fir (*Abies balsamea*) was the most frequently encountered species within the sample plots, followed by black spruce (*Picea mariana*), bigleaf aster (*Eurybia macrophyllus*), bunchberry dogwood (*Cornus canadensis*), and Canada mayflower (*Maianthemum canadense*).

The 152 species identified were also grouped into seven distinct ECS community types (Zellie 2012). Three plant species were found in five of the seven ECS community types, including balsam fir, speckled alder (*Alnus incana*), and low-bush blueberry (*Vaccinium angustifolium*). Eleven species were found in four of the seven ECS community types, and 12 species were found in three of the seven ECS community types (see Table 4.2.9-6). These 26 species occur in a larger range of habitat types and are thus more likely to occur in the NorthMet Project area. Plant species found in multiple community types would generally be more broadly available to gatherers of plants, whereas plant species found in only one community type would require a trip to that specific community to gather it (Zellie 2012). Of the 26 species listed in Table 4.2.9-6, only one (blue-joint grass) does not have a traditional Ojibwe use according to *Plants Used by the Great Lakes Ojibwa* (Meeker et al. 1993).

Table 4.2.9-6 Plant Species Found in At Least Three ECS Vegetation Community Types

Number of ECS Community Types Found In	Common Name (Scientific Name)
Five	Balsam fir, speckled alder, low-bush blueberry
Four	Lady fern (*Athyrium filix-femina*), paper birch (*Betula papyrifera*), creeping snowberry (*Gaultheria hispidula*), tamarack (*Larix laricina*), Labrador tea (*Ledum groenlandicum*), black spruce, blue-joint grass (*Calamagrostis canadensis*), goldthread (*Coptis trifolia*), bunchberry dogwood, beaked hazelnut (*Corylus cornuta*), wild red raspberry (*Rubus idaeus*)
Three	Northern white cedar (*Thuja occidentalis*), twinflower (*Linnea borealis*), red maple (*Acer rubrum*), mountain maple (*Acer spicatum*), serviceberry (*Amelanchier sanguinea*), wild sarsaparilla (*Aralia nudicaulis*), blue-bead lily (*Clintonia borealis*), bigleaf aster, three-lobed bedstraw (*Galium trifidum*), Canada mayflower, quaking aspen (*Populus tremuloides*), rosy twisted-stalk (*Streptopus roseus*)

Source: Zellie 2012.

According to the *NorthMet Project Cultural Landscape Study* (Zellie 2012), the “Ojibwe organized their economy around wild rice and the seasonal cycle of fishing, sugaring, trapping, and hunting.” Reliance on wild rice varied with the availability and cycle of abundance, but because of its shelf life of up to 10 years, it was a staple food for native peoples and early explorers and fur traders. Wild rice is included in Table 4.2.9-5 as an 1854 Treaty Authority-regulated resource, as it is a culturally important plant species. The annual harvest of wild rice totals more than 2 million pounds, and involves thousands of tribal members, demonstrating its continuing role in Ojibwe spiritual practices, culture, livelihood, and identity (Zellie 2012). Wild rice is not known to occur within the Plant Site, Transportation and Utility Corridor, or the Mine Site. However, it was identified through surveys in isolated patches in the Upper Partridge River upstream of Colby Lake, in the Partridge River downstream of Colby Lake, in isolated patches on the Embarrass River above Embarrass Lake, and downstream of Embarrass Lake. See Sections 4.2.2 and 4.2.4 for further discussions of wild rice near the NorthMet Project area.

Similarly, the sugar maple (*Acer saccharum*) is a culturally important plant species, as it has traditionally been and is still tapped to make maple syrup and sugar. “The sugar, in granular form or syrup, provided seasoning for grains and breads, stews, teas, berries, and vegetables” (Zellie 2012). A stand of sugar maple was located southwest of Spring Mine Lake between the Mine Site and Plant Site. This site, called the “sugarbush” or “sugar camp” site, appears to be a natural maple-basswood stand that has been utilized during the past two centuries. Many of the sugar maple trees at this site display evidence that they have been tapped for maple syrup in the past, including misshapen boles from 4 to 8 ft off the ground. Small groups of sugar maple were also identified near the overlook area northeast of the Plant Site, but nowhere else, including the Mine Site.

In addition to sugar maple and wild rice, the Ojibwe also relied on spruce root, birch and cedar bark, sage, hazelnuts, and blueberries and other berries (Zellie 2012). Many of these species also had medicinal uses besides being used as food sources. This is consistent with the 1854 Treaty Authority-regulated resources listed in Table 4.2.9-5, and many of these species were identified in multiple ECS community types during surveys (see Table 4.2.9-6).

Wildlife

The 1854 Treaty Authority developed a Ceded Territory Conservation Code (2012) to regulate hunting, fishing, trapping, and gathering of resources for subsistence use in the 1854 Ceded Territory. The wildlife species regulated by the 1854 Treaty Authority are listed in Table 4.2.9-6, and are categorized by the habitat type they typically utilize. Table 4.2.9-7 also lists the acreage of these habitats present at the Mine Site, Transportation and Utility Corridor, and Plant Site.

Table 4.2.9-7 Key Habitat, Cover Types, and Associated Species Regulated by the 1854 Treaty Authority in the NorthMet Project Area

Key Habitat Type, Cover Types, and Management Indicator Habitats	Associated Wildlife Species Regulated by the 1854 Treaty Authority	Mine Site (Acres)	Transportation and Utility Corridor (Acres)	Plant Site (Acres)
1. Mature Upland Forest, Continuous Upland/Lowland Forest: aspen forest/aspen-birch forest, jack pine forest, mixed pine-hardwood forest (MIHs 1-13)	Snowshoe hare, bobcat, fisher, pine marten, ruffed grouse, spruce grouse	2,627.2	5.5	789.3
2. Open Ground, Bare Soils: disturbed/developed (no MIH)		128.0	94.4	2,755.5
3. Grassland and Brushland, Early Successional Forest (no MIH)	American badger, sharp-tailed grouse	246.6	17.5	333.8
4. Aquatic Environments: Tailings Basin, Partridge River, Embarrass River, former LTVSMC mine pits, wetlands (MIH 14)	American mink, muskrat, beaver, river otter, sora, Virginia rail, Wilson's snipe, Canada goose, snow goose, redhead, northern pintail, canvasback, mallard, American black duck, red-breasted merganser, American coot, common gallinule	12.7	2.7	636.8

Key Habitat Type, Cover Types, and Management Indicator Habitats	Associated Wildlife Species Regulated by the 1854 Treaty Authority	Plant Site (Acres)	Mine Site (Acres)	Transportation and Utility Corridor (Acres)
5. Multiple Habitats (MIHs 1-14)	White-tailed deer[1] (1, 3), moose (1, 3, 4), black bear (1, 3), coyote (1, 3), red fox (1, 3), raccoon (1, 3, 4), gray fox (1, 3), eastern cottontail rabbit (1, 3), eastern fox squirrel (1, 3), eastern gray squirrel (1, 3), Virginia opossum (1, 3), Canada lynx (1-4), wild turkey (1, 3, 4), American crow (1-4), mourning dove (1, 3), American woodcock (1, 3), ring-necked pheasant (3, 4), Canada goose (3, 4), snow goose (3, 4), greater white-fronted goose (3, 4), brant (3, 4), wood duck (1, 4), greater scaup (3, 4), lesser scaup (1, 3, 4), hooded merganser (1, 4), common merganser (1, 4)			
Total[2]		3,014.5	120.1	4,515.4

Sources: 1854 Treaty Authority 2013; 1854 Treaty Authority 2012.

Notes:
[1] Numbers refer to the Key Habitat Types (1-5) where those species may occur or are known to occur.
[2] Total acres may be more or less than presented due to rounding.

Mature upland and lowland forest is the most common habitat type at the NorthMet Project area (primarily at the Mine Site). Section 4.2.4 provides a more detailed discussion of vegetation cover and habitat types. Species that may be present include snowshoe hare, bobcat, fisher, pine marten, ruffed grouse, and spruce grouse. These species represent a group that generally requires large forested blocks and/or minimal human intrusion.

Areas of open ground and bare soils are rare at the Mine Site but are abundant at the Plant Site due to former LTVSMC operations or deposition in the existing LTVSMC Tailings Basin. Both open ground and bare soils are considered non-natural habitats. No 1854 Treaty Authority-regulated species are specifically associated with this habitat type.

Brush/grassland and very early successional forest are uncommon at the Mine Site and Plant Site (ENSR 2005) and, where present, are typically small patches resulting from recent logging. The revegetation of the existing LTVSMC Tailings Basin is counted as grassland, though it is disturbed habitat and is unlikely to be heavily used by wildlife species. The species listed in Table 4.2.9-7 include the American badger and sharp-tailed grouse, which are generally associated with large patches of grassland and savanna habitats that are not present in the NorthMet Project area. The USFS has indicated that American woodcock has been observed at the Mine Site.

The Mine Site and adjacent federal lands contain a large expanse of wetland habitat consisting primarily of coniferous and open bogs. Species that utilize this habitat include semi-aquatic mammals, shorebirds, and waterfowl. Currently, there are no bodies of open water at the Mine Site. At the Plant Site, open water and aquatic communities are confined to the existing LTVSMC Tailings Basin. The Tailings Basin attracts Canada geese and other waterfowl, though the NorthMet Project area does not otherwise appear to provide good habitat for waterfowl or shorebirds.

Multiple habitats are not mapped as such, but are made up of combinations of other key habitat types. This category is used for 1854 Treaty Authority-regulated species that are known to use multiple habitats during a season, such as white-tailed deer, bear, moose, and multiple other species listed in Table 4.2.9-7.

Other wildlife species may be considered culturally important, including but not limited to the gray wolf and bald eagle, and are discussed in Section 4.2.5.

Aquatic Species

As mentioned above, the 1854 Treaty Authority manages the off-reservation fishing rights of the Grand Portage and Bois Forte Bands of Lake Superior Chippewa in the 1854 Ceded Territory. They have developed the *1854 Treaty Authority Fishing Seasons, 2013-2014* (2013) document to address fishing seasons and limits on waters open to the public within the 1854 Ceded Territory. Fish species with a season and limit are presented in Table 4.2.9-8 below, along with fish species that have been collected at sites in the vicinity of the NorthMet Project area. Five fish species that are regulated by the 1854 Treaty Authority (i.e., northern pike, white sucker, burbot, black bullhead, and yellow perch) occur near or on the NorthMet Project areas; the remaining species collected near the Mine Site, Transportation and Utility Corridor, or Plant Site include species more typical for first- and second-order streams (e.g., minnows, darters, etc.). Section 4.2.6 describes in more detail the species collected and the stream and shoreline habitat available.

Table 4.2.9-8 Fish Species Regulated by the 1854 Treaty Authority and Collected in the NorthMet Project Area

1854 Treaty Authority-Regulated Fish Species[1]
Northern pike, *white sucker*, *burbot*, *black bullhead*, *yellow perch*, walleye, sauger, muskellunge, largemouth/smallmouth bass, rock bass, black/white crappie, sunfish/bluegill, white/yellow bass, flathead/channel catfish, yellow/brown bullhead, lake whitefish, rainbow smelt, lake sturgeon, ruffe, white perch, round goby, lake trout, chinook/pink/coho salmon, brook/brown/rainbow trout, splake, carp, bigmouth buffalo, sheepshead/freshwater drum, bowfin, cisco, gar, goldeye
Species Collected in the Vicinity of the NorthMet Project Area[1, 2]
Northern pike, *white sucker*, *burbot*, *black bullhead*, *yellow perch*, longnose dace, common shiner, Johnny darter, brassy minnow, northern redbelly dace, brook stickleback, blacknose dace, pearl dace, tadpole madtom, central mudminnow, fathead minnow, mottled sculpin, golden shiner, finescale dace, creek chub

Sources: 1854 Treaty Authority 2013; 1854 Treaty Authority 2012.

Notes:
[1] Species in common between the 1854 Treaty Authority fishing season list and those collected in the NorthMet Project area are listed in italics.
[2] Species list from tables in Section 4.2.6.

The lake sturgeon is a culturally important fish species that has a season and limits enforced (1854 Treaty Authority 2013), and it is also listed as a USFS RFSS. However, lake sturgeon are not known to occur near the NorthMet Project area, and there is no likely habitat for them on the federal lands. Though lake sturgeon have been stocked into the St. Louis River above the Fond du Lac dam, upstream migration would be blocked by a dam downstream of the Embarrass River confluence with the St. Louis River. See Section 4.2.6 for a more thorough discussion of lake sturgeon and their management.

<u>Access to the NorthMet Project Area for Subsistence Use</u>

The Mine Site is entirely surrounded by private restricted property, roads, and railroads. There are access points to the NorthMet Project area, however, via a Forest Service road, the Partridge River, and various trails segments. The Plant Site and the Transportation and Utility Corridor are owned by either Cliffs Erie LLC or PolyMet, and are not open to the public. Entry points are gated and/or guarded, and crossing the corridor is prohibited. As such, current subsistence use in the NorthMet Project area is limited, but not restricted.

4.2.10 Socioeconomics

The Arrowhead region of northeastern Minnesota, which includes Cook, Lake, and St. Louis counties, contains the well-known Mesabi Iron Range. Precious metal mining in this region can be dated to the late 1800s, with St. Louis County in particular having a long mining heritage. Many local communities were established to support these iron mining operations. While mining is still a major component of the area's economy and culture, the same can also be said for the region's other natural resources. As with much of Minnesota, timber production has a long history in this area. Tourism, much of it centered on the BWCAW and the region's other outstanding public lands, is an important and growing economic sector and is deeply ingrained in the region's culture.

The study area for socioeconomics extends beyond the area of direct potential project effects to include all of Cook, Lake, and St. Louis counties (see Figure 4.2.10-1). This geography includes the proposed Mine Site, Transportation and Utility Corridor, and Plant Site as well as the non-federal tracts included in the Land Exchange Proposed Action.

Socioeconomic data are not available, and thus are not reported for the Mine Site, Transportation and Utility Corridor, and Plant Site on an individual basis. Socioeconomic data in this section are instead collected and analyzed at the county level and, where appropriate, for cities (Aurora, Babbitt, Biwabik, Duluth, Ely, Hibbing, Hoyt Lakes, Tower, and Virginia), as well as the unincorporated area known as Soudan (all of which are located in St. Louis County, and which are collectively referred to hereafter as "study area communities"). While other portions of northeastern Minnesota could experience some socioeconomic effects from the NorthMet Project Proposed Action, these cities were chosen for several reasons. Duluth, which is approximately 2 hours driving distance from the NorthMet Project area, is included because its population is a large share of St. Louis County's overall population. Other larger cities are those within approximately a 1 hour driving distance. These are the population centers most likely to provide labor and housing (temporary and permanent) and thus are the most likely to be impacted by the NorthMet Project Proposed Action.

Data and observations for the Fond du Lac (St. Louis and Carlton counties), Grand Portage (Cook County), and Bois Forte (St. Louis and Koochiching counties) reservations and off-reservation areas are also included where information was available. While portions of these reservations are outside of the study area, tribal members nonetheless exercise usufructuary rights to hunt, fish, and gather plants within the 1854 Ceded Territory.

4.2.10.1 Mine Site, Transportation and Utility Corridor, Plant Site

4.2.10.1.1 Demographics

This section describes the demographics of the three-county study area in terms of population, age, race, income, poverty, and educational statistics.

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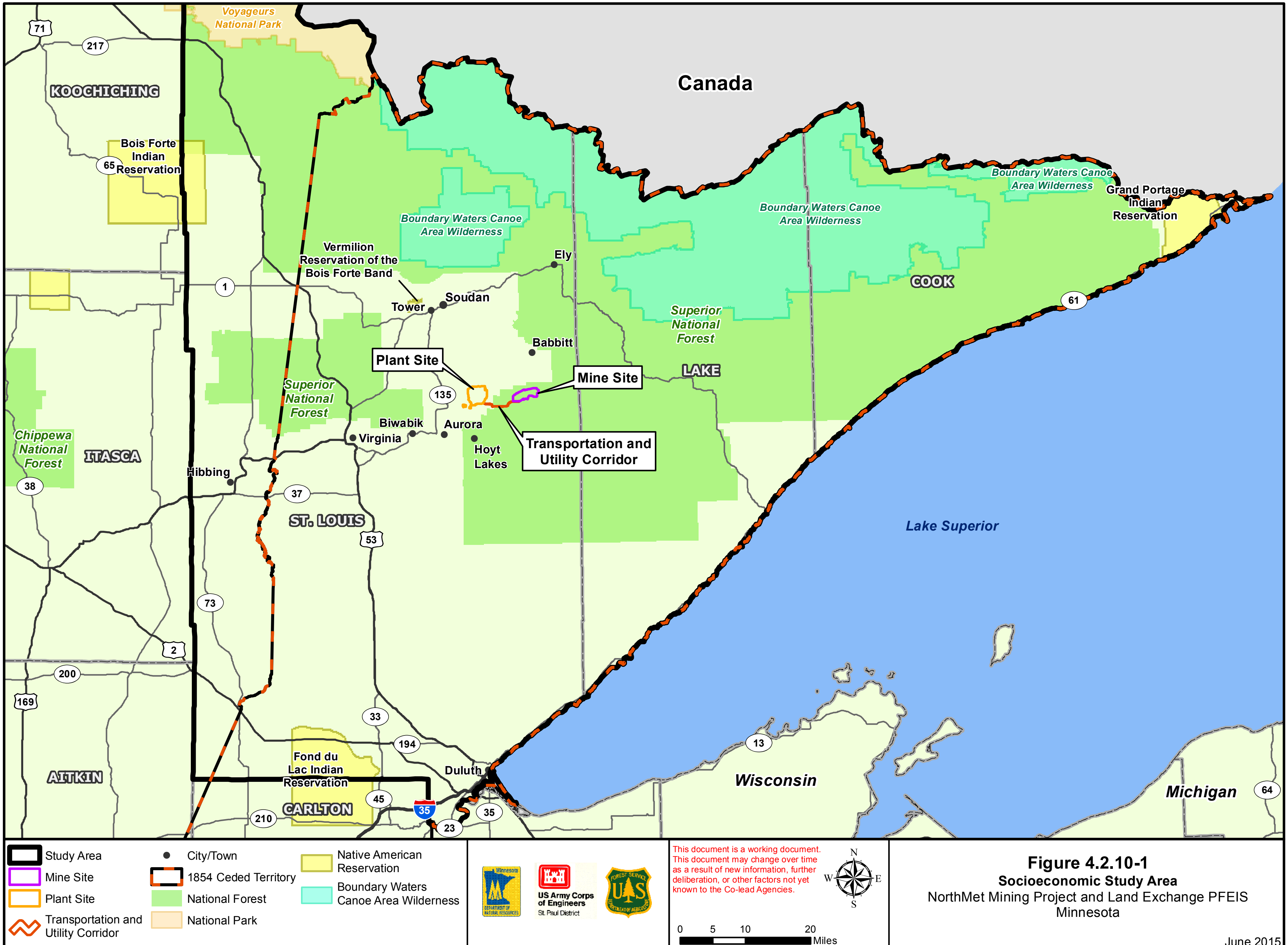

Figure 4.2.10-1
Socioeconomic Study Area
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

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Population, Age, and Race

Population and population trends for the study area from 1980 through 2010 are shown in Table 4.2.10-1. The population of St. Louis County is concentrated in and around the City of Duluth, approximately 65 miles south of the NorthMet Project area, with smaller, secondary centers in the Iron Range communities of Ely, Hibbing, and Virginia. Lake and Cook counties have few large population centers near the NorthMet Project area. The population of the study area and its individual communities has declined by nearly 10 percent since 1980 (from more than 239,000 in 1980 to 216,000 in 2010), while the population of the state as a whole has increased by more than 30 percent. In individual communities listed in Table 4.2.10-1, population has declined substantially compared to the study area as a whole. At least some of this population decline may be attributable to “the out-migration of previous residents after the decline in economic opportunity represented by the loss of so many iron industry jobs” (Powers 2007). The exceptions are the Fond du Lac, Grand Portage, and Bois Forte reservations, where populations have increased since 1990.

Table 4.2.10-1 Population of Study Area Communities 1980 to 2010

	Year				Change (1980–2010)[1]	
Geography	**1980**	**1990**	**2000**	**2010**	**Number**	**%**
Minnesota	4,075,970	4,375,099	4,919,479	5,303,925	1,227,955	30.10
Cook County	4,092	3,868	5,168	5,176	1,084	26.50
Lake County	13,043	10,415	11,058	10,866	-2,177	-16.70
St. Louis County	222,229	193,433	200,528	200,226	-22,003	-9.90
Study Area	**239,364**	**207,716**	**216,754**	**216,268**	**-23,096**	**-9.60**
Aurora	2,670	1,965	1,850	1,682	-988	-37.00
Babbitt	2,435	1,562	1,670	1,475	-960	-39.40
Biwabik	1,428	1,097	954	969	-459	-32.10
Bois Forte Reservation	na	358	657	874	516	144.10
Duluth	92,811	85,493	86,918	86,265	-6,546	-7.10
Ely	4820	3,968	3,724	3,460	-1,360	-28.20
Fond du Lac Reservation	na	3,229	3,728	4,240	1,011	31.30
Grand Portage Reservation	na	306	557	565	259	84.60
Hibbing	21193	18,046	17,071	16,361	-4,832	-22.80
Hoyt Lakes	3,186	2,348	2,082	2,017	-1,169	-36.70
Soudan	na	502	372	446	-56	-11.20
Tower	640	502	469	500	-140	-21.90
Virginia	11056	9,410	9,157	8,712	-2,344	-21.20

Sources: U.S. Census Bureau 1980, 1990, 2000, and 2010b.

Notes:
[1] Population data for 1980 were not available for Soudan, Minnesota and the three Native American reservations. In these cases, the population change reflects the 1990–2010 time period.
na = Not available

As shown in Table 4.2.10-2, the median age of the population in study area counties and cities (typically age 40 to 45) is substantially higher than that of the state (age 35). Moreover, the median age of study area communities has grown at a more rapid pace than the state as a whole. Minnesota’s median age grew by two full years between 2000 and 2010, while the median age of most study area communities—with the exception of Duluth, Hibbing, and Virginia—grew by 3 to 5 years. Again, with the exception of Duluth, study area communities tend to have (as a percentage of the total population) fewer children under 18, fewer adults (18 to 64), and more senior citizens (age 65 or older) than the state as a whole.

The study area is more than 93 percent Caucasian (see Table 4.2.10-3), compared to 85 percent for the state as a whole. However, Native Americans comprise 2 percent of the study area's population compared to 1 percent of the state's overall population.

Table 4.2.10-2 Age Characteristics of Study Area Residents, 2010

	Median Age,	Median Age,	Population Segments (% of total)		
Geography	**2000**	**2010**	**0-17 yrs.**	**18-64 yrs.**	**65+ yrs.**
State of Minnesota	35.4	37.4	24	63	13
Cook County	44.0	49.8	17	63	20
Lake County	42.9	48.3	19	59	22
St. Louis County	39.0	40.8	30	64	16
Study Area	**na**	**na**	**29**	**64**	**16**
Aurora	45.2	48.4	19	56	24
Babbitt	46.8	51.1	17	52	31
Biwabik	41.5	46.8	20	58	22
Bois Forte Reservation	31.6	34.1	33	55	13
Duluth	35.4	33.6	19	68	14
Ely	40.8	45.3	16	61	23
Fond du Lac Reservation	33.5	36.5	28	60	12
Grand Portage Reservation	36.5	39.2	23	67	10
Hibbing	41.0	42.5	22	61	18
Hoyt Lakes	45.6	49.3	20	55	25
Soudan	na	46.7	18	62	20
Tower	45.3	48.4	19	57	24
Virginia	43.2	44.9	19	59	22

Sources: U.S. Census Bureau 2000 and 2010b.

Notes:
Percent totals may be greater or less than 100% due to rounding.
na = Not available

Table 4.2.10-3 Racial Characteristics of Study Area Residents, 2010

Geography	Total Population	White (%)	African American (%)	Native American (%)	Asian (%)	Hawaiian/ Pac. Islander (%)	Other (%)	Multiple Races (%)	Hispanic[1] (%)
State of Minnesota	5,303,925	85	5	1	4	<1	2	2	5
Cook County	5,176	88	<1	8	<1	<1	<1	2	1
Lake County	10,866	98	<1	<1	<1	<1	<1	1	<1
St. Louis County	200,226	93	1	2	<1	<1	<1	2	1
Study Area	**216,268**	**93**	**1**	**2**	**<1**	**<1**	**<1**	**2**	**1**
Aurora	1,682	98	<1	<1	<1	0	0	1	<1
Babbitt	1,475	98	<1	<1	<1	0	<1	1	<1
Biwabik	969	98	<1	<1	<1	0	<1	<1	<1
Bois Forte Reservation	874	26	<1	70	<1	0	<1	3	3
Duluth	86,265	90	2	3	2	0	<1	3	2
Ely	3,460	96	1	<1	<1	0	<1	2	1
Fond du Lac Reservation	4,240	55	<1	39	<1	0	<1	6	2
Grand Portage Reservation	565	27	1.1	68	2	0	<1	2	<1
Hibbing	16,361	96	<1	<1	<1	0	<1	2	1
Hoyt Lakes	2,017	98	<1	<1	<1	0	0	1	<1
Soudan	446	96	1	<1	<1	0	0	<1	<1
Tower	500	95	<1	2	<1	0	<1	2	1
Virginia	8,712	92	2	3	<1	0	<1	3	2

Source: U.S. Census Bureau 2010b.

Notes:
[1] Hispanic status is considered separately from racial identification.
Percent totals may be greater or less than 100% due to rounding.

<u>Educational Attainment</u>

Table 4.2.10-4 shows the educational attainment of residents in the study area. Educational attainment in the study area as a whole and in most study area communities (as measured by the percentage of residents age 25 and over who achieved degrees beyond a high school diploma) was lower in these communities than in St. Louis County as a whole and the state in 2010. Whereas 41 percent of state residents (age 25 and older) and 37 percent of St. Louis County residents had achieved Associate's degrees or higher in 2010, approximately 15 to 30 percent of residents of study area communities (except for Duluth, Ely, and Soudan) had achieved similar degrees.

Table 4.2.10-4 Educational Characteristics of Study Area Residents, 2010

Geography	Total[1]	No High School Diploma (%)	High School Diploma and/or Some College (%)	Associate's Degree (%)	Bachelor's Degree (%)	Advanced Degree (%)
State of Minnesota	3,450,999	9	50	10	21	10
Cook County	4,091	7	52	8	20	13
Lake County	8,167	7	63	10	14	6
St. Louis County	133,796	8	56	11	18	8
Study Area	**146,054**	**8**	**56**	**11**	**17**	**8**
Aurora	1,146	11	64	13	9	3
Babbitt	1,047	14	68	12	5	2
Bois Forte Reservation	759	10	63	14	10	3
Biwabik	425	22	61	5	9	4
Duluth	51,753	8	51	9	21	11
Ely	2,333	8	53	14	20	6
Fond du Lac Reservation	2,472	14	61	13	10	3
Grand Portage Reservation	314	26	57	9	5	4
Hibbing	11,454	12	62	10	11	5
Hoyt Lakes	1,612	7	66	14	12	2
Soudan	348	6	49	28	12	4
Tower	315	5	67	13	9	5
Virginia	6,347	11	56	15	13	5

Source: U.S. Census Bureau 2010a.

Notes:
[1] Data are for residents age 25 or older.
Percent totals may be greater or less than 100% due to rounding.

Income and Poverty

Table 4.2.10-5 shows income and poverty characteristics for the study area communities. The median income of individual study area communities is significantly lower than that of the state as a whole, with the exception of Soudan. It is also the case that the median income of individual communities is generally lower than that of St. Louis County. The median income in Babbitt and Hoyt Lakes—the communities closest to the NorthMet Project area—are two-thirds and four-fifths, respectively, of the state median income. In some study area communities, such as Ely and Tower, the median household income is slightly more than half of the state total. Poverty rates are also higher in the study area as a whole than in the state. In many individual communities, poverty rates are as high or higher than the state (with the exceptions of Hoyt Lakes, Soudan, and Tower).

Table 4.2.10-5 Income and Poverty Characteristics of Study Area Communities in 2010

Geography	Median Household Income ($)	Percentage of State Median Household Income	Population with Income Below Poverty Level[1, 2]	Percentage of Population Below Poverty Level[1,2]
State of Minnesota	57,243	na	542,133	11
Cook County	49,162	86	463	9
Lake County	46,765	82	1,252	12
St. Louis County	44,941	79	28,931	15
Study Area	**na**	**na**	**30,646**	**15**
Aurora	45,285	79	182	12
Babbitt	37,500	66	133	10
Biwabik	40,417	57	197	19
Bois Forte Reservation	32,656	71	100	15
Duluth	41,092	72	16,339	20
Ely	31,905	56	561	18
Fond du Lac Reservation	41,300	72	893	22
Grand Portage Reservation	33,056	58	82	17
Hibbing	36,585	64	2,737	17
Hoyt Lakes	45,338	79	89	5
Soudan	65,000	114	27	7
Tower	31,607	55	21	5
Virginia	32,664	57	1,759	21

Source: U.S. Census Bureau 2010a.

Notes:
[1] Percentage based on the "Population for whom poverty status is determined" which is less than the total population.
[2] The United States Census Bureau defines poverty status using a set of monetary standards (consistent with *Office of Management and Budget Statistical Policy Directive 14*) that vary by family size and composition (e.g., marital status and number of children). Poverty thresholds are updated annually to reflect economic conditions. Poverty thresholds in 2009 (the year for which the data in this table are presented) can be found at:
http://www.census.gov/hhes/www/poverty/data/threshld/thresh09.html
Percent totals may be greater or less than 100% due to rounding.
na = Not available

4.2.10.1.2 Employment

This section evaluates two different measures of employment. At-place employment describes jobs that exist in a given location, regardless of where job-holders live. It is a measure of the economic activity in a community. However, workers in northeastern Minnesota are often accustomed to driving long distances to jobs, particularly in the mining industry (Powers 2007). Thus, information about at-place employment is supplemented with information about jobs held by residents. This second measure describes the extent to which a community's residents are employed.

At-place Employment

Tables 4.2.10-6 and 4.2.10-7 show at-place employment trends for the study area by major industry classification. Data from 1980 and 1990 are reported by SIC (see Table 4.2.10-6), while 2009 data reflect industries as defined by the North American Industrial Classification System

(NAICS) (see Table 4.2.10-7), which replaced the Standard Industrial Classification (SIC) system in 1997.

Table 4.2.10-6 At-place Historical Employment by Major SIC Industry in 1980 and 1990

Major Industry	**Minnesota**		**Cook County**		**Lake County**		**St. Louis County**	
Year	1980	1990	1980	1990	1980	1990	1980	1990
Agricultural services	3,950	6,812	na	na	A[1]	B	93	152
Metal mining	16,182	7,437	0	A	F	E	12,208	5,317
Construction	82,673	76,200	75	101	E	B	4,305	2,577
Manufacturing	392,742	394,202	122	C	366	621	8,595	6,162
Transportation, communications, utilities	84,967	106,166	22	A	113	122	3,360	3,713
Wholesale trade	114,717	133,464	A	A	74	B	4,247	2,907
Retail trade	322,153	395,801	265	459	590	633	16,457	16,602
Finance, insurance, real estate	101,314	133,678	34	82	102	C	3,211	2,805
Services	367,202	573,009	358	F	455	595	16,716	22,598
Public administration	8,780	5,387	A	A	18	A	366	184
Total	1,494,680	1832,156	895	1,401	2,985	2,555	69,558	63,017

Source: UVGSDC 2008.

Notes:
[1] Letter codes indicate suppression flags in the original data set—cases where exact data were withheld by the United States Census Bureau in order to protect company-confidential data. As a result, study area data cannot be calculated. Flags indicate approximate employment, as follows: A: 0-19 employees; B: 20-99 employees; C: 100-249 employees; E: 250-499 employees; F: 500-999 employees.
na = Not available

Table 4.2.10-7 At-place Employment by Major NAICS Industry in 2009

	Minnesota		Cook County		Lake County		St. Louis County	
Major NAICS Industry	Number	% of Total	Number	% of Total	Number	% of Total	Number	% of Total
Forestry, fishing, hunting	2,462	<1	A[1]	na	A	na	172	<1
Mining, quarrying, oil/gas	4,703	<1	B	na	C	na	3,151	4
Utilities	13,711	<1	120	6	B	na	921	1
Construction	99,101	4	B	na	96	3	3,261	4
Manufacturing	307,822	13	9	<1	F	na	4,378	5
Wholesale trade	131,638	5	283	14	B	na	2,279	3
Retail trade	291,328	12	A	na	332	11	12,583	15
Transportation, warehousing	75,384	3	59	3	A	na	1,934	2
Information	64,096	3	36	2	C	na	2,187	3
Finance and insurance	148,621	6	B	na	179	6	3,655	5
Real estate	36,296	2	B	na	84	3	1,017	1
Professional, sci., tech. svcs.	139,270	6	26	1	B	na	3,269	4
Management	118,124	5	42	2	41	1	937	1
Admin., support, waste mgt.	123,915	5	C	na	B	na	3,212	4
Educational services	66,458	3	304	15	E	na	2,360	3
Health care, social assistance	421,935	18	641	33	54	2	21,789	27
Arts, entertainment, recreation	39,550	2	46	2	607	21	1,221	2
Accommodation, food svcs.	213,136	9	A	na	174	6	9,308	11
Other svcs.	119,334	5	-	0	-	0	3,995	5
Industries not classified	290	<1	-	0	-	0	5	<1
Total	2,417,174	100.0	1,975	100.0	2,955	100.0	81,634	100.0

Source: U.S. Census Bureau 2009.

Notes:
[1] Letter codes indicate suppression flags in the original data set—cases where exact data were withheld by the United States Census Bureau in order to protect company-confidential data. As a result, study area data cannot be calculated. Flags indicate approximate employment, as follows: A: 0-19 employees; B: 20-99 employees; C: 100-249 employees; E: 250-499 employees; F: 500-999 employees.
Percent totals may be greater or less than 100% due to rounding.
na = Not available

In 2009, the top employment sectors in the study area were health care and social assistance, retail trade, manufacturing, educational services (which does not include public schools or other public education functions), and accommodation and food services. SIC and NAICS data are available for counties, whole zip codes, and Metropolitan Statistical Areas, but not for the specific geographic areas considered in this chapter (i.e., most of the study area communities occupy only a portion of a zip code; thus, the data for the whole zip code are not appropriate). Therefore, only county-level data are used. The U.S. Census Bureau withholds some data for smaller geographies (such as cities); therefore, study area totals cannot be calculated.

Mining employment has declined consistently in all three study area counties, from more than 12,000 in 1980 to approximately 3,000 in 2009 in St. Louis County. Mining-related employment is volatile and fluctuates from year to year due to the market price of commodities being extracted. Since mining employment can vary greatly from one year to the next, the decline observed from 1980 and 2009 does not represent a steady reduction in mining-related employment. At the same time, service-related employment in the study area (which includes the NAICS categories for professional services, management, health care, education, arts/entertainment, and accommodation/food) has increased substantially since 1980, mirroring broader state and national trends.

Industry Concentrations

Certain industries, particularly mining and utilities, are more concentrated in the study area, particularly St. Louis County, than in the state as a whole. Sector concentration can be measured by the location quotient (LQ), which is the ratio between the local economy and the economy of a reference unit, such as the state. For this analysis, the LQ was calculated using each study area county as a local economy and the state as the reference unit. Given the number of industry totals that were suppressed by the U.S. Census Bureau in Tables 4.2.10-6 and 4.2.10-7, a combined study area LQ could not be calculated. A LQ of 1.00 indicates that a given industry is exactly as strong, in terms of employment, in the local economy as it is in the reference economy. A LQ below 1.00 indicates a relatively weak local industry, while a LQ above 1.00 indicates a relatively strong local industry.

As illustrated by Table 4.2.10-8, the LQ for the mining industry in St. Louis County is nearly 20, meaning that mining employment in the county is approximately 20 times as concentrated as in the state as a whole. As noted above, LQs for the study area as a whole could not be calculated because of data confidentiality. However, this concentration has been declining in recent years. In 1980 (see Table 4.2.10-6), St. Louis County accounted for approximately 75 percent of the state's mining employment. In 2009 (see Table 4.2.10-7), that share had fallen to approximately 66 percent of state mining employment. Mining employment in other study area counties was minimal.

The high LQ for the utilities industry is likely tied to power plants and utility infrastructure that support the region's mining activity. Other relatively high LQ values vary by county, but generally include educational services, health care and social assistance, and arts/entertainment. Forestry, fishing, and hunting have high LQ values in St. Louis County, while Real Estate has a high LQ value in Lake County. Industries with particularly low LQ values include manufacturing and management. These findings support stakeholder observations about the strength of the region's tourism economy (real estate in Lake County, arts, entertainment, accommodation, and food).

Regional Tourism

Tourism is rooted in the Arrowhead region's unique recreation opportunities such as the BWCAW, and is more broadly dependent on recreational opportunities such as hunting, fishing, boating, sightseeing, and wilderness experiences provided by the region's high-quality natural environment.

Mining and tourism have coexisted in the study area for decades. As shown in Table 4.2.10-7, industries associated with tourism (arts, entertainment, recreation, accommodation, and food) account for nearly 13 percent of all employment in St. Louis County (data could not be summed for the entire study area). The "attractive landscape and climatic features [of the region have] attracted recreationists, retirees, and other new residents" (Powers 2007). In particular, retirement income (from individuals who move to the Arrowhead region for its recreational and scenic resources) has been an important source of economic vitality for the region's communities (Powers 2007). These non-mining economic gains have occurred in the presence of active mining activity (including the Northshore Mine adjacent to the NorthMet Project area) and the remnant landscape of past mining activity.

Retirees

The demographic data in Section 4.2.10.1.1, as well as some of the industry clusters identified above, support the views, expressed by some stakeholders, that the study area is an increasingly attractive location for retirees. The median ages in nearly all study area communities increased between 2000 and 2010, and are, in most cases, higher than the state median (see Table 4.2.10-2). The relative strength of the Health Care and Social Assistance industry category is also consistent with an older population in need of such services.

The employment status data in Table 4.2.10-9 may also support this conclusion about retirees: statewide, 71 percent of residents over the age of 16 participate in the workforce (i.e., they hold or are actively looking for a job). By comparison, only 62 percent of the over-16 population in the study area is in the workforce. While some of this difference is likely attributable to long-term unemployment (which often leads workers to drop out of the workforce entirely), this gap may also suggest the presence of retired individuals, who are, by definition, no longer in the workforce.

Research also shows links between the presence of recreation and natural amenities and increased retirement throughout the United States (see McGranahan 1999). The economic data cited above, combined with the amenities present in and near the study area—such as BWCAW, Superior National Forest, and the other resources described throughout this FEIS—are consistent with the findings of this type of research.

Table 4.2.10-8 Location Quotients for Major NAICS Industries in the Study Area, 2009

Industry	Cook County	Lake County	St. Louis County
Forestry, fishing, hunting	na	na	2.07
Mining, quarrying, oil/gas	na	na	19.84
Utilities	10.71	na	1.99
Construction	na	0.79	0.97
Manufacturing	0.04	na	0.42
Wholesale trade	2.63	na	0.51
Retail trade	na	0.93	1.28
Transportation, warehousing	0.96	na	0.76
Information	0.69	na	1.01
Finance and insurance	na	0.99	0.73
Real estate	na	1.89	0.83
Professional, scientific, technical services	0.23	na	0.70
Management	0.44	0.28	0.23
Admin., support, waste mgt.	na	na	0.77
Educational services	5.60	na	1.05
Health care, social assistance	1.86	0.10	1.53
Arts, entertainment., rec.	1.42	12.55	0.91
Accommodation, food services	na	0.67	1.29
Other services	NA	NA	0.99
Industries not classified	NA	NA	0.51

Source: U.S. Census Bureau 2009.

Notes:
LQs compare county employment to statewide employment. LQs for the entire study area cannot be calculated.
na = Not available

Jobs Held by Residents

Employment data for residents of study area communities is shown in Table 4.2.10-9. Unemployment rates in Lake and Cook counties were generally consistent with or lower than statewide unemployment. However, unemployment in St. Louis County and particularly in individual St. Louis County communities was generally much higher than in the state as a whole. These data are estimates based on information collected by the U.S. Census Bureau from 2005 to 2009, and thus may not fully capture the depth of the unemployment effects that the study area has experienced as a result of the national recession during and following that time period.

Occupation (e.g., general type of work) and industry classifications of jobs held by study area residents are shown in Tables 4.2.10-10 and 4.2.10-11. These data show that management, science, business, arts, sales, education, health, manufacturing, and retail make up a large percentage of the jobs held by study area residents. The sectors of agriculture, forestry, fishing and hunting, and mining (including metal mining such as the NorthMet Project Proposed Action) account for a higher share of locally held jobs than the statewide average. This is especially true for communities closer to the mine (e.g., Aurora, Babbitt, Biwabik, and Hoyt Lakes).

Occupational categories are provided for each community per the U.S. Census Bureau's SIC definitions. The occupation categories also show the prevalence of management and service job functions as opposed to more traditional production and manufacturing activities typically associated within mining.

Table 4.2.10-9 Employment Status of Study Area Communities, 2009

Geography	Total Population ≥16 Years	In Civilian Labor Force[1]	Employed	Unemployed	Unemployment Rate (%)
State of Minnesota	4,111,966	2,916,931	2,730,721	186,210	6
Cook County	4,455	2,875	2,741	134	5
Lake County	9,143	5,596	5,395	201	4
St. Louis County	164,849	102,619	94,402	8,217	8
Study Area	**178,447**	**111,090**	**102,538**	**8,552**	**7.7**
Aurora	1,264	681	641	40	6
Babbitt	1,167	579	544	35	6
Biwabik	508	318	240	78	25
Bois Forte Reservation	850	481	445	36	8
Duluth	71,606	46,415	42,629	3,786	8
Ely	3,064	1,751	1,617	134	8
Fond du Lac Reservation	3,089	1,935	1,662	273	14
Grand Portage Reservation	331	227	218	9	4
Hibbing	13,222	7,166	6,531	635	9
Hoyt Lakes	1,740	996	834	162	16
Soudan	397	273	256	17	6
Tower	353	201	178	23	11
Virginia	7,157	3,814	3,413	401	11

Source: U.S. Census Bureau 2010a.

Notes:
[1] Excludes armed forces personnel, and individuals who reported that they were not seeking employment.
Percent totals may be greater or less than 100% due to rounding.

Table 4.2.10-10 Employment in Study Area Communities by Occupation

Geography	Civilian Employed Pop. ≥16 Years	Occupation (% of total employed population)				
		Management, Science, Business, Arts	Services	Sales/ Office	Natural Resources	Production/ Transportation
State of Minnesota	2,730,721	38	16	25	9	13
Cook County	2,741	33	18	27	13	9
Lake County	5,395	27	22	22	14	15
St. Louis County	94,402	34	21	24	11	10
Study Area	**102,538**	**34**	**21**	**24**	**11**	**10**
Aurora	641	25	21	17	21	16
Babbitt	544	21	19	27	14	18
Biwabik	445	22	30	17	16	15
Bois Forte Reservation	240	22	26	29	14	10
Duluth	42,629	37	23	24	7	9
Ely	1,617	25	31	29	10	5
Fond du Lac Reservation	1,662	24	25	23	11	17
Grand Portage Reservation	218	21	38	24	15	2
Hibbing	6,531	27	23	28	13	10
Hoyt Lakes	834	20	21	20	18	21
Soudan	256	22	28	20	14	17
Tower	178	26	29	17	19	8
Virginia	3,413	31	22	25	16	6

Source: U.S. Census Bureau 2010a.

Note:
Percent totals may be greater or less than 100% due to rounding.

Table 4.2.10-11 Employment in Study Area Communities by Industry

		Industry (% of total employed population)												
Geography	**Civilian Employed Population ≥16 Years**	Forestry, Fishing, Hunting, and Mining	Construction	Manufacturing	Wholesale	Retail	Transportation and Utilities	Information	Finance, Insurance, Real Estate	Professional, Scientific, Management, Administration	Education, Health	Arts, Entertainment, Recreation, Accommodation, Food	Other Services, except Public Administration	Public Administration
Minnesota	2,730,721	2	6	14	3	12	5	2	7	9	24	8	4	3
Cook County	2,741	2	10	7	1	14	2	1	9	10	13	20	4	9
Lake County	5,395	8	7	9	1	10	5	2	6	6	27	13	4	3
St. Louis County	94,402	4	7	7	2	12	6	2	5	6	31	11	4	5
Study Area	**102,538**	**4**	**7**	**7**	**2**	**12**	**5**	**2**	**5**	**6**	**30**	**11**	**4**	**5**
Aurora	641	15	14	8	2	8	9	1	5	4	25	8	0	1
Babbitt	544	17	5	7	2	11	4	1	6	6	19	12	6	5
Biwabik	445	15	5	4	2	16	4	1	3	3	35	10	2	1
Bois Forte Reservation	240	5	8	5	1	4	6	0	1	3	16	35	2	14
Duluth	42,629	1	5	6	2	12	5	2	5	7	35	12	4	4
Ely	1,617	6	5	3	1	12	1	1	5	13	20	19	8	6
Fond du Lac Reservation	1,662	1	7	12	4	11	3	1	4	4	21	16	3	12
Grand Portage Reservation	218	0	5	2	1	19	2	0	14	6	15	25	2	9
Hibbing	6,531	7	6	9	2	13	7	1	4	6	27	9	6	4
Hoyt Lakes	834	13	8	12	0	14	9	0	6	8	21	5	3	3
Soudan	256	7	8	12	2	4	5	0	8	1	23	26	0	5
Tower	178	1	2	8	2	8	0	0	7	1	19	33	12	7
Virginia	3,413	6	8	7	1	12	5	2	7	7	28	8	4	5

Source: U.S. Census Bureau 2010a.

Note:
Percent totals may be greater or less than 100% due to rounding.

Income

Table 4.2.10-12 shows the average income earned by employees in each major NAICS industry. Mining and utilities pay very high average wages statewide and in St. Louis County. However, wages paid to health care and social services workers account for more than one-quarter of the total wages paid by private companies in St. Louis County and for more than 16 percent of statewide wages.

4.2.10.1.3 Public Finance

Sales and use tax revenues from study area counties by all industries and the mining industry are summarized in Table 4.2.10-13. This table illustrates the relative sales and use tax contribution from the mining industry in the state.

The mining and processing of base and precious metals in the state are not currently subject to production tax. However, mining is subject to the following taxes (MDR 2011):

- Net proceeds tax: tax proceeds are distributed to the state general fund if mined resources do not fall within the taconite assistance area. Taxes paid on mined resources within the taconite assistance area (which includes the NorthMet Project area) are distributed as follows: 5 percent to the city or town where mined, 10 percent to the Municipal Aid Account, 10 percent to the school district, 20 percent to the Regular School Fund, 20 percent to Taconite Property Tax Relief, 5 percent to IRRRB, 5 percent to the Douglas J. Johnson Economic Protection Trust Fund, and 5 percent to the Taconite Environmental Protection Fund.
- Occupation tax: 2.45 percent of the taxable amount (typically the mine value), as determined by the Minnesota Department of Revenue. Revenue generated through the occupation tax is credited to the general fund, with 10 percent designated for the University of Minnesota, 40 percent designated for public elementary and secondary schools, and 50 percent remaining in the state's general fund.
- Sales and use tax: 6.875 percent of all purchases that do not qualify for an exemption.
- Withholding tax on royalty payments: 6.25 percent of royalty payment.

Ad valorem tax is established and collected by the counties, local communities, and school districts according to Minnesota state law.

4.2.10.1.4 Housing

Table 4.2.10-14 illustrates the housing characteristics of the study area. Much of the overall vacancy rate reflects the large number of seasonal (vacation) homes in the region, particularly in Cook and Lake counties where nearly two-thirds of vacant housing units are for seasonal use. Excluding seasonal units, vacancy rates in the study area are somewhat higher than in the state as a whole, although vacancy rates in individual communities vary significantly. There are approximately 5,400 hotel rooms and 1,175 occupied berths and 225 vacant berths in mobile home parks in the study area (Northland Connection 2012). Hotels and mobile homes are often used by mine construction employees, especially those with short-term assignments. The study area has a slightly lower share of owner-occupied housing units than in the state. Household sizes are smaller in the study area than in the state as a whole. These data are consistent with trends (see Section 4.2.10.1.2) suggesting that the study area is becoming increasingly attractive to retirees, who tend to have higher home ownership rates and smaller household sizes than other segments of the population.

Table 4.2.10-12 Payroll ($1,000s) by Major NAICS Industry, 2009

	Minnesota		Cook County		Lake County		St. Louis County	
Industry	**Payroll**	**Avg. per Employee**	**Payroll**	**Avg. per Employee**	**Payroll**	**Avg. per Employee**	**Payroll**	**Avg. per Employee**
Forestry, fishing, hunting	$79,116	$32,135	D	na	$172	na	$4,723	$27,459
Mining, quarrying, oil/gas	$322,301	$68,531	D	na	D	na	$196,993	$62,518
Utilities	$1,085,613	$79,178	$5,043	$42,025	D	na	$73,916	$80,256
Construction	$5,558,534	$56,090	D	na	$2,959	$30,823	$179,640	$55,087
Manufacturing	$14,782,085	$48,022	$483	$53,667	$23,083	na	$187,373	$42,799
Wholesale trade	$8,320,168	$63,205	$6,647	$23,488	D	na	$96,299	$42,255
Retail trade	$6,773,100	$23,249	D	na	$7,672	$23,108	$265,991	$21,139
Transportation, warehousing	$2,938,953	$38,986	$2,589	$43,881	D	na	$73,216	$37,857
Information	$3,920,852	$61,172	$1,518	$42,167	$2,540	na	$82,475	$37,711
Finance and insurance	$10,454,638	$70,344	$804	na	$5,819	$32,508	$146,947	$40,204
Real estate	$1,335,591	$36,797	$796	na	$1,339	$15,940	$25,263	$24,841
Professional, sci., tech. svcs.	$8,121,631	$58,316	$611	$23,500	$1,172	na	$148,666	$45,478
Management	$9,246,827	$78,281	$989	$23,548	$972	$23,707	$59,195	$63,175
Admin., support, waste mgt.	$4,215,273	$34,017	D	na	D	na	$65,069	$20,258
Educational services	$1,661,448	$25,000	$6,027	$19,826	$11,497	na	$50,130	$21,242
Health care, social assistance	$16,303,572	$38,640	$11,675	$18,214	$1,447	$26,796	$822,689	$37,757
Arts, entertainment, rec.	$1,087,163	$27,488	$655	$14,239	$9,972	$16,428	$18,759	$15,364
Accommodation, food svcs.	$3,068,339	$14,396	D	na	$2,722	$15,644	$125,175	$13,448
Other svcs.	$2,898,411	$24,288	$-	na	$-	na	$79,563	$19,916
Industries not classified	$5,619	$19,376	$-	na	$-	na	$169	$33,800
Total	$102,179,234	$42,272	$52,668	$26,667	$86,786	$29,369	$2,702,251	$33,102

Source: U.S. Census Bureau 2009.

Notes:
Letter codes indicate suppression flags in the original data set—cases where exact data were withheld by the United States Census Bureau in order to protect company-confidential data. Flags indicate approximate employment, as follows:
A: 0-19 employees; B: 20-99 employees; C: 100-249 employees; E: 250-499 employees; F: 500-999 employees.
na = Not available

Table 4.2.10-13 Select Sales and Use Tax Statistics ($1,000s)

	Total Tax (Sales and Use)					
	Cook County		Lake County		St. Louis County	
Year	All Industries	Metal Mining	All Industries	Metal Mining	All Industries	Metal Mining[2]
1995	$3,345	NR[1]	$4,318	NR	$91,008	NR
2000	$4,192	0	$5,390	0	$114,011	$4,150
2009	$5,897	0	$8,515	0	$158,227	$7,210

Source: MDR 2010.

Notes:
[1] NR: Not reported
[2] 2009 data reported as "Mining – All Other".

Table 4.2.10-14 Study Area Housing Unit Characteristics, 2010

Geography	Total HU	Occupied HU (%)	Owner-Occupied HU (%)	Renter-Occupied HU (%)	Vacancy Rate (%)	Vacancy Rate, Non-seasonal (%)	Average Household Size (persons)
Minnesota	2,347,201	89	65	24	11	6	2.48
Cook	5,839	43	32	11	57	5	2.05
Lake	7,681	63	51	12	37	6	2.21
St. Louis	103,058	82	59	24	18	6	2.25
Study Area	**116,578**	**79**	**57**	**22**	**21**	**6**	**2.24**
Aurora	887	88	68	20	12	9	2.09
Babbitt	818	86	74	13	14	9	2.07
Biwabik	543	86	63	24	14	10	2.03
Duluth	38,208	93	57	37	7	6	2.23
Ely	2,022	83	54	29	17	13	1.93
Hibbing	8,200	90	64	26	10	8	2.17
Hoyt Lakes	1,016	87	77	10	13	9	2.27
Soudan	244	84	75	9	16	8	2.18
Tower	331	80	54	26	20	10	1.89
Virginia	4,738	90	51	38	11	10	1.95
Bois Forte Reservation	451	65	46	20	35	5	2.97
Fond du Lac Reservation	1,729	89	66	23	11	3	2.72
Grand Portage Reservation	313	82	41	41	18	4	2.20

Source: U.S. Census Bureau 2010a.

Notes:
Percent totals may be greater or less than 100% due to rounding.
HU = Housing unit(s).

4.2.10.1.5 Public Services and Facilities

Water and Sewer

Table 4.2.10-15 summarizes the condition of public water and sewer facilities throughout the study area. All of the cities evaluated have public water and wastewater systems, with varying degrees of available capacity. Residents and businesses in unincorporated areas typically rely on individual wells and septic systems. Potable water for municipal systems comes from either groundwater or surface water (notably, Duluth obtains its drinking water from Lake Superior). Most of the public water and sewer infrastructure supporting the study area communities was constructed to accommodate larger populations than currently reside in the area (e.g., the 1980 and 1990 populations listed in Table 4.2.10-1).

Table 4.2.10-15 Water and Wastewater Capacity

	Water			Wastewater		
Geography	**Capacity (MGD)[1]**	**Average Demand (MGD)**	**System Issues/Upgrades**	**Capacity (MGD)**	**Average Demand (MGD)**	**System Issues/Upgrades**
Aurora	0.864	0.222	Study underway with Biwabik to identify new water source. Considering building a new facility for both.	0.900	0.200	$7 million upgrade in the last four years.
Babbitt	0.600	0.200	None	0.500	0.200	Consulting firm hired to look into upgrading or rebuilding a new wastewater plant.
Biwabik	0.430	0.128	Study underway with Aurora to identify new water source. Considering building a new facility for both.	0.220	0.160	None
Duluth	40	19	Water tower to go online mid-May 2012 adding 900,000 gallons to the 68 million storage capacity.	100	16	The city is upgrading or replacing two wastewater lift stations each year at an annual cost of $600,000 per year.
Ely	1	0.350	$350,000 rehab work every year.	1.5	0.400	$350,000 rehab work every year.
Hibbing	3.2	2.3	None	4.5	2	Wastewater inflow & infiltration concerns throughout the city; certain neighborhoods have wastewater backups during large rain events.
Hoyt Lakes	1.5	0.307	Minor upgrades to the water plant.	0.650	0.270	Began preliminary engineering for rebuilding wastewater facility.
Soudan/ Tower[2]	0.300	0.0900	Needs new water tower.	0.176	0.13	None
Virginia[3]	5	1.7	None	4.3	2	Starting project to expand wastewater plant and reduce mercury; projected completion 1st quarter 2013.

Source: Northland Connection 2012.

Notes:
[1] MGD = million gallons per day.
[2] Soudan and Tower share resources
[3] Data reflect current wastewater system. Once wastewater upgrade is complete, capacity will increase to 9.9 mg/d and average demand will go up to 3.1 mg/d.

Emergency Services

Table 4.2.10-16 illustrates the available public safety resources. Each county in the study area has its own sheriff's department, which provides law enforcement and other services for unincorporated areas. Municipalities provide their own police protection, except for Aurora, which contracts with the St. Louis County Sherriff's Office (SLCPD 2012) and Biwabik, which receives law enforcement from Gilbert (Northland Connection 2012). The St. Louis County Sheriff's Office also maintains countywide 911 service, coordinating police, fire, and emergency medical response. Similarly, each community maintains its own fire department, typically a volunteer department. The City of Babbitt fire department provides emergency response to the Northshore Mine, and has up-to-date equipment.

A variety of public and private ambulances provide emergency medical service for the study area. Ambulance service is integrated into some municipal fire departments (such as Babbitt, Duluth, Hibbing, and Virginia). Other municipalities either contract with nearby cities or with private ambulance services.

Table 4.2.10-16 Public Safety

Geography	Police Officers	Firefighters	EMS Ambulance Personnel
Aurora	5	22	7
Babbitt	4	35	25
Biwabik	7[2]	21	21
Duluth	152	125	48
Ely	8	32	27
Hibbing	30	23	19
Hoyt Lakes	6	21	23
Soudan/Tower[1]	1	15	19
Virginia	18	21[3]	21[3]

Source: Northland Connection 2012.

Notes:
[1] Soudan and Tower share resources.
[2] Biwabik receives law enforcement from Gilbert.
[3] Firefighters are full-trained EMS and operate ambulance services from fire hall.

Medical Services

The study area communities are served by both medical clinics and hospital facilities. The closest medical facility to the NorthMet Project area is Essentia Health Northern Pines in Aurora. This 16-bed facility has Level IV trauma status, indicating that staff are able to stabilize patients for transport to more advanced trauma centers (Essentia 2012). Other nearby Level IV trauma centers are in Ely and Virginia, while the nearest advanced care (Level II) hospitals are Essentia Health St. Mary's Medical Center and St. Luke's Hospital, both in Duluth (MDH 2011).

Education

Table 4.2.10-17 shows the capacity and enrollment of public schools. As with other public services and facilities, each municipality maintains its own public school system, supplemented with county-run independent school systems. Most public schools in the region are designed to accommodate larger populations. Some jurisdictions, such as the Duluth school district, are choosing to close or repurpose school buildings.

Table 4.2.10-17 Capacity and Enrollment of Public Schools

Geography	Capacity	Enrollment	Facilities to be Upgraded, Replaced, Combined, or Closed
Aurora[1]	1,500	886	The district plans to replace boilers and resurface parking lots at their facilities.
Babbitt	1,200	348	None
Biwabik[1]	1,500	886	The district plans to replace boilers and resurface parking lots at their facilities.
Duluth	9,800	8,308	School district is downsizing and modernizing its facilities, resulting in one less high school, one less middle school, two less elementary schools, and one less K-8 facility.
Ely	1,775	542	None
Hibbing	2,680	2,319	None
Hoyt Lakes[1]	1500	886	The district plans to replace boilers and resurface parking lots at their facilities.
Tower/Soudan[2]	175	94	None
Virginia	1,623	1,623	Considering setting up portable classrooms for fall 2012; community is in the process of securing funding and support to either add or build new facilities.

Source: Northland Connection 2012.

Notes:
[1] These communities are part of the Mesabi School district.
[2] Soudan and Tower share resources.

The region is also served by a number of community and technical colleges (MNSCU 2012):

- **Mesabi Range Community and Technical College (Virginia and Eveleth)**: Offers 50 diploma, certification, or degree (A.A.) programs, with notable specialties in wind energy technology, and human services.
- **Vermilion Community College (Ely):** Offers 30 programs, many focused on environmental programs and outdoor careers, such as water quality science, outdoor therapeutic recreation, sports management, park ranger training.
- **Hibbing Community College:** Offers a mix of more than 40 programs ranging from traditional liberal arts to career-oriented programs.
- **Fond du Lac Tribal and Community College (Cloquet):** Offers nearly 40 programs, ranging from liberal arts and nursing to specialty programs in American Indian studies, geospatial technologies, environmental science, and clean energy technology.
- **Lake Superior College (Duluth):** Offers nearly 100 programs, with heavy emphasis on nursing and other medical specialties, along with a full range of liberal arts and professional training.

The study area is also home to two 4-year institutes of higher learning. These include the University of Minnesota Duluth, with nearly 12,000 enrolled undergraduate, graduate, and other students (University of Minnesota Duluth 2011); and the College of St. Scholastica in Duluth, with more than 4,000 enrolled students (CSS 2012).

4.2.10.1.6 Subsistence

There is no nationwide federal definition of subsistence, nor has the State of Minnesota developed a formal definition. Title VIII of the Alaska National Interest Lands Conservation Act (P.L. 96-487) defines subsistence for rural Alaska residents (regardless of whether they are Native American) as:

> the customary and traditional uses…of wild renewable resources for direct, personal, or family consumption as food, shelter, fuel, clothing, tools, or transportation; for the making and selling of handicraft articles out of non-edible byproducts of fish and wildlife resources taken for personal or family consumption; for barter, or sharing for personal or family consumption; and for customary trade.

This Alaskan definition is consistent with subsistence activities within the study area as well. For many study area residents, particularly members of Bois Forte, Fond du Lac, and Grand Portage, as well as other Native American bands, subsistence hunting, fishing, trapping, and gathering activities are a significant activity. Individuals participate in subsistence activities for numerous reasons, including food supply, personal income, and the continuance of cultural customs and traditions.

As part of the 1854 Treaty, Native American bands retain the right "to hunt, fish, trap, and gather for subsistence on public lands and waters open to the public (publicly owned and accessible to the public without charge) within the [1854 Ceded Territory]" (MDNR 2010a). The 1854 Treaty and subsequent court interpretations also include limited rights to commercial harvest.

A 2002 study of subsistence activities amongst the Bois Forte and Grand Portage Bands (Vogt 2004) demonstrates the wide variety of species and items collected as part of subsistence activities in the study area, including the following:

- fish: more than 25 species, with the most commonly harvested being walleye, northern pike, lake trout, and crappie;
- birds and mammals: more than 10 species, with the most commonly harvested being deer, grouse, moose, and duck; and
- plants: more than 12 species/items, with the most commonly harvested being wild rice, various berries, and maple sap/syrup.

Among the survey respondents, subsistence activity (including hunting, fishing, and plant gathering) accounted for approximately one meal per week. Subsistence activity typically occurs either on Native American reservations or within other parts of the 1854 Ceded Territory. Fishing and hunting occur throughout the year, although harvesting fish for consumption is more prevalent during warmer months, while harvesting land animals is more prevalent during colder months (Vogt 2004). Grand Portage's subsistence fish consumption averages 144 grams/day, five times higher than the MPCA assumed fish consumption rate of 30 grams/day. Fond du Lac's subsistence fish consumption is on average 60 grams/day, two times higher than the MPCA assumed fish consumption rate (MPCA 2012d). The effects of mercury bioaccumulation on subsistence activity are discussed in Section 5.2.10.2.6.

In addition to the survey results described above, Table 4.2.9-3 in Section 4.2.9 shows other animal and plant species that have historically been and/or could potentially be harvested in the 1854 Ceded Territory.

The 1854 Treaty Authority manages big game (moose, deer, and bear) hunting, as well as furbearer trapping (pine marten, fisher, otter, and bobcat) on behalf of the Bois Forte and Grand Portage bands, in accordance with a 1988 negotiated agreement with Minnesota. Under this agreement, big game harvests are limited. Harvests for all species (including big game and trapping) have generally declined since 1994 (Edwards 2012).

The Mine Site and Transportation and Utility Corridor fall partially within the state-defined moose harvest area, although no moose were harvested by the bands within approximately 20 miles of this location from 1994-2011. The majority of deer hunting and a portion of furbearer trapping occurred in St. Louis County during this time period (Edwards 2012).

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4.2.11 Recreation and Visual Resources

This section describes the recreational facilities and activities that typically take place in the NorthMet Project area, as well as the surrounding Arrowhead region. Because recreation in this region is strongly tied to the aesthetic condition of the landscape, this section also describes the visual setting of the NorthMet Project area and surrounding land.

4.2.11.1 Mine Site

4.2.11.1.1 Recreational Facilities and Activities

Surface rights to the Mine Site and adjoining federal lands are held by the USFS, and the Mine Site is part of the Superior National Forest. Management of the physical, biological, and social resources of the Superior National Forest are set forth in the Forest Plan. Intended to ensure that ecosystems are capable of a sustainable flow of beneficial goods and services, the Forest Plan includes guidelines and standards for almost 20 activities and categories of resources within the Superior National Forest including recreation and scenic, or visual, resources.

Recreation opportunities in the Superior National Forest are managed within the framework of the Recreation Opportunity Spectrum (ROS). Using criteria that consider distance to roads, motorized lakes, and trails (i.e., lakes and trails where motorized transportation is permitted), this system includes five ROS classes, each of which prescribes a set of recreational settings, opportunities, and experiences. At one end of the ROS, areas designated “primitive” have little evidence of people and are difficult to access. At the other end of the ROS, “rural” areas are more accessible and provide developed facilities as well as opportunities to interact with other recreationists.

Most of the Mine Site is within the Semi-Primitive Motorized ROS, with a small portion falling within the Roaded Natural ROS. Both ROS designations indicate areas where motor vehicles may be permitted, where interactions between visitors are intended to be infrequent, but where human activity such as timber harvesting may be visible.

While this designation permits recreational activity, the Mine Site is entirely surrounded by private, restricted property, roads, and railroads. In particular, the Northshore Mine borders the Mine Site to the north, the restricted-access Plant Site borders the Mine Site to the west, and the Transportation and Utility Corridor isolates the Mine Site from adjacent portions of the Superior National Forest to the south. Some portions of the Mine Site are contiguous with Superior National Forest and state-owned public land, notably the eastern boundary of the Mine Site. However, these public lands are also encircled by restricted property, roads, and railroads. The Mine Site is accessible by water via the Partridge River, but there is no public land access to, and no practical opportunity to engage in recreational activity at, the Mine Site.

The region surrounding the Mine Site and adjoining federal lands is a popular and highly valued destination for recreation. Recreational activities that typically occur within 25 miles of the federal lands include (but are not limited to):

- Boating and camping in the BWCAW (approximately 20 miles north of the federal lands) and other local, state, and federal lands.
- Hunting, fishing (particularly in the Embarrass and Partridge Rivers), and hiking.

- Year-round recreation, including downhill skiing at the Giants Ridge Golf & Ski Resort (approximately 15 miles east of the Mine Site), cross-country skiing, snowmobiling, mountain biking, hiking, and golf.
- Biking, hiking, and roller-blading on the Mesabi Trail, which spans 70 miles across the Iron Range.

These activities typically do not occur in the immediate vicinity of the Mine Site, Plant Site, and Transportation and Utility Corridor. For example, the nearest designated USFS campgrounds are Cadotte Lake, 16 miles southeast, and Birch Lake, 12 miles north. There are two back-country camping facilities on Stone Lake and Big Lake, approximately 8 miles southeast of the Mine Site. The nearest designated boat launch (Colby Lake) is 5 miles away, and the nearest designated USFS trails (including the St. Louis River and Bird Lake Trails) are south and east of Hoyt Lakes, more than 8 miles south of the Plant Site. The USDA Visitor Use report for the Superior National Forest indicates that the forest received 1.1 million national visits in 2011, with roughly 76 percent of those visits being for recreational purposes. The Visitor Use report defines a visit as “the entry of one person upon a national forest to participate in recreation activities for an unspecified period of time” (USFS 2012). It is important to note that the Visitor Use Report does not contain information about specific types of visitation to specific parts of the Superior National Forest.

4.2.11.1.2 Visual Resources

The NorthMet Project area lies within and adjacent to Superior National Forest, which provides over 3 million acres of rich and varied visual resources (USFS 2007c). The visual character of the NorthMet Project area varies from upland forests and wetlands to developed industrial areas. There are several active, closed, and reclaimed mines near the NorthMet Project area, and evidence of past and ongoing mining (such as reclaimed or abandoned waste rock piles) is present in many parts of the area surrounding the Mine Site.

The Mine Site and the adjoining federal lands are located along the south flank of the Mesabi Iron Range, immediately south of the Giants Range formation (see Figure 1.1-1). The Iron Range supports numerous active mining operations, including the Northshore taconite mine located north of the Mine Site. The Mine Site is relatively flat, with elevations between 1,570 ft and 1,600 ft amsl. The Giants Range formation is the dominant landscape feature in the area. It rises steeply to an average elevation of approximately 1,700 ft amsl (with some elevations above 1,800 ft amsl) along the ridgeline (approximately 1 to 2 miles from the Mine Site), and declines approximately 150 to 200 ft on its northern flank. The One Hundred Mile Swamp, Partridge River, and the Northshore Mine are to the north between the Mine Site and the Giants Range.

The Mine Site is surrounded by wetlands (including the One Hundred Mile Swamp) and mixed deciduous and coniferous upland forests to the east, south, and west. The average canopy height in the upland forest is 30 to 60 ft with occasional white pine and white spruce in excess of 70 ft. In the wetland areas, the coniferous canopy is approximately 30 to 40 ft while the deciduous growth is less than 20 ft tall. The Partridge River makes a horseshoe bend around the north, east, and south sides of the Mine Site.

The nearest potential visual receptors to the Mine Site—places where the public may be able to see the Mine Site on a regular basis, such as homes or public roads with open views—are illustrated on Figure 4.2.11-1. The ability to view the Mine Site is highly dependent on the topography and foliage present at a viewer's specific location, but views of the Mine Site may be present at:

- clusters of rural homes, approximately 7 miles to the south near the unincorporated village of Skibo;
- the City of Hoyt Lakes, approximately 9 miles to the southwest;
- along Lake County Road 2 within the incorporated limits of the City of Babbitt, approximately 12 miles to the east; and
- the Skibo Vista Scenic Overlook, along Lake County Highway 15, approximately 12 miles south (see Figure 4.2.11-2).

The Mine Site may also be visible from Forest Road 112, which passes less than 2 miles from the Mine Site; however, traffic on this road is likely to be low, given the absence of population centers or significant recreational sites along the road.

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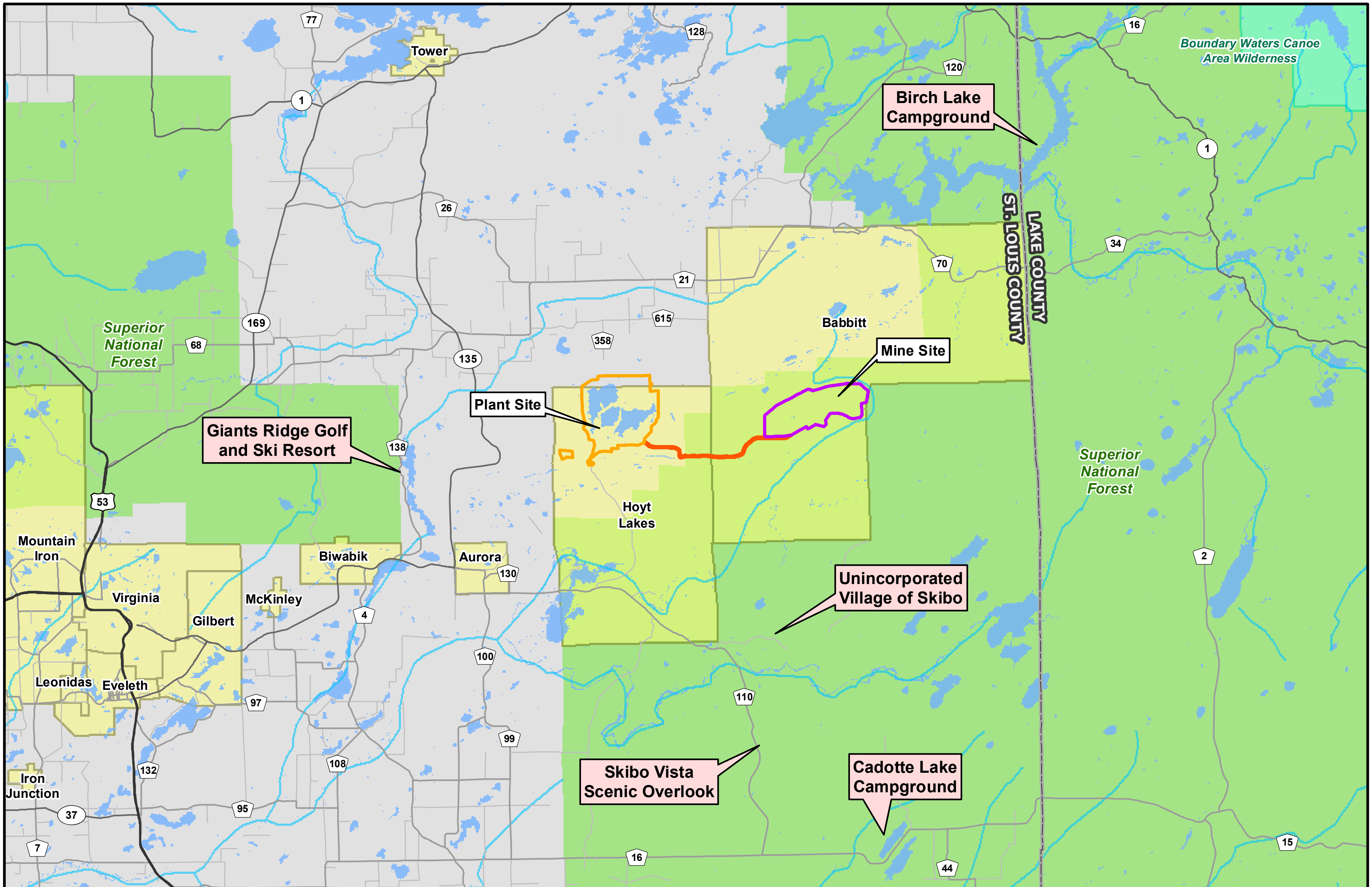

Mine Site
Plant Site
Transportation and Utility Corridor
Municipal Boundary
Boundary Waters Canoe Area Wilderness
National Forest
City/Town
Streams/Rivers
Lakes

US Army Corps of Engineers
St. Paul District

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Figure 4.2.11-1
Representative Visual Receptors
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

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This document is a working document. This document may change over time as a result of new information, further deliberation, or other factors not yet known to the Co-lead Agencies.

Figure 4.2.11-2
Mine Site and Plant Site, as Viewed from Skibo Vista Scenic Overlook
NorthMet Mining Project and Land Exchange PFEIS
Minnesota
June 2015

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The USFS uses the Scenery Management System to identify desired visual conditions within National Forests. The Scenery Management System uses Scenic Integrity Objectives (SIOs) to express these desired conditions. The SIO designations for Superior National Forest are defined in the Forest Plan. SIO definitions are as follows (based on USFS 1995):

- Low SIO: The landscape appears moderately altered, and non-natural landscape features may begin to dominate.
- Moderate SIO: The landscape appears slightly altered. Non-natural features or activities may be apparent, but do not dominate.
- High SIO: The landscape appears unaltered, essentially in a "natural" state, with minimal evidence of non-natural features or activities.

The Mine Site and adjoining federal lands are designated by the USFS as areas of Low SIO. Within this designation, the landscape appears altered, and non-natural landscape features may begin to dominate. There are no major recreational trails within the portion of Superior National Forest adjacent to the Mine Site that would expose recreational users to views of the mine on a regular basis.

Native American tribal members exercise rights to hunt, fish, and gather on Superior National Forest lands, including lands near the Mine Site. The frequency with which tribal members exercise these rights in portions of Superior National Forest with views of the Mine Site is not known; however, as described in Sections 4.2.9 and 5.2.9, there are several cultural resources and locations adjacent to or potentially within sight of the Mine Site (as well as the Plant Site and Transportation and Utility Corridor), such as the Spring Lake Mine Sugarbush, Trygg Trail Corridor, and *Mesabe Widjiu*. Note that these sites are not depicted in the figures in this section due to sensitivity regarding cultural resources and locations.

4.2.11.2 Transportation and Utility Corridor

4.2.11.2.1 Recreational Facilities and Activities

The Transportation and Utility Corridor is within an area with a Roaded Natural ROS designation. This designation indicates areas that are mostly natural in appearance (with some modification), and where evidence of other users and interactions between users are somewhat frequent. The Transportation and Utility Corridor is owned or leased by PolyMet, and is not open to the public. Entry points are gated and/or guarded, and crossing the corridor is prohibited. No recreational activity is permitted along the corridor.

4.2.11.2.2 Visual Resources

The Transportation and Utility Corridor follows Dunka Road between the Mine Site and the Plant Site and includes existing road and rail lines. Viewpoints for the corridor are the same as those for the Mine Site and Plant Site. The portions of Superior National Forest near the Transportation and Utility Corridor are within the Low SIO designation. As described in Section 4.2.11.1, users of culturally important locations may have views of the Transportation and Utility Corridor.

4.2.11.3 Plant Site

4.2.11.3.1 Recreational Facilities and Activities

The Plant Site is located at the former LTVSMC processing plant. It is owned by PolyMet, and it is not open to the public. Entry roads are gated and/or guarded. No recreational activity is permitted at this site. Because the Plant Site is not in Superior National Forest, it does not have an ROS designation.

4.2.11.3.2 Visual Resources

Topography at the Plant Site rises from approximately 1,550 ft amsl near the railroad at the south end of the plant to approximately 1,780 ft amsl at the north end adjacent to the Tailings Basin (on the northern flank of the Giants Range). The inactive LTVSMC industrial processing buildings—including crushing, grinding, concentrating, and maintenance and pellet storage/rail loading facilities—were constructed in the 1950s, and dominate the visual landscape at the Plant Site. The nearest potential visual receptors are residences approximately 3.5 miles north of the Plant Site on County Road 358 and County Road 615. These rural residences are outside the incorporated limits of the cities of Babbitt and Hoyt Lakes. The City of Hoyt Lakes is the next closest visual receptor and is approximately 5 miles south of the Plant Site. The Tailings Basin and some buildings at the Plant Site would likely be visible from the ski slopes at the Giants Ridge Golf and Ski Resort, approximately 8 miles west-southwest of the Plant Site.

The existing LTVSMC Tailings Basin is located to the north of the buildings, with legacy mine pits and waste rock stockpile sites to the south and east and a railroad to the west. Second Creek and its headwater wetlands also border the site immediately to the south. The Tailings Basin is surrounded by wetlands and low, forested (mixed coniferous and deciduous) uplands to the north, east, and west. The closest residences to the Tailings Basin are along Beckman Road and Salo Road, approximately 1.5 and 2.5 miles north of the Tailings Basin, respectively. Some of the culturally important locations described above and in Section 4.2.9 are closer: the Sugarbush is approximately 0.5 miles from the Plant Site, the *Mesabe Widjiu* intersects the Plant Site and is less than 2 miles from the Mine Site, and portions of the Trygg Trail Corridor cross both the Mine Site and Plant Site. As described above for the Mine Site, users of these culturally important locations may have views of the Plant Site.

Because the Plant Site is not in Superior National Forest, it does not have an SIO designation.

Figure 4.2.11-1 shows the Plant Site in relation to the Mine Site, from the Skibo Vista Scenic Overlook, approximately 13 miles south of the Plant Site.

4.2.12 Wilderness and Other Special Designation Areas

For this analysis, the term "wilderness" is defined by the Wilderness Act of 1964 (Public Law 88-577) (16 USC §§ 1131-1136). In its planning, management, and monitoring, the USFS identifies four characteristics of wilderness, as defined in the Wilderness Act:

- Untrammeled: The Wilderness Act states that wilderness "[is] an area where the earth and its community of life are untrammeled by man," and "generally appears to have been affected primarily by the forces of nature." This quality monitors human activities that directly control or manipulate the components or processes of ecological systems inside wilderness.
- Undeveloped: The Wilderness Act states that wilderness is "an area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements or human habitation," "where man himself is a visitor who does not remain" and "with the imprint of man's work substantially unnoticeable." This quality monitors the presence of structures, construction, habitations, and other evidence of modern human presence or occupation.
- Natural: The Wilderness Act states that wilderness is "protected and managed so as to preserve its natural conditions." This quality monitors both intended and unintended effects on ecological systems inside a wilderness. The natural quality of wilderness character may potentially be affected by actions located outside the wilderness through effects on water quality and air quality.
- Solitude or a Primitive and Unconfined Type of Recreation: The Wilderness Act states that wilderness has "outstanding opportunities for solitude or a primitive and unconfined type of recreation." This quality monitors conditions that affect the opportunity for people to experience solitude or primitive, unconfined recreation in a wilderness setting. An indicator of this quality is remoteness from occupied and modified areas outside the wilderness, such as noise or visual effects.

Other federal special designation areas are identified by Presidential Designation, Congressional Designation, or Administrative Designation, and define lands that are considered to have remarkable ecological, paleontological, historic, scenic, recreational, geologic, or fish and wildlife value. They include wilderness areas, wilderness study areas, RNAs and cRNAs, national scenic or historic trails, wild or scenic rivers, UBAs, national natural landmarks, national historic landmarks, and national monuments, among others. These special designation areas are managed by federal land management agencies such as the BLM, USFS, National Park Service, and USFWS. The state similarly designates areas for special management due to their wilderness value.

None of the elements of the NorthMet Project Proposed Action are located within or adjacent to any wilderness areas. Similarly there are no special designation areas within or adjacent to the Mine Site, Plant Site, or Transportation and Utility Corridor. While recreation facilities such as parks are listed in this section, recreational use of those facilities is described in Section 4.2.11.

4.2.12.1 Federally Managed Areas

This section discusses federally managed wilderness and special designation areas that are close enough to the NorthMet Project area that they may be affected by activities related to the

NorthMet Project Proposed Action. Isle Royale National Park is outside of the study area for evaluation of Wilderness and Other Special Designation Areas; however, the visibility analyses in Section 5.2.7.2.2 do include Isle Royale National Park.

4.2.12.1.1 Wilderness Areas

The NorthMet Project area is approximately 20 miles south of the BWCAW (see Figure 4.2.12-1). Portions of the BWCAW were formally designated as a wilderness area in 1964 under the Wilderness Act. This wilderness area was further expanded and given its current name in 1978 under Public Law 95-495, and now encompasses more than 1 million acres along the United States' international boundary with Canada. The BWCAW is managed by the USFS as part of the larger Superior National Forest. It attracts more than 250,000 visitors annually and is used year-round for camping, hiking, fishing, canoeing, and hunting. Motorized vehicle use is limited. Activity and access are controlled by use permits managed by the USFS (USFS 2004c).

The BWCAW contains several hundred miles of streams and approximately 1,175 lakes that vary in size from 10 to 10,000 acres. Together, there are about 190,000 acres of open water or 20 percent of the surface area of the BWCAW that provides opportunities for long-distance travel by watercraft. The BWCAW is the only large lakeland wilderness in the National Wilderness Preservation System (USHR 1978).

The wilderness has approximately 80 entry points that provide access to 1,200 miles of designated canoe routes, 18 hiking trails, and nearly 2,200 campsites. There are numerous cultural resources in the BWCAW including camp sites, villages, wild ricing sites, cemetery areas, pictographs, and sites of spiritual and traditional importance. The wilderness also contains evidence of a number of historic European and early Native American activities.

The same 1978 law that created the BWCAW also designated the BWCAW as a Mining Protection Area. This designation prohibits exploration, lease, and exploitation of minerals in the wilderness, and the prohibition of mineral exploration or exploitation on property owned by the United States if that activity could materially change the wilderness characteristics of the BWCAW (USHR 1978).

Voyageurs National Park is adjacent to the BWCAW and is located approximately 50 miles northwest of the NorthMet Project area (see Figure 4.2.12-1). The National Park Service manages nearly 127,500 acres of park lands designated for wilderness study. The BWCAW and Voyageurs National Park are contiguous with Canada's Quetico Provincial Wilderness Park. Together, these three areas represent 2.39 million acres of managed wilderness area.

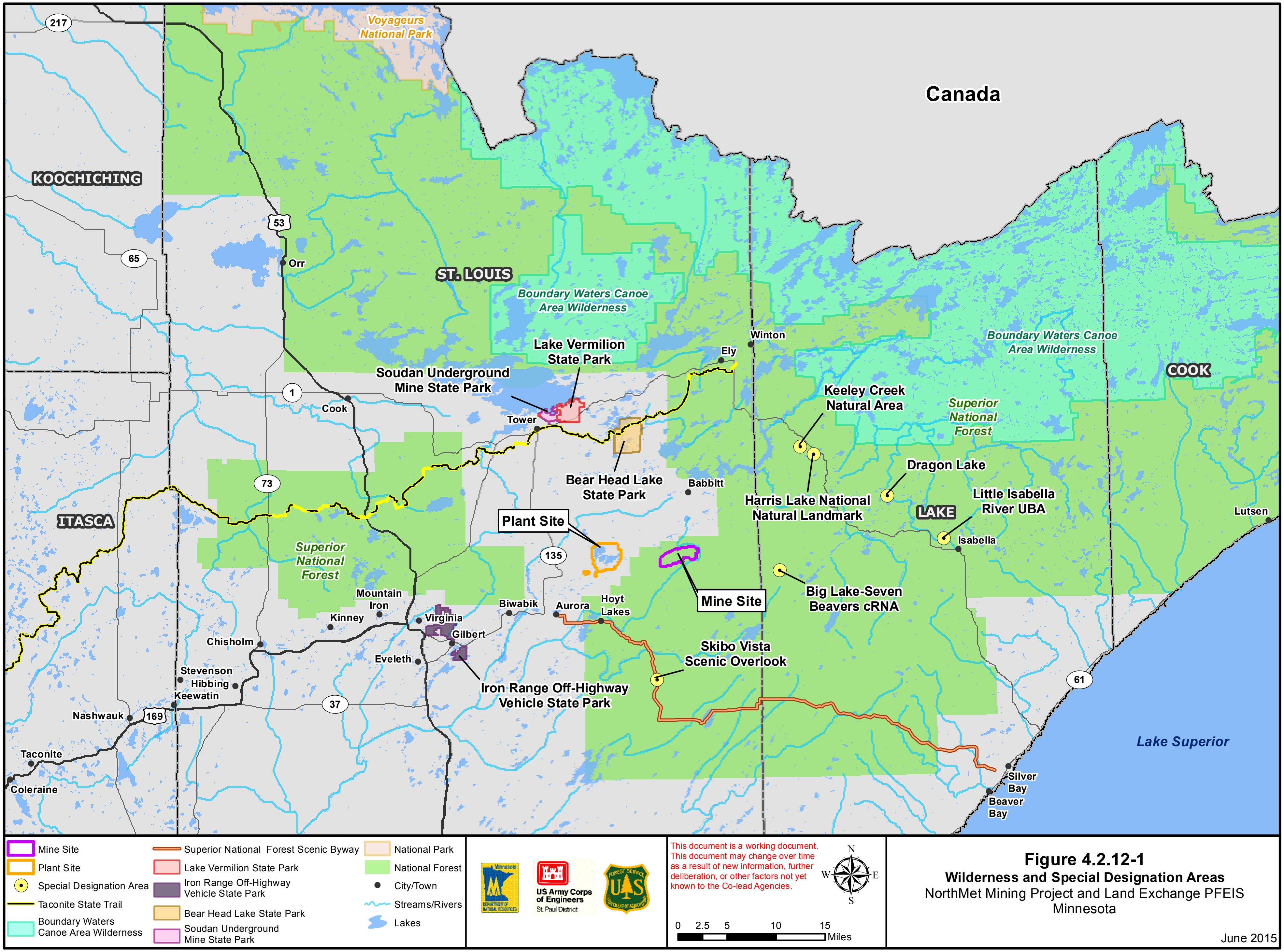

Figure 4.2.12-1
Wilderness and Special Designation Areas
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

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4.2.12.1.2 Established and Candidate Research Natural Areas

The Forest Service designates and manages RNAs and cRNAs for the purpose of preserving and maintaining areas for ecological research, observation, genetic conservation, monitoring, and educational activities (USFS 2004b). The RNAs may serve as baseline or reference areas for comparison to other similar ecosystems that are subject to a wider range of management activities. They also provide opportunities for low-impact activities designed to educate people about ecological processes. No recreation facilities are provided. Dispersed recreation use occurs but is generally discouraged. The cRNAs are managed in similar fashion to the RNAs, with the exception that semi-primitive, non-motorized recreation is permitted.

Three RNAs are within 25 miles of the NorthMet Project area: the Big Lake – Seven Beavers cRNA, the Keeley Creek RNA, and the Dragon Lake cRNA.

The Big Lake – Seven Beavers Area includes an excellent representation of a variety of characteristic upland and lowland plant communities, dominated by wetland communities including lowland black spruce, lowland cedar, shrub swamp, and bog, connected to Sand Lake Peatland SNA (managed by the MDNR). The 5,599 acres of the cRNA are located approximately 12 miles east of the NorthMet Project area (USFS 2011h) (see Figure 4.2.12-1). This cRNA (and adjacent Sand Lake Peatland SNA) is located within the Headwaters Site, which is an area of ecological significance. Due to high biodiversity, low disturbance, and the size and complexity of the peatlands present on the site, it is considered a blueprint for natural resource management in the Laurentian Uplands subsection.

Keeley Creek Natural Area, located within the Superior National Forest in Stony River Township, approximately 25 miles northeast of the NorthMet Project area (see Figure 4.2.12-1), comprises 640 acres designated as an RNA within a larger 1,180-acre area designated as a national natural landmark. The Keeley Creek area contains a large tract of undisturbed mixed pine and black spruce forest with rare mature jack pine stands and significant upland bogs (USFS 2011h).

Dragon Lake is located approximately 25 miles northeast of the NorthMet Project area (see Figure 4.2.12-1). The cRNA comprises 2,075 acres of old growth red pine, upland and lowland black spruce, wetland bog, and wetland shrub swamp communities, as well as former Isabella pinery (USFS 2011h).

4.2.12.1.3 Unique Biological Areas

UBAs are designated by the USFS for their outstanding biological and other special values and managed within the USFS land and natural resource management plans. The common thread to these areas is that they exhibit plant communities, associations, and/or individual species of particular interest. UBAs are primarily managed for interpretive purposes. None are suitable for timber management. The Dry Mesic Jack Pine/Black Spruce and Lowland Conifer Landscape Ecosystems dominate this area in the Superior National Forest. UBAs are protected from actual or potential damage due to public use. Dispersed recreation use may occur, but is generally discouraged, and may be limited to bird watching, orienteering, fishing, hunting, berry picking, plant identification, and wildlife viewing (USFS 2004b).

UBAs within the 25-mile vicinity of the NorthMet Project area include the Little Isabella River UBA (approximately 25 miles east of the NorthMet Project area) and the Harris Lake National Natural Landmark (approximately 20 miles northeast of the NorthMet Project area) (USFS

2004b) (see Figure 4.2.12-1). National Natural Landmark sites are designated by the Secretary of the Interior as sites that contain outstanding biological and geological resources, based on their outstanding condition, illustrative value, rarity, diversity, and value to science and education.

4.2.12.1.4 National Historic Landmark

National Historic Landmarks are nationally significant places designated by the Secretary of the Interior as possessing exceptional value or quality in illustrating or interpreting US heritage. The Soudan Iron Mine has been designated as a National Historic Landmark. It is known as the state's oldest and deepest iron mine and now hosts the Soudan Underground Laboratory. It resides within the Soudan Underground Mine State Park, located approximately 18 miles northwest of the NorthMet Project area, near Tower, on the southern shore of Lake Vermilion (see Figure 4.2.12-1). The park comprises approximately 1,300 acres and receives more than 33,000 visitors annually (MDNR 2011m).

4.2.12.1.5 National Recreation Trail

National Recreation Trails are designated by the Secretary of Interior or the Secretary of Agriculture to recognize exemplary trails of local and regional significance. The Taconite State Trail is designated as a National Recreation Trail and managed by the MDNR. Running from Grand Rapids to the Arrowhead State Trail, the Taconite State Trail is 165 miles long. A segment of the trail is 15 to 17 miles north of the NorthMet Project area, running from the City of Ely westward to Tower (see Figure 4.2.12-1). Spur trails run south from this segment into the City of Babbitt, and then east and west. The trail provides year-round opportunities for hiking, biking, snowmobiling, in-line skating, and other recreational uses (MDNR 2011n).

4.2.12.2 State-Managed Areas

Like the federal government, the State of Minnesota also designates and manages for wilderness values a number of areas.

4.2.12.2.1 Boundary Waters Canoe Area Wilderness

In 2003, Minnesota designated 18,000 acres of state-owned lands within the BWCAW as state wilderness. These are state forest lands that are described as an inholding within the federally designated wilderness. The definition of wilderness used by the state is similar to that set forth in the federal Wilderness Act. Legislation passed in 1975 established the state's wilderness program. *Minnesota Statues* 2006, Chapter 86A.05, subdivision 6 contains management guidelines for wilderness areas. However, the state lands now designated as state wilderness are using the management directions of the larger BWCAW and there is no state wilderness management plan for the area (Propst and Dawson 2008).

4.2.12.2.2 Scenic Byway

Minnesota Scenic Byways are roads that feature many of Minnesota's finest cultural, historic, natural, recreational, archaeological, and cultural locations and landscapes. The Superior National Forest Scenic Byway (Forest Highway 11) is a 54-mile long scenic roadway that runs from Aurora to Silver Bay, with the closest segment approximately 9 miles southeast of the NorthMet Project area along County Route 110 (see Figure 4.2.12-1). It is designated as a scenic byway by the State of Minnesota. The majority of the Byway runs through the Superior National

Forest, offering access to hiking trails, historic sites, and the Superior National Forest itself. A key feature of the Byway is the opportunity it provides travelers to views of 250-year-old stands of white pine (US DOT 2011). Skibo Vista Scenic Overlook is one of the other key features along the Superior National Forest Scenic Byway. See Section 4.2.11 for further information about visual resources at the Skibo Vista Scenic Overlook.

4.2.12.2.3 State Parks

Soudan Underground Mine State Park is located 18 miles northwest (see Figure 4.2.12-1) of the NorthMet Project area and is home to Minnesota's oldest iron ore mine. The park covers 1,322 acres and has 5 miles of hiking trails. The park is located on a ridge on the south shore of Lake Vermilion and offers a combination of recreational opportunities, including picnicking, hiking, snowmobiling, and tours of a former iron ore mine. There are stands of white and Norway pine—mixed with some balsam, aspen, and birch—that cover the upland areas. The lowlands are dominated by white cedar interspersed with balsam, tamarack, black spruce, ash, and muskeg (MDNR 2011m).

Lake Vermilion State Park is 16 miles northwest of the NorthMet Project area (see Figure 4.2.12-1), on the eastern shores of Lake Vermilion, adjacent to Soudan Underground Mine State Park. Lake Vermilion is just south of the Superior National Forest and BWCAW. The park is Minnesota's newest state park, open since 2010 for recreation opportunities such as hiking, snowshoeing, snowmobiling, and geocaching. It is the first major state park built in Minnesota in more than 30 years. Construction is underway for boat docks, fishing platforms, picnic shelters, roads, parking areas, and a paved bike route that will connect to the Mesabi Trail (MDNR 2012f).

Bear Head Lake State Park, which covers 5,685 acres, is located 11 miles north of the NorthMet Project area, just south of the BWCAW (see Figure 4.2.12-1). The woods are made up of red and white pine, spruce, paper birch, and fir on the highlands and tamarack, black spruce, and white cedar on the lowlands. Small, clear trout lakes similar to those found in the BWCAW provide recreational opportunities such as fishing, swimming, and boating. The park also offers 17 miles of hiking trails, campgrounds, cross-country skiing, snowmobiling, and snowshoeing (MDNR 2012a).

Iron Range Off-Highway Vehicle State Park is located 17 miles southwest of the NorthMet Project area in Gilbert, Minnesota (see Figure 4.2.12-1). The park offers 36 miles of off-highway vehicle trails over 4,064 acres (MDNR 2012b).

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4.2.13 Hazardous Materials

A hazardous material, as defined by the Institute of Hazardous Materials Management (2012), is any biological, chemical, or physical item or agent which has the potential to cause harm to humans, animals, or the environment. Categories of hazardous materials include, but are not limited to, explosives, flammables, oxidizers, poisons, irritants, and corrosives. At the federal level, management, handling, and transportation of these materials are regulated by laws and regulations administered by the USEPA, Occupational Safety and Health Administration (OSHA), and DOT, each with its own specific definition of hazardous material. The State of Minnesota also has regulations related to hazardous materials.

In addition, wastes generated from process operations can be classified as hazardous. Minnesota Statutes define a hazardous waste as any refuse, sludge, or other waste material or combinations of refuse, sludge, or other waste materials in solid, semi-solid, liquid, or contained gaseous form, which, because of quantity, concentration, or chemical, physical, or infectious characteristics, may cause or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible illness. A waste can also be determined to be hazardous if it poses a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, disposed, or otherwise managed. Hazardous waste does not include source, special nuclear, or byproduct material as defined by the Atomic Energy Act of 1954, as amended (*Minnesota Statute* 116.06 Subdivision 11). As with hazardous materials, hazardous wastes are subject to state and federal management, transportation, and disposal regulations. Issues relating to the presence of hazardous materials or waste may include the accidental release of these materials during transportation, storage, handling, and/or use and any resulting potential effects on the environment.

There are no current mining or other operations or activities at either the Mine Site or Plant Site that involve the use of hazardous materials. As discussed in Section 4.2.1, there are AOCs associated with contamination by hazardous materials from the former LTVSMC mining operations.

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4.2.14 Geotechnical Stability

This section describes the existing geotechnical conditions for the proposed sites for the material storage facilities proposed as part of the NorthMet Project Proposed Action: the waste rock stockpiles, the Tailings Basin, and the Hydrometallurgical Residue Facility.

The waste rock stockpiles would be constructed on undisturbed highland and lowland areas at the Mine Site that consist of varying layers (thicknesses and material types) of glacial till and surficial peat, .The Hydrometallurgical Residue Facility would be constructed partially on top of the existing LTVSMC Emergency Basin and would extend onto the adjacent undisturbed ground. The Tailings Basin constructed as part of the NorthMet Project Proposed Action would be located on top of a portion of the existing LTVSMC Tailings Basin and would extend onto the adjacent undisturbed ground. Geotechnical conditions are generally similar along the length of the LTVSMC Tailings Basin dams, with varying layers of coarse tailings, fine tailings, and slimes. The characteristics and design of the proposed material storage facilities are discussed in Chapter 3.0, while the rationale of the design—including consideration for design criteria, factors of safety, and modeling of geotechnical stability of the existing and proposed features—is discussed in Chapter 5.0. Further information on the geology and hydrogeology associated with the structures is provided in Section 4.2.2.

4.2.14.1 Waste Rock Stockpiles

4.2.14.1.1 Location and Descriptive Overview

The waste rock stockpiles would be located at the Mine Site, an undeveloped site currently affected only by logging and exploration drilling activities.

The locations of the proposed stockpiles are shown in Figure 4.2.14-1. The acreages for the stockpiles would be as follows:

- The permanent Category 1 Stockpile would occupy 526 acres to the north of the West Pit;
- The temporary Category 2/3 Stockpile would occupy 180 acres to the south east of the East Pit;
- The temporary Category 4 Stockpile would occupy 57 acres above the Central Pit (it would be removed and placed into the East Pit prior to mining at the Central Pit); and
- The temporary Ore Surge Pile would occupy 32 acres to the south of the East Pit and west of the Category 2/3 Stockpile.

In addition to the stockpiles listed above, the temporary Overburden Storage and Laydown Area would occupy 31 acres to the southeast of the West Pit.

There are no existing mining facilities or constructed geotechnical features that are at risk of geotechnical instability at the proposed stockpile locations.

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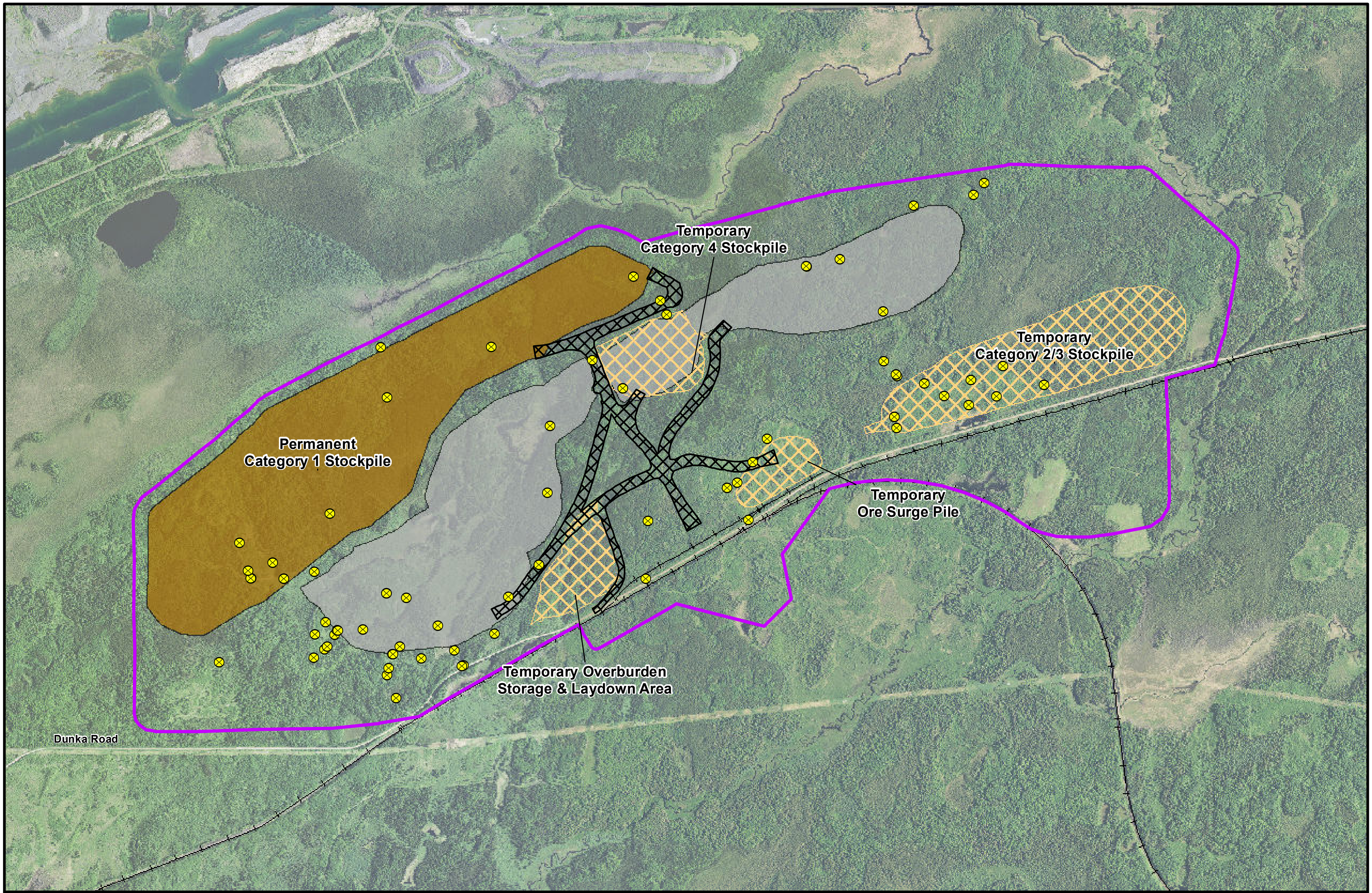

Geotechnical Investigation Location
Permanent Stockpile (Year 20)
Reclaimed Stockpile (Year 20)
Mine Site
Mine Pit (Year 20)
Haul Road (Year 20)

US Army Corps of Engineers
St. Paul District

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Figure 4.2.14-1
Mine Site Geotechnical Investigation Locations
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

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4.2.14.1.2 Investigations

The site conditions at the proposed stockpile location have been evaluated and reported by Golder Associates, Inc. for PolyMet (PolyMet 2014p). As shown in Figure 4.2.14-1, geotechnical information for the Mine Site was gathered from a number of borings and test trenches. The site exploration drilling database, drilling logs, and geophysics (electrical resistivity) data were used to develop an estimated depth to bedrock isopach map. Laboratory tests were also conducted to obtain index properties (American Society for Testing and Materials [ASTM] C-117, C-136, D2216) of the samples recovered from the test trenches and boreholes, to confirm field classifications, and for use in developing correlations with engineering properties of the soils encountered.

4.2.14.1.3 Surficial Soils and Geology

Site Conditions for Category 1 Stockpile

Borings and mapping indicate that bedrock depths at the proposed Category 1 Stockpile range from 4 ft in the central part of the northern extent up to 40 ft at the southwestern edge. Soils in the highland areas are glacial tills in origin and the consistency typically varies from coarser material to clays. Geotechnical testing indicates that lowland areas contain horizons of glacial, alluvial, and lacustrine deposits overlain by peat and relatively finer-grained soils.

Site Conditions for Category 2/3 Stockpile

Borings and mapping indicate that bedrock depths at the proposed Category 2/3 Stockpile range from 3.5 to 33 ft below the surface. Soils in the highland areas typically consist of sands and gravel with varying amount of silt. Lowland areas typically contain surficial peat and fine grained soils, underlain by glacial and alluvial deposits.

Site Conditions for Category 4 Stockpile

Borings and mapping indicate that bedrock depths at the proposed Category 4 Stockpile range from 8.0 to 26 ft. The Category 4 Stockpile would be located on highland soils, which typically consist of sands and gravels. Because the soil samples were collected only in the highland areas at the northeastern and the southwestern end of the stockpile, they may differ from foundation soils at other locations within the Category 4 Stockpile footprint, especially in wetland areas.

Site Conditions for Ore Surge Pile

Borings and mapping indicate that bedrock depths at the proposed Ore Surge Pile range from 6.5 to 12 ft. Soil samples were collected only from the highland areas of the stockpile, which may differ from foundation soils at other locations within the Ore Surge Pile stockpile footprint, especially from soils within the lowland areas located on the eastern side of the stockpile.

Site Conditions for Overburden Storage and Laydown Area

The conditions for the Overburden Storage and Laydown Area include wetland areas interspersed with areas of glacial till (typically silty sand) overlying bedrock of varying depth.

<u>NorthMet Waste Rock and Ore Characterization</u>

Analysis of the NorthMet Deposit indicates the average dry density of the waste rock is 1.90 tons per cubic yard with an assumed average of 23 percent porosity (30 percent swell).

Local granular material or crushed rock could be used to provide drainage layers for the stockpiles. Native till could be compacted and supplemented with bentonite to achieve an acceptable permeability relative to *Minnesota Rule* 6132.2400, Subpart 2. A. (1)) needed for the subgrade and liner layers (along with a geomembrane layer for the Category 2/3 and 4 stockpiles).

4.2.14.1.4 Geotechnical Summary

The majority of the soils collected were non-plastic. Measured in situ moisture contents for non-peat material ranged from 1.0 to 26.9 percent. The permeability of the tested (ASTM D5084, D698) undisturbed native soils ranged from 3.1×10^{-7} to 9.4×10^{-7} cm/sec. The permeability of the tested compacted native soils ranged from 1.1×10^{-7} to 2.0×10^{-7} cm/sec, indicating that the native soils are favorable for use as a compacted soil liner. Typically, the native glacial tills have sufficiently high fines content, and are considered good candidates for materials to be used with the geomembrane cover construction as proposed for the reclamation of the Category 1 Stockpile.

One-dimensional consolidation test (ASTM D2435) and a consolidated-undrained (CU) triaxial shear test (ASTM D4767) was undertaken for one sample taken from the Category 1 Stockpile footprint area. The in situ effective stress strength parameters yielded an effective cohesion of zero with an effective friction angle of 34.6 degrees. The consolidation testing indicated a coefficient of consolidation of 5.3×10^{-1} to 9.6×10^{-1} ft^2/day and a coefficient of compression of 0.05 to 0.13 under the loading range of 1 to 16 kips per square foot (ksf).

Additional geotechnical investigations such as soil borings, test trenches, and geotechnical laboratory tests of on-site materials are required at the locations of the proposed stockpiles to verify the geotechnical information currently available. Examples of information that the additional investigations would yield include: confirmation of the classification of native soils; identification of depths to bedrock and groundwater; identification and delineation of on-site borrow sources; and procurement of additional material samples of waste rock and overburden soils for laboratory testing. This information would be used to modify stockpile and foundation design and confirm the design assumptions and earthwork balance computations. The additional investigations would take place before stockpile construction but cannot be undertaken until the land exchange has been completed, appropriate permitting has been received, and dewatering of the wetland areas has been performed. PolyMet has committed to undertake further investigations as necessary.

4.2.14.2 Tailings Basin

4.2.14.2.1 Location and Descriptive Overview

The Tailings Basin constructed as part of the NorthMet Project Proposed Action would be located on top of the existing LTVSMC Tailings Basin and adjacent undisturbed ground. The LTVSMC Tailings Basin is contained by constructed dams with a small portion on the east and south side of the basin abutting natural higher ground, and, as shown in Figure 4.2.14-2, is configured as a combination of three adjacent cells identified as Cell 1E, Cell 2E, and Cell 2W. With an average dam height of 95 ft, Cell 2E is the lowest of the three cells and covers approximately 620 acres in surface area. Cell 1E covers approximately 980 acres and has an average height of 125 ft. Cell 2W is the largest and highest of the three cells, covering approximately 1,450 acres in surface area, with an average dam height of 200 ft.

Additional perimeter dams would be constructed and flotation tailings would be deposited on top of the LTVSMC Tailings Basin, beginning in Cell 2E and then progressing into the combined Cell 2E and 1E when they achieve equal elevation, to a proposed final height of 200 ft. Cell 2W is not proposed for use for tailings deposition. Refer to Chapter 3.0 and Section 5.2.14 for more information on the proposed design of the Tailings Basin.

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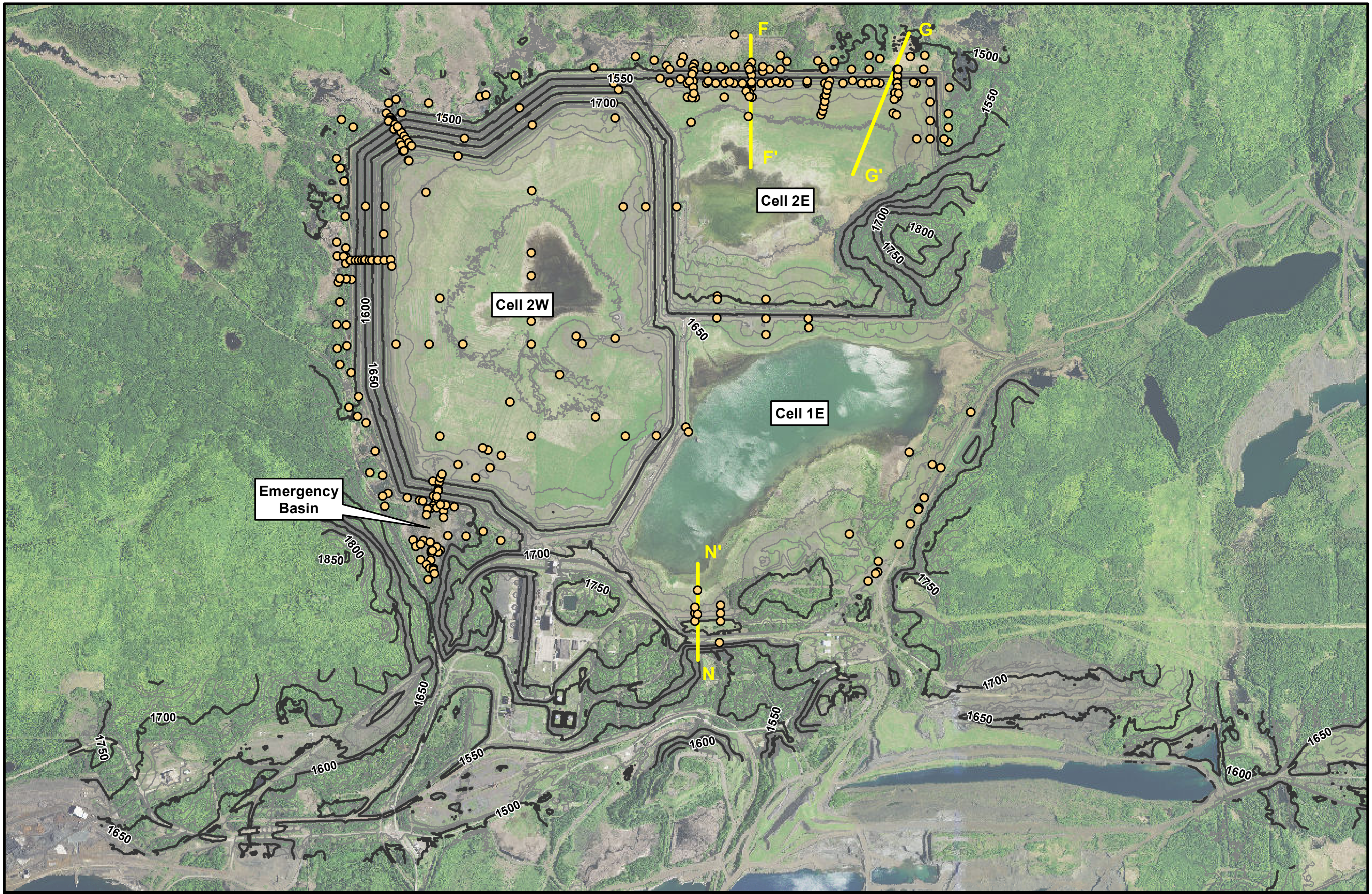

Geotechnical Investigation Locations
Contour - 50 Ft
Contour - 5 Ft
Cross Section

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Figure 4.2.14-2
Existing LTVSMC Tailings Basin Layout
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

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4.2.14.2.2 Development of the Existing LTVSMC Tailings Basin

The existing LTVSMC Tailings Basin was constructed in stages beginning in the 1950s. Constructed perimeter dams were established using a rock, sand, and gravel starter dam over natural surface material (glacial till and fibrous peat in areas). The facility was unlined such that tailings from taconite processing were discharged directly on native material. The basin was filled to near the crest of the original starter dam and then berms were progressively developed on top of the starter dams and deposited tailings using the discharged coarse tailings (upstream construction method).

Upstream tailings basin construction methods generally involve spigotting of tailings in a slurry from the cell perimeter (or dam) into the interior of the cell using a portable spigotting system. Coarse tailings tend to settle out of the slurry near the spigot point near the perimeter of the dam, while the fine tailings and slimes tend to flow further into the basin. Very fine materials such as slimes tend to settle in the interior pond. The base of new lifts were developed inward in the upstream direction, hence the term upstream construction method.

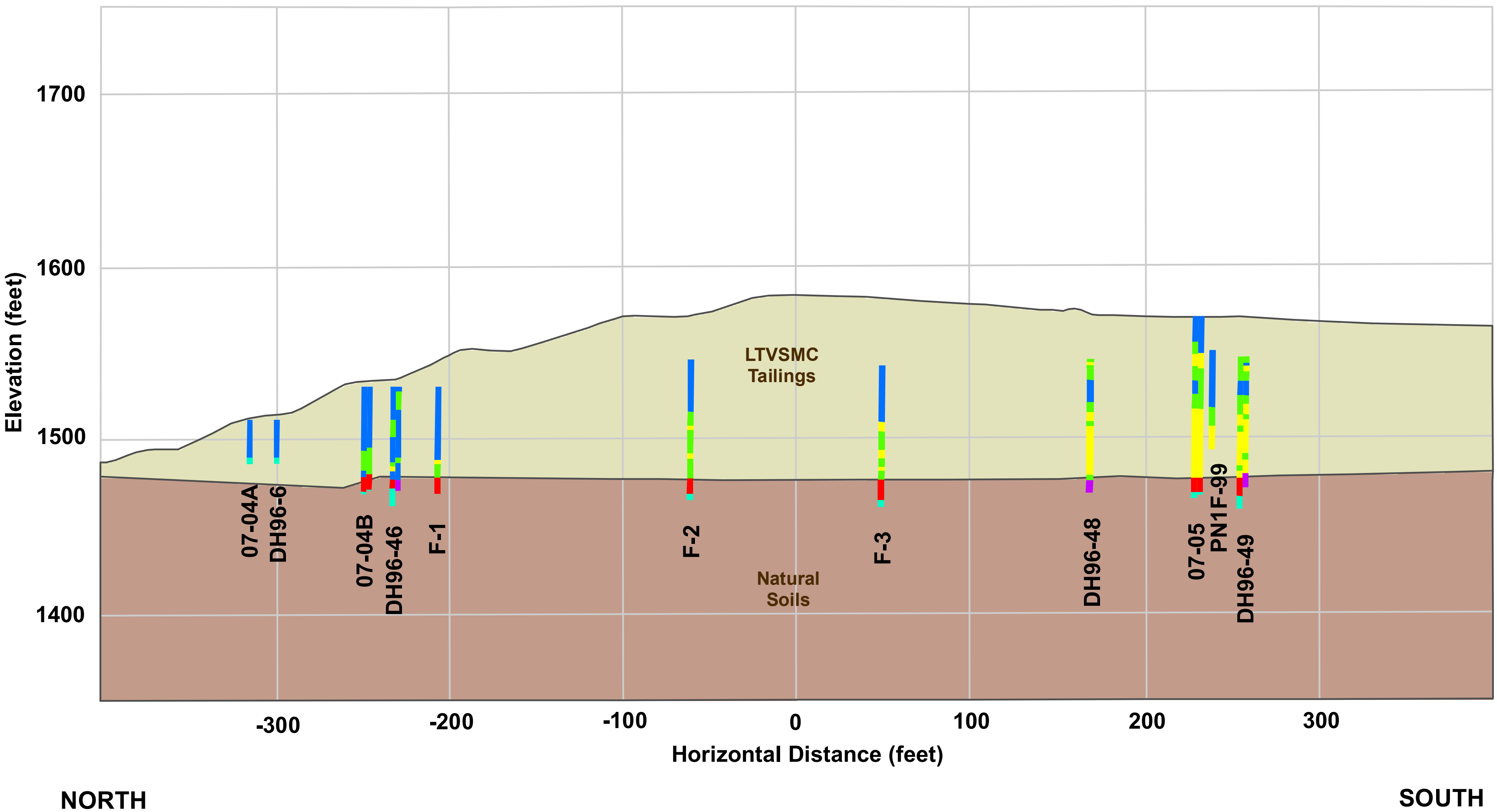
During the spigotting process, some fine tailings and slimes are normally trapped within the coarse tailings near the spigot point. In periods of very high water levels in the tailings pond or during periods of operational difficulties or operator error, additional fines and slimes may be deposited close to the perimeter dams. Typically, the material near the spigot points forms the foundation of future lifts of the shell, and is preferably a well-drained, coarse material that would provide a stronger base while reducing the height of the phreatic head within the shell. The inclusion of relatively large zones of finer-grained tailings within this outer shell reduces the drainage ability of the shell, increasing the phreatic surface, and reduces the localized shear strength due to the generally weaker behavior of the finer-grained tailings. There were instances during the operation of the LTVSMC Tailings Basin where significant amounts of fine tailings and slimes settled near the perimeter dams. These fine tailings and slimes were then covered with coarse tailings as the basin continued to be developed. Figure 4.2.14-3, Figure 4.2.14-4, and Figure 4.2.14-5show complex and varying layers of materials identified in drilling along Cross Section F, G, and N. It should be noted that these figures provide idealized cross section information that may not be located exactly along the section lines. As such, some information was translated horizontally to provide a more detailed description of the material variability, and some materials may appear out of context (e.g., for Cross Section F, the left-most boreholes show layers of peat found within the tailings; however, these layers of peat are projected from boreholes that have a native ground surface at a relatively higher elevation than is shown in this figure). Additional investigation and modeling show similar inclusions throughout the basin. This is discussed further in the Surficial Geology section below.

In 1993, approximately 260,000 long tons of higher-sulfur waste rock from the Dunka Mine was mixed with approximately 29,000 tons of limestone and buried under spigotted LTVSMC tailings in the southern part of Cell 2W. Additionally, in Cell 2W, rapid construction in later years of development resulted in oversteepened dams on all sides of Cell 2W. Some seepage has occurred from the dam in this and other areas. Other points along the dams have been subject to erosion due to the leakage from and failure of LTVSMC discharge pipes, and from the natural geomorphological processes such as melting snow, precipitation runoff, soil creep, wind erosion and others. No large-scale failures were reported due to these events and eroded surfaces were filled with available material as needed.

In 1995 and 1996, approximately 1,500 cubic yards of spoil material dredged from Taconite Harbor in Lake Superior was placed in the south-eastern portion of Cell 1E.

Fly ash, dredging spoil, and coal pile cleanup material have also previously been disposed of in a solid waste storage site upgradient to the east of Cell 1E. PolyMet has committed to remove this material prior to inundation of that area by NorthMet tailings.

The LTVSMC Tailings Basin operations were shut down in January 2001 and have been inactive since then except for closure and reclamation activities consistent with an MDNR-approved Closure Plan. Reclamation also includes the use of some parts of Cell 2W as a land farm where contaminated soil is mixed with organics for remediation. These activities are expected to be completed by 2016.



Coarse Tailings
Fine Tailings
Slimes
Clay
Peat
Till

*Colors represent results of boring samples

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Figure 4.2.14-3
Tailings Basin - Cross Section F (Existing Conditions)
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Minnesota

June 2015

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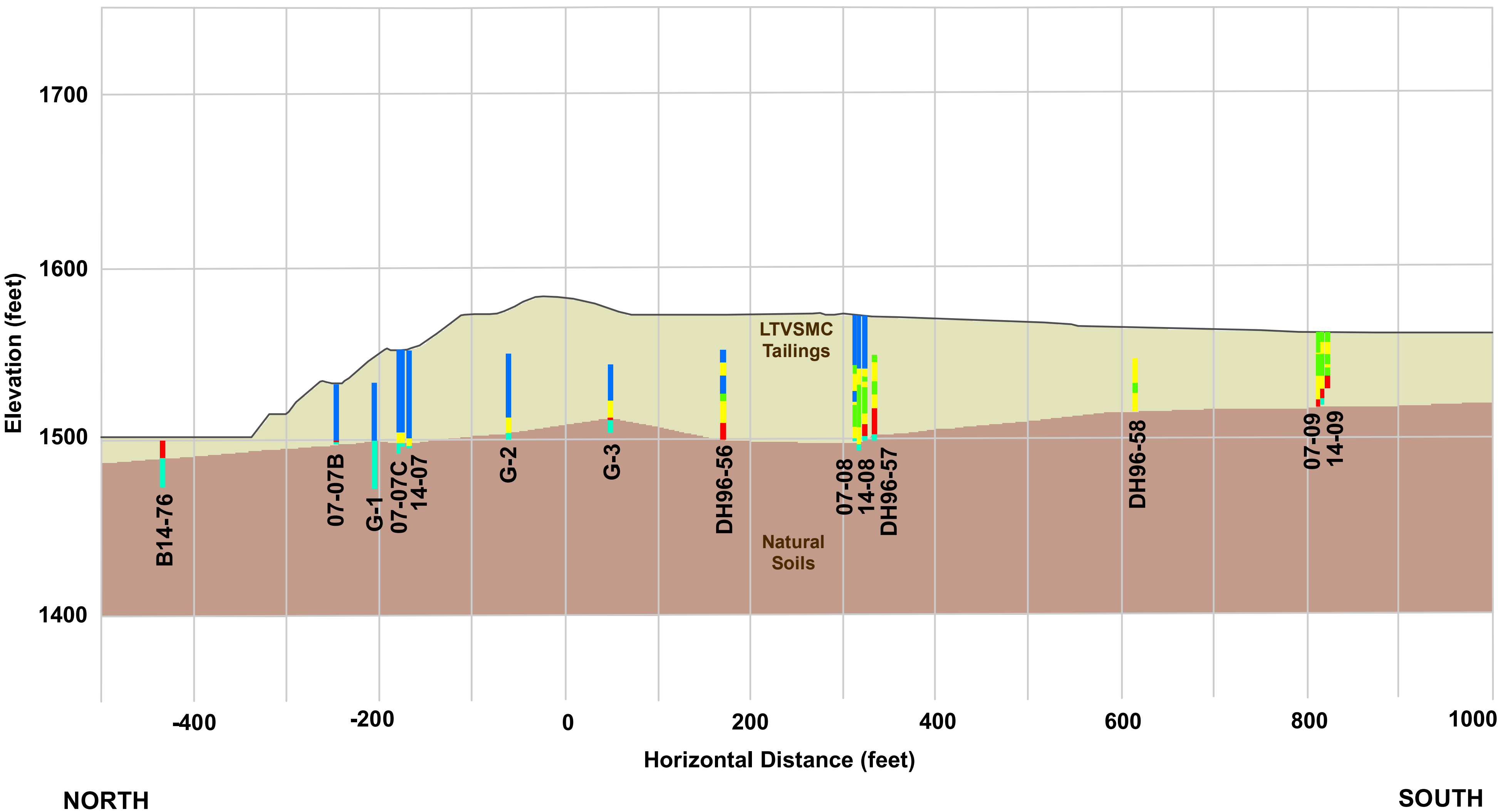

Coarse Tailings
Fine Tailings
Slimes
Peat
Till

*Colors represent results of boring samples

US Army Corps of Engineers
St. Paul District

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Figure 4.2.14-4
Tailings Basin - Cross Section G (Existing Conditions)
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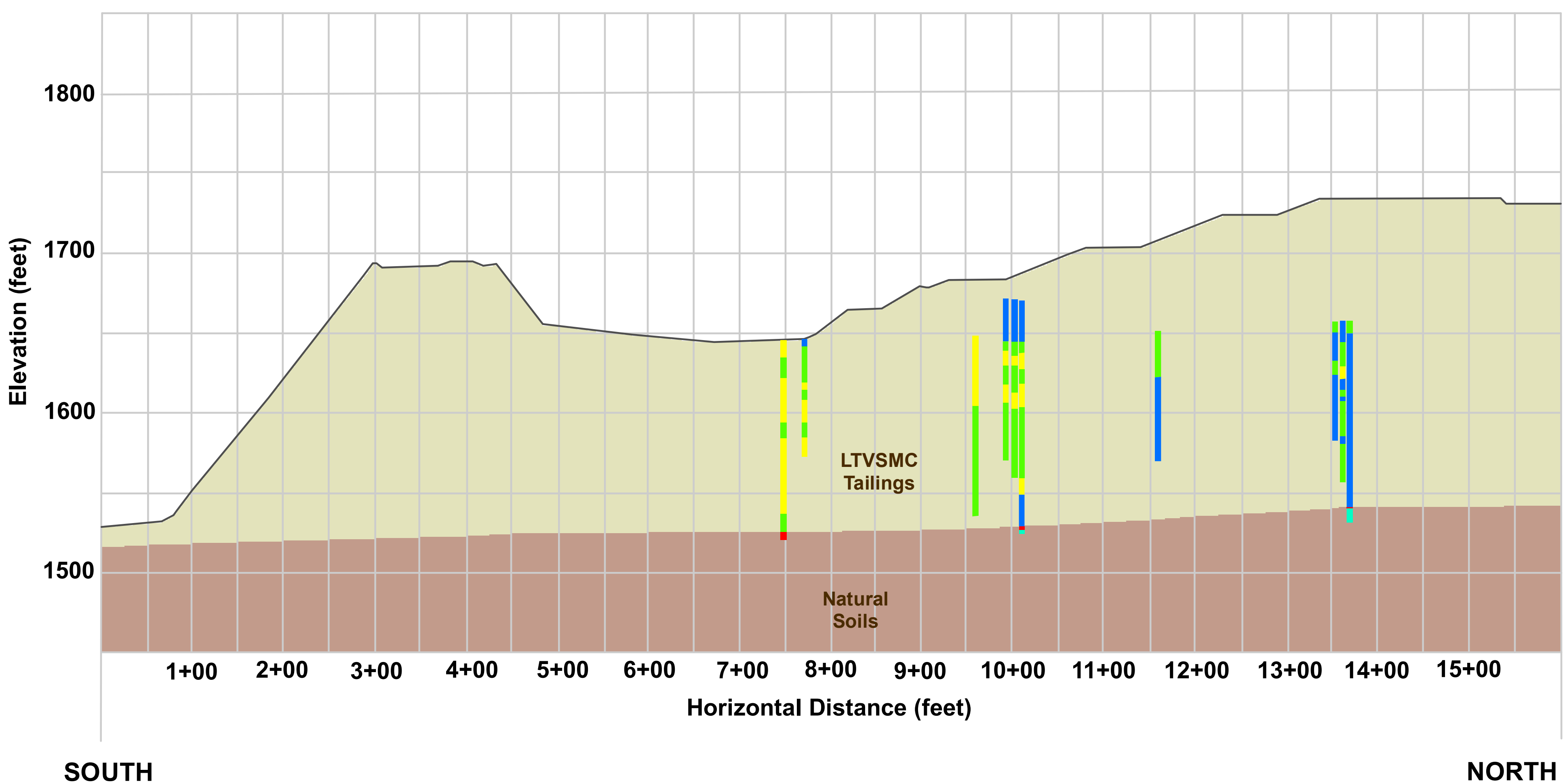

Coarse Tailings
Fine Tailings
Slimes
Peat
Till

*Colors represent results of boring samples

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Figure 4.2.14-5
Tailings Basin - Cross Section N (Existing Conditions)
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Minnesota

June 2015

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4.2.14.2.3 Investigations

The site conditions at the LTVSMC Tailings Basin have been evaluated throughout its existence and most recently reported by PolyMet in 2007 and 2014 (PolyMet 2015l). As shown in Figure 4.2.14-2, information has been gathered over several geotechnical investigation efforts at various locations around the basin since its development. Collected site data include:

- cone penetrometer testing (CPT and CPTu) involving probing at 9 points in Cell 1E, 30 points in Cell 2E, and 12 points in Cell 2W; dissipation testing at nearly all CPT locations during the probing in 2007 and 2014;
- seismic shear wave velocity testing conducted at each of the CPT locations during the probing in 2007;
- dilatometer testing in borings approximately 10 ft adjacent to each CPT location in 2007;
- standard penetration test borings at a total of 27 locations near the CPT locations in 2007 and 12 locations along the western and northern sides of Cell 2W and Cell 2E in 2014;
- vane shear testing at various depths performed at nine locations in Cells 1E and 2E in 2007; and
- solid flight auger borings near the western, northern, and eastern crests of the dams around Cell 2W.

Laboratory testing of bulk and undisturbed materials was also undertaken to verify the data collected during in situ testing, as well as to further assess the characteristics of the material for its hydraulic and strength parameters.

Field and laboratory tests have been completed to describe the general geotechnical properties, permeability, and shear strength of the NorthMet tailings. These tests include:

- Atterberg Limits tests (ASTM D4318);
- Physical model studies;
- Falling-head, flexible-wall laboratory permeability testing (ASTM D5084); and
- Triaxial tests (ASTM D2850).

Geotechnical modeling of the Tailing Basin uses material properties obtained in the testing of the tailings for the seepage and stability analysis of future conditions. Filter criteria for the tailings were also evaluated to determine the effectiveness of LTVSMC bulk tailings to control water levels within the perimeter dam and to prevent piping.

Other studies performed to investigate the hydrogeology of the site are discussed in Section 4.2.2.

4.2.14.2.4 Surficial Materials, Geology, and Other Existing Structures

LTVSMC Tailings

The existing LTVSMC Tailings Dam generally consists of a shell of LTVSMC coarse tailings, with interbedded fingers of LTVSMC fine tailings and slimes. The interior of the cells consists primarily of layers of LTVSMC fine tailings and slimes, while coarse tailings are generally found near the perimeter of the basin. These interbedded layers vary in thicknesses and extent throughout the basin due to changing of tailings deposition points and durations. The depth of the tailings to the underlying native material varies between each of the cells.

Sampling to date has identified that the stratigraphy is very complex. Figures 4.2.14-3, 4.2.14-4, and 4.2.14-5 shows cross sections F, G, and N respectively, These cross sections illustrate the complexity and variability of the tailings layers within each borehole, and between boreholes. This variability between boreholes also contributes to the uncertainty in determining the depth and continuity of the layers, and therefore, the extent of fine tailings and slimes at various depths near the cell perimeter dams.

The LTVSMC coarse tailings are generally classified as poorly graded fine- to medium-grained sand. The LTVSMC slimes particle sizes have been classified to range from silty sand to lean clay.

The LTVSMC Tailings Basin is abutted in the location of Cross Section N by an existing railway.

Natural Soils and Geology

Native, surficial deposits in the area of the LTVSMC Tailings Basin generally consist of native glacial till material that ranges from clay to gravel. In places, the till is overlain by up to 20 ft of organic peat.

The depth to bedrock (Giant's Range granite) varies throughout the Tailings Basin. The bedrock at the toe of Cross Section F starts at an average of 30 ft below the top of the till. Bedrock along Cross-Section G was modeled as 25 ft below the top of the till at the toe and increases in elevation towards the center of the basin. No borings have been extended to bedrock along Cross-Section N; however, depth to bedrock was assumed as 20 ft below the top of the till and to increase in elevation towards the center of the basin.

NorthMet Tailings Characterization

The tailings from the NorthMet floatation process would be hydraulically deposited and are expected to undergo less hydraulic segregation than the LTVSMC tailings. While some segregation would occur, significant amounts of fines would be captured within the tailings matrix. Therefore, for geotechnical stability modeling (Section 5.2.14), the NorthMet tailings were treated as a single material, rather than defining parameters for coarser and finer portions of the tailings. Based on laboratory testing, a decrease in saturated permeability of the flotation tailings is anticipated with increase in overburden depth. As such, three saturated permeabilities have been used in geotechnical modeling with respect to depth.

4.2.14.2.5 Geotechnical Summary

The selected drained and undrained strength and saturated permeability inputs for the various materials used in modeling (Section 5.2.14.2.2) are summarized in Table 4.2.14-1.

Analyses determined that the LTVSMC coarse tailings are anticipated to behave in a dilative manner (i.e., expand in volume) as they are sheared, and are therefore less conducive to pore water pressure generation during shearing. The fine tailings and slimes are anticipated to behave in a contractive manner (i.e., reduce in volume) as they are sheared and are therefore prone to pore water pressure generation during shearing, resulting in a loss of effective strength. Organic peat has also been characterized as being prone to strength loss during shearing.

The northern dam in Cell 2E has been identified as a potential area of weakness as it is underlain by a layer of fibrous peat up to approximately 20 ft thick that extends north beyond the toe of the dam into a nearby wetland and due to the presence of interbedded layers of contractive fine tailings and slimes. A deposit of glacial till lies beneath the peat. The crest of the dam in this area is approximately 90 ft above the surrounding ground surface and consists mostly of coarse tailings with some weaker layers of interbedded fine tailings and slimes close to the base of the dam.

As part of the NorthMet Project Proposed Action, PolyMet would apply CDSM to increase the shear strength of select zones of the existing LTVSMC fine tailings, slimes, and peat layers. More information regarding the CDSM feature is provided in Sections 3.2.2.3.3 and 5.2.14.2.2. Hydrogeology suggests that the upper portion of bedrock is variably fractured and therefore has a higher saturated permeability compared to bedrock deeper in the formation.

Table 4.2.14-1 Summary of Seepage and Stability Modeling Parameters for the Material at the Existing LTVSMC Tailings Basin and Proposed NorthMet Tailings

	Saturated Permeability		Saturated Unit Weight	ESSA		USSA			
				Cohesion, c'	Friction, ϕ	Cohesion, Su	Friction, ϕ_{cu}	$USSR_{yield}$, Su(yield)/σ'v	$USSR_{liq}$, Su(liq)/σ'v
Material	**cm/sec**	**ft/sec**	**pcf**	**psf**	**deg**	**psf**	**degree**		
LTVSMC Coarse Tailings	2.44E-03	8.00E-05	135	0	38.5	0	38.5	-	-
LTVSMC Fine Tailings	2.00E-05	6.56E-07	130	0	33.0	-	-	0.25	0.1
LTVSMC Slimes	9.60E-07	3.15E-08	120	0	33.0	-	-	0.22	0.1
LTVSMC Bulk Tailings	8.02E-05	2.63E-06	130	0	38.5	0	38.5	-	0.1
LTVSMC FT/slimes	3.05E-06	1.00E-07	125	0	33.0	-	-	0.24	-
Glacial Till	5.03E-03	1.65E-04	135	0	36.5	0	36.5	-	-
Compressed Peat(1)	3.60E-06	1.18E-07	85	Shear/normal function(2)		-	-	0.23	-
Virgin Peat	1.00E-03	3.30E-05	70						-
Rock Starter Dam	1.52	5.00E-02	140	0	40.0	0	40.0	-	-
Flotation Tailings(3) – 0.45 tsf	1.90E-04	6.23E-06	125	0	33.0	-	-	0.26	0.12
Flotation Tailings(3) – 1.35 tsf	5.61E-05	1.84E-06							
Flotation Tailings(3) – 2.29 tsf	2.00E-05	6.56E-07							
Cement Deep Soil Mix (CDSM)	7.04E-07	2.31E-08	125	9600	0	-	-	-	-

	Saturated Permeability		Saturated Unit Weight	ESSA		USSA			
				Cohesion, c'	Friction, ϕ	Cohesion, Su	Friction, ϕ_{cu}	USSR$_{yield}$, Su(yield)/σ'_v	USSR$_{liq}$, Su(liq)/σ'_v
Material	**cm/sec**	**ft/sec**	**pcf**	**psf**	**deg**	**psf**	**degree**		
Slimes									
Cement Deep Soil Mix (CDSM) Peat	2.55E-06	8.36E-08	125	-	-	-	-	-	-
Fractured Bedrock	7.19E-04	2.36E-05	140	0	45.0	-	-	-	-
Bedrock	1.92E-05	6.30E-07	Impenetrable						
Rail Grade	1.52	5.00E-02	140	0	45.0	-	-	-	-

Notes:
[1] Permeability of the compressed peat (below the dam) was altered for anisotropy, applying a ratio of ky/kx = 0.067.
[2] Drained strength of the peat was included as a shear/normal function with $\phi \approx 27$ degrees.
[3] Permeability of the tailings was varied based on effective overburden pressure
ESSA = Effective Stress Stability Analysis
ft/sec = Feet per second
pcf = Pound(s) per cubic foot
psf = Pound(s) per square foot
USSA = Undrained Strength Stability Analysis
USSR = Undrained Sheer Strength Ratio

Further information on the parameters used for the design and modeling of the existing LTVSMC and proposed Tailings Basins is provided in Chapter 5.0 and in the Geotechnical Data Package Volume 1 (PolyMet 2015l).

4.2.14.3 Hydrometallurgical Residue Facility

4.2.14.3.1 Location and Descriptive Overview

As shown in Figure 4.2.14-2, the Hydrometallurgical Residue Facility is located in a natural low point in the topography adjacent to Cell 2W of the existing LTVSMC Tailings Basin and over the LTVSMC Emergency Basin and the adjacent undisturbed ground. The southern tip of the LTVSMC Emergency Basin begins near the central portion of the Hydrometallurgical Residue Facility, widening and deepening into a former ravine that trends to the north. Seepage from the LTVSMC Emergency Basin occurs to the northwest between Cell 2W and a railroad grade located along the western perimeter of the area. This and additional seepage would be collected in a constructed drainage blanket between the LTVSMC embankment and the Hydrometallurgical Residue Facility embankment, and collected water would be conveyed away from the coincident area.

The southern dam of Cell 2W is approximately 160 ft in height from the surface of the LTVSMC Emergency Basin. It has an overall slope angle of 4 horizontal to 1 vertical (4:1) including mid-slope benches.

4.2.14.3.2 Development of the Existing LTVSMC Emergency Basin

The original purpose of the LTVSMC Emergency Basin was to contain taconite tailings (slimes, and fine and coarse tailings) from the main tailings thickeners in the event of a power failure or plant upset conditions which necessitated draining the tailings delivery system. Accidental overflows, spillage, and floor drainage from the former LTVSMC Concentrator Building was also placed in the LTVSMC Emergency Basin. These materials were deposited by gravity through an underground emergency tunnel terminating at the southeast side of the LTVSMC Emergency Basin. Overflow from sumps in the former LTVSMC booster pump house number 1 was also directed into the LTVSMC Emergency Basin.

Prior to the construction of the LTVSMC Tailings Basin Cell 2W, the LTVSMC Emergency Basin extended roughly 3,000 ft north from its current confinement. The southern starter dam for the LTVSMC Tailings Basin Cell 2W (the same dam as the proposed Hydrometallurgical Residue Facility north dam) was constructed over the unconsolidated emergency tailings in 1970 and 1971. An upstream construction method was used to construct the dam whereby the height of the dam was advanced incrementally by constructing a new lift upstream (into the basin) and above the crest of the dam. The north dam consists predominantly of LTVSMC coarse tailings with occasional inclusions of fine tailings and slimes. LTVSMC tailings were deposited over the emergency tailings in Cell 2W following this time.

4.2.14.3.3 Investigations

The site conditions at the Hydrometallurgical Residue Facility have been evaluated throughout its existence and most recently reported on by PolyMet (PolyMet 2014c).

The geotechnical assessment of the proposed site for the Hydrometallurgical Residue Facility utilized regional geological surveys and maps as well as historical and recent site surveys undertaken at the LTVSMC Tailings Basin as shown in Figure 4.2.14-6.

Residue from the hydrometallurgical process pilot-plant testing was collected to determine the geochemical and geotechnical material properties. The makeup of hydrometallurgical residue and other material proposed for disposal in the Hydrometallurgical Residue Facility process is described in Section 3.2.2.3.7.

4.2.14.3.4 Surficial Materials, Geology, and Other Existing Structures

LTVSMC Emergency Tailings

Existing materials in the LTVSMC Emergency Basin consist of a mixture of coarse tailings, fine tailings, and slimes. This layering is shown in Cross Section A in Figure 4.2.14-7. Deposited materials have experienced relatively minor amounts of self-weight consolidation since cessation of LTVSMC operations in early 2001 as no additional loading has occurred on these materials. There are approximately 50 ft of tailings in the thickest part of the Emergency Basin. A railroad track is also located along the western perimeter of the area.

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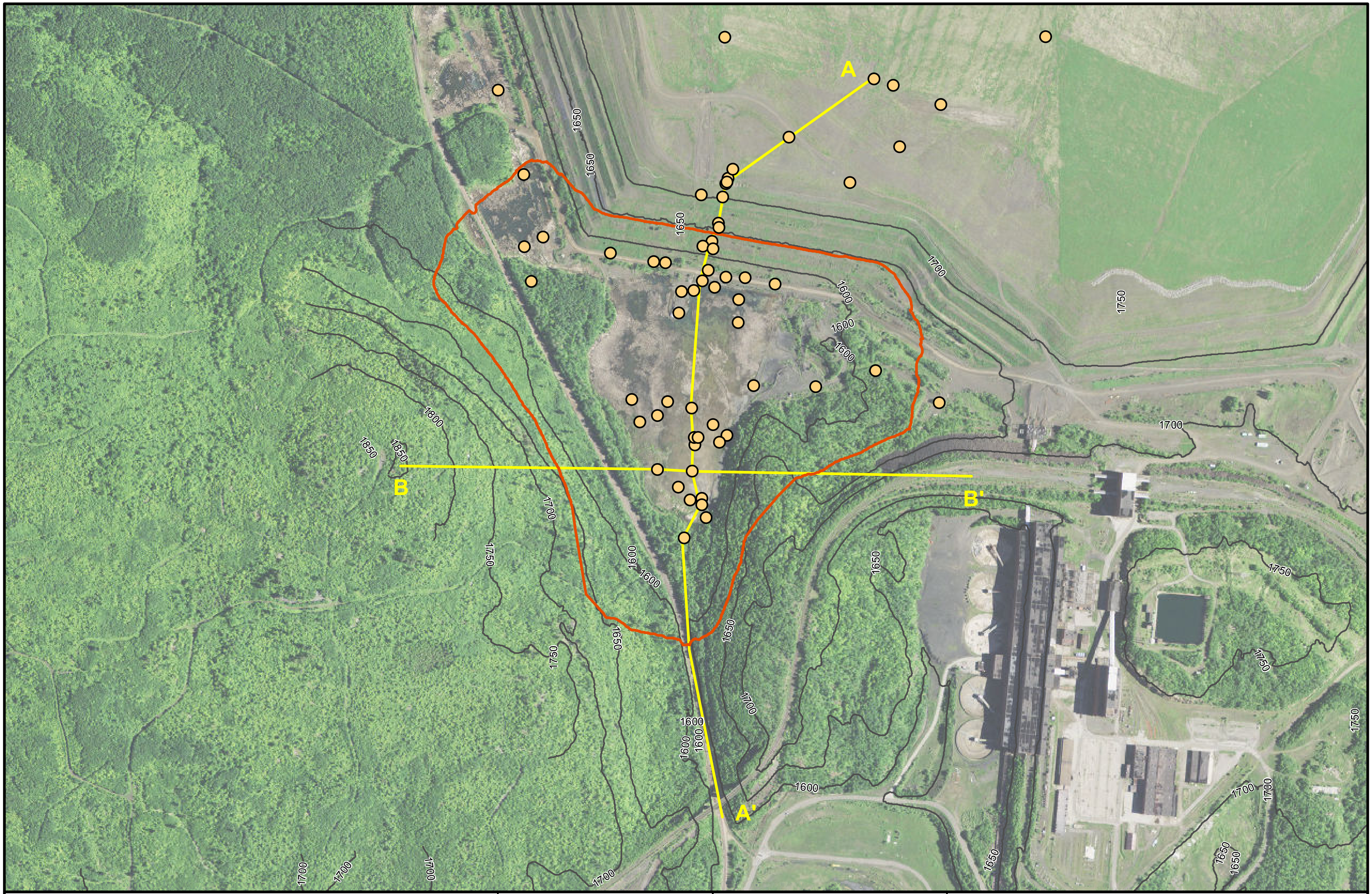

Hydrometallurgical Residue Facility

Geotechnical Investigation Locations

Cross Section

US Army Corps of Engineers
St. Paul District

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0 250 500 1,000 Feet

Figure 4.2.14-6

Hydrometallurgical Residue Facility - Geotechnical Investigation Locations

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Minnesota

June 2015

347

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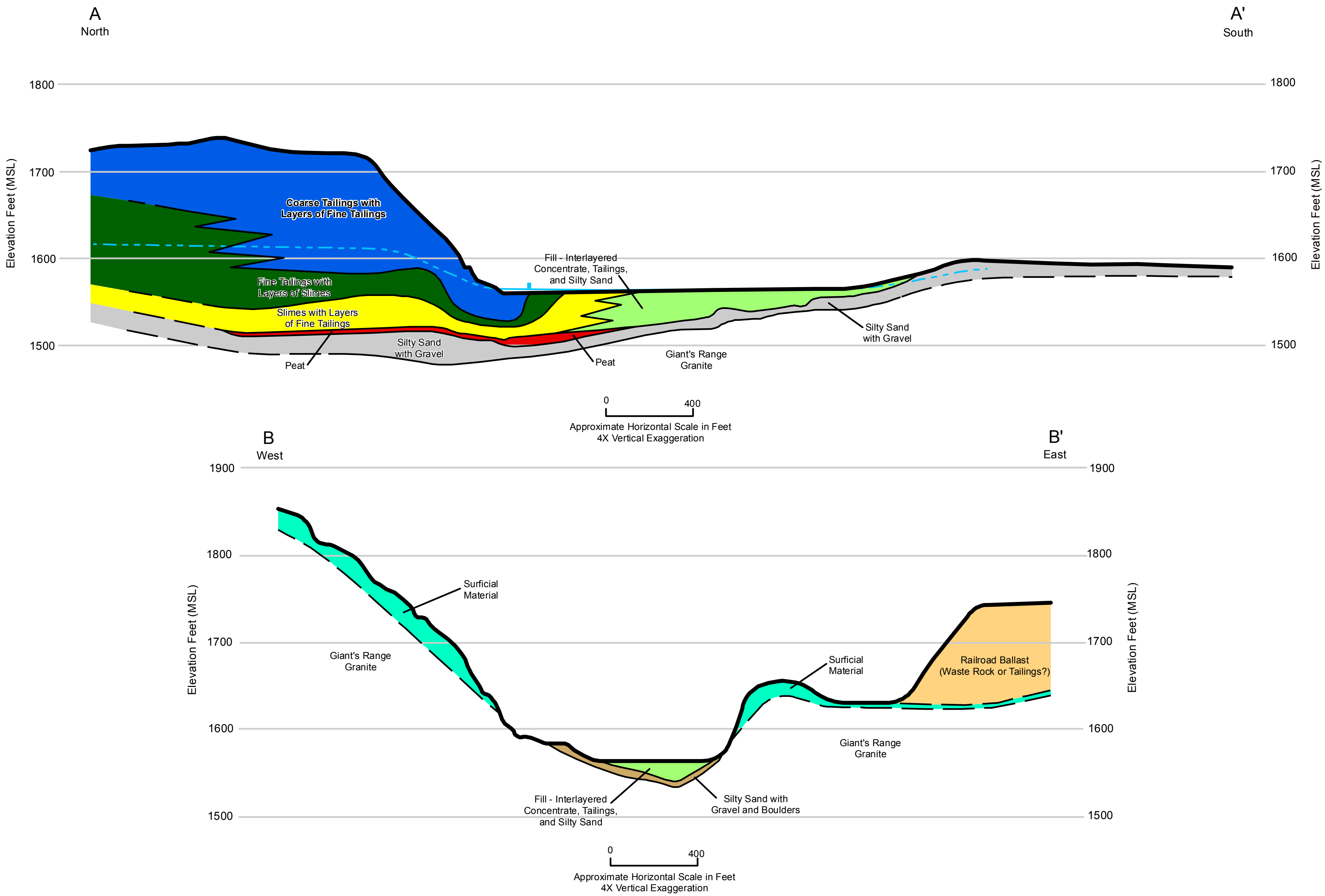

- Coarse Tailings with Layers of Fine Tailings
- Fill - Interlayered Concentrate, Tailings, and Silty Sand
- Slimes with Layers of Fine Tailings
- Fine Tailings with Layers of Slimes
- Railroad Ballast
- Peat
- Silty Sand with Gravel
- Silty Sand with Gravel and Boulders
- Surficial Material

US Army Corps of Engineers
St. Paul District

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Figure 4.2.14-7
Hydrometallurgical Residue Facility - Cross Sections A and B (Existing Conditions)
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

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Natural Soils and Geology

In the area of the Hydrometallurgical Residue Facility, bedrock is generally within 25 ft of the native ground surface, except where surface materials have been built up either to support the former LTVSMC facilities or where emergency tailings have been deposited in the LTVSMC Emergency Basin (see Figure 4.2.14-7). To expedite the consolidation of the in-place LTVSMC tailings so as to provide a more stable base for the Hydrometallurgical Residue Facility, wick drains may be installed within the Emergency Basin. This would reduce drainage path lengths, increase the drainage ability in the LTVSMC tailings and underlying compressed peat, and result in a stronger foundation for the Hydrometallurgical Residue Facility.

Native surficial deposits, which have been sampled and logged at boring locations in and around the LTVSMC Emergency Basin, include silty sands with interbedded coarser grained alluvial deposits and peat. A thin layer of peat below the tailings in the LTVSMC Emergency Basin thickens beneath the toe of the LTVSMC Tailings Basin.

The LTVSMC Emergency Basin is entirely underlain by Giant's Range granite. Bedrock granite has been historically scoured by glaciers creating features such as linear valleys. The location of linear valleys is sometimes interpreted to correspond with the location of potential faults in the bedrock. However, on published geologic maps, the faults in these areas are dashed and identified as conjectural with inferred (not exact) locations. Regional geologic maps of the Iron Range do show the existence of fault lines, but hydrogeologic studies have not provided evidence that any faults that may be present are active, nor do they behave as conduits for groundwater flow.

NorthMet Hydrometallurgical Residue Characterization

The Hydrometallurgical Residue Facility is designed for the storage of residue produced during mill operations. The grain size of the residue would primarily consist of material which would be classified as silt and sand with a small amount of clay. Structural fill used to construct the Hydrometallurgical Residue Facility dams would consist of blasted rock, sand, glacial till, or LTVSMC coarse tailings. Additional materials such as gypsum from the WWTP, lime for residue pH neutralization (if necessary), and coal ash would also be disposed of within the Hydrometallurgical Residue Facility. These additional materials may represent approximately 5 to 10 percent of the facility solids volume. The chemical and physical properties of any non-residue materials proposed to be stored in the Hydrometallurgical Residue Facility would be tested prior to placement to ensure proper containment.

4.2.14.3.5 Geotechnical Summary

The values for the material properties used in geotechnical modeling are discussed in Section 5.2.14 and summarized in Table 4.2.14-2 and Table 4.2.14-3.

There are no structures at the proposed Hydrometallurgical Residue Facility site that appear to be at risk of geotechnical instability.

Further information on the parameters used for the design and modeling of the Hydrometallurgical Residue Facility is provided in Section 5.2.14.

Table 4.2.14-2 Summary of Modeling Permeabilities for the Material Relevant to the Hydrometallurgical Residue Facility

Material	**Modeling Permeability**	
	cm/sec	**ft/sec**
LTVSMC Coarse Tailings	2.44E-03	8.00E-05
LTVSMC Fine Tailings	2.00E-05	6.56E-07
LTVSMC Slimes	9.60E-07	3.15E-08
LTVSMC Bulk Tailings	8.02E-05	2.63E-06
Glacial Till	5.03E-03	1.65E-04
Sand	1.00E-02	3.28E-04
Residue (used for rate of drainage computation – quantity vs. time)	3.40E-05	1.12E-06
Residue (used for computation of time for drainage to occur)	5.50E-06(1)	1.80E-07(1)
Compressed Peat	3.60E-06	1.18E-07
Bedrock	8.56E-08	2.81E-09
LTVSMC Slimes – with wick drains	2.34E-06	7.69E-08
Compressed Peat – with wick drains	8.75E-07	2.87E-08

Note:
[1] To account for anticipated consolidation (densification) of the residue within the cell and corresponding reduction in residue permeability, average permeability used to estimate time for drainage to occur is assumed.

Table 4.2.14-3 Summary of Shear Strength Parameters for the Material Relevant to the Hydrometallurgical Residue Facility

Material	**Model**	**Unit Weight (pcf)**	**Elasticity modulus, (psf)**	**ϕ (deg)[1]**	**Poisson's ratio, μ**	**Normal Consol. line slope, λ**	**Consol. Line slope, Swelling line slope, κ**	**Initial Void Ratio, e_o**
Glacial Till	Linear Elastic	135	5.00E+05	-	0.30	-	-	-
LTVSMC Coarse Tailings	Linear Elastic	135	8.40+05	-	0.30	-	-	-
LTVSMC Fine Tailings	Soft Clay (Modified Cam Clay)	130	-	33	0.30	0.05	0.01	1.07
LTVSMC Slimes	Soft Clay (Modified Cam Clay)	120	-	34	0.30	0.07	0.01	1.14
LTVSMC Slimes – with wick drains	Soft Clay (Modified Cam Clay)	120	-	34	0.30	0.07	0.01	1.14
Residue[2]	Linear Elastic	115	-	30	0.30	0.18	0.03	1.92
Giant's Range Granite	Linear Elastic	165	1.69E+09	-	0.18	-	-	-
Sand	Linear Elastic	120	6.00E+05	-	0.30	-	-	-
LTVSMC Bulk Tailings	Linear Elastic	130	1.00E+06	-	0.30	-	-	-
Bedrock – blasted	Linear Elastic	135	1.00E+06	-	0.30	-	-	-
Compressed Peat	Soft Clay (Modified Cam Clay)	85	-	30	0.30	0.70	0.09	3.84
Compressed Peat – with wick drains	Soft Clay (Modified Cam Clay)	85	-	30	0.30	0.70	0.09	3.84

Note:
[1] The term M (the slope of the critical state line) can be defined by the equation: $M = \frac{6sin\phi'}{3-sin\phi'}^{2}$ Other than the Residue Settlement Column, stress-deformation models modeled residue using placeholder linear elastic parameters. These models only require the thickness and unit weight of the residue to be valid. Residue consolidation is considered in the Residue Settlement Column analysis (PolyMet 2014c)
pcf = Pound(s) per cubic foot
psf = Pound(s) per square foot

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4.3 LAND EXCHANGE

4.3.1 Land Use

The federal and non-federal lands were reviewed against parameters similar to the Mine Site and Plant Site, including existing land use plans, zoning designations, public access routes, mineral ownership and economic potential, and title.

Additionally, each tract of the Land Exchange Proposed Action was evaluated for the presence of known existing hazardous material effects and contaminated sites and for the potential for hazardous materials to currently affect the lands. Research to evaluate potential hazardous materials or hazardous material sites on these land areas consisted of review of three types of data sources, depending on the size and geographic spread of the land area. The data sources used include:

- An ASTM/AAI Phase I ESA;
- An Environmental Regulatory Database search, which was conducted by Environmental Data Resources, Inc. (EDR), and consists of a report of federal, state, local, or tribal agency databases; and
- The MPCA website database titled, "What's In My Neighborhood?"

A Phase I ESA provides a comprehensive review of environmental regulatory databases and includes a physical site visit, interviews with property or adjacent property owners and local officials, and review of historical data such as aerial photographs, topographic maps, fire insurance maps, land title records, or property tax files. Conclusions are drawn based upon the findings to identify recognized environmental conditions based on the comprehensive review and the opinion of the environmental professional.

The Environmental Regulatory Database search defines and summarizes the ASTM databases reviewed in the EDR report and notes whether any sites (including the target property) were identified within a specified search radius. The database sites identified in the EDR report were evaluated with respect to the target land area to determine which sites indicate hazardous material effects.

The MPCA website database identifies potentially contaminated sites through a searchable inventory of properties, as well as sites that have already been cleaned up and those currently being investigated or cleaned up. The website also contains a searchable inventory of businesses that have applied for and received different types of environmental permits and registrations from the MPCA.

4.3.1.1 Federal Lands

4.3.1.1.1 Land Exchange Proposed Action

The boundaries of the federal lands include the Mine Site, as well as land to the north and west, but exclude the privately owned land bordering Dunka Road to the south of the Mine Site. Section 4.2.1.2 provides a discussion of the existing land use on the federal lands.

The Land Exchange Proposed Action includes 6,495.4 acres of federal lands with a perimeter of approximately 23 linear miles. By comparison, Superior National Forest comprises 4,600,831.8 acres, of which 2,171,603.9 acres, with a perimeter of 10,054.8 linear miles (including the federal lands), are managed by the USFS (the remainder are privately owned or managed in-parcels). The majority of the federal lands are within the General Forest – Longer Rotation Management Area, while the remainder is within the General Forest Management Area (see Figure 4.3.1-1). These management areas are defined in Section 4.2.1.2. Table 4.3.1-1 summarizes the acreage of the federal lands, by management area, for the Land Exchange Proposed Action.

There is no known existing contamination by hazardous materials in the federal lands.

Table 4.3.1-1 Management Area Designations for the Federal Lands under the Land Exchange Proposed Action

Management Area Designation	Total Acreage
General Forest – Longer Rotation	6,140.1
General Forest	355.3

4.3.1.1.2 Land Exchange Alternative B

Under the Land Exchange Alternative B, 4,752.6 acres of federal lands would be exchanged for the 4,926.3-acre Tract 1. Table 4.3.1-2 summarizes the acreage of the federal lands, by management area, for the Land Exchange Alternative B. Section 4.3.1.2.1 describes Tract 1.

Table 4.3.1-2 Management Area Designations for the Federal Lands under Land Exchange Alternative B

Management Area Designation	Total Acreage
General Forest – Longer Rotation	4,397.3
General Forest	355.3

4.3.1.2 Non-federal Lands

The non-federal lands comprise five tracts—each consisting of one or more individual parcels—totaling 7,075.0 acres. The land use conditions of each tract are described below. Tracts 1 and 2 of the Land Exchange Proposed Action include areas with potential conservation value (i.e., cRNA Management Area and Riparian Emphasis Management Area). Some of the parcels within Tract 2, Tract 3, and Tract 4 have limited accessibility by either road or foot trail, although there are segments that show evidence of timber harvesting (see Figures 5.3.1-1 and 5.3.1-2).

4.3.1.2.1 Tract 1 – Hay Lake Lands

Tract 1 is located in central St. Louis County, approximately 3 miles north-northwest of the City of Biwabik. The tract consists of one parcel covering approximately 4,926.3 acres, with a perimeter of approximately 15 linear miles.

Land Use Regulation

Land use in Tract 1 is governed by the St. Louis County zoning ordinance. It is divided among the following zoning districts (St. Louis County 2011):

- **Forest Agricultural Management (FAM-1)**: This district recognizes and promotes the development of forestry and agricultural industry and encourages recreational activity. It is typically applied to areas with very low density land development. This district is located in the northeast corner and occupies approximately 5 percent of the Tract 1 lands.
- **Forest Agricultural Management (FAM-2)**: This district recognizes and promotes the development of forestry and agricultural industry and encourages recreational activity. It is typically applied to areas with very low density land development. Whereas FAM-1 has a minimum parcel size of at least 35 acres, FAM-2 has a minimum parcel size of 17 acres. This district is located throughout the parcel and occupies approximately 57 percent of the Tract 1 lands.
- **Sensitive Areas (SENS-3)**: In addition to the forestry/agriculture focus embodied in the FAM-2 district, the SENS-3 district also recognizes significant areas that are unsuitable for intensive development due to the potential for environmental hazards or other features to negatively affect environmental conditions. This classification surrounds most of Hay Lake and Little Rice Lake, as well as a large portion of the river and riparian areas. This district is located throughout the parcel and occupies approximately 33 percent of the Tract 1 lands.
- **Residential (RES-3)**: This district recognizes and promotes residential development with limited non-residential uses. This district is located northeast and southwest of Hay Lake and occupies approximately 5 percent of the Tract 1 lands.

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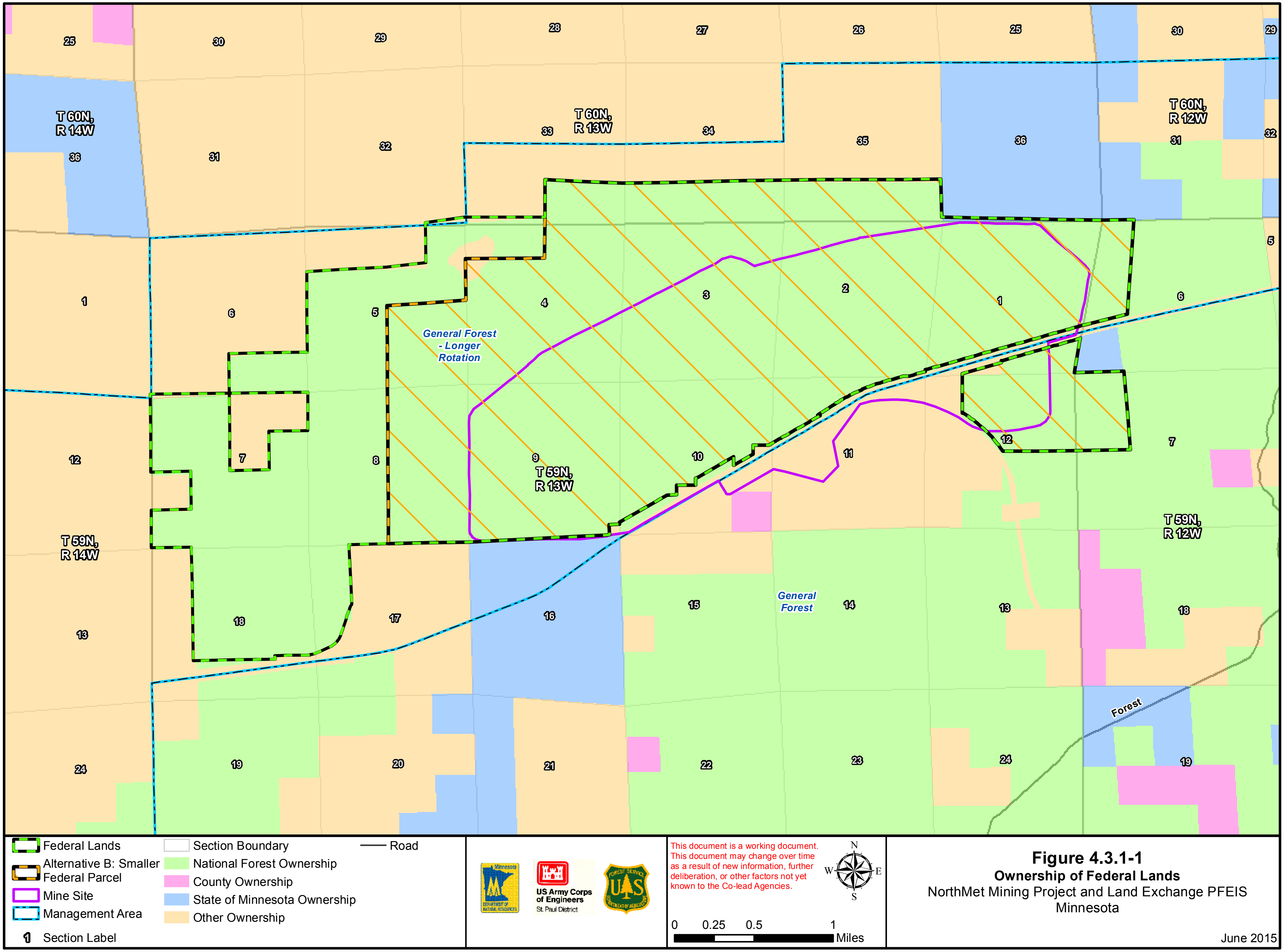

Figure 4.3.1-1
Ownership of Federal Lands
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Minnesota

June 2015

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Adjacent to Tract 1 on the west and north are Superior National Forest lands that fall within the General Forest Management Area. Two cRNA management areas adjoin the tract: Pike Mountain on the southwest corner and Loka Lake on the northeast corner (USFS 2011b). The cRNAs are designated by the USFS for the purpose of preserving and maintaining areas for ecological research, observation, genetic conservation, monitoring, and educational activities. No recreation facilities are provided in these management areas; while dispersed recreation occurs (see Section 4.3.11.2.4), it is generally discouraged. The Pike Mountain cRNA is characterized by a hardwoods forest plant community. The Loka Lake cRNA is characterized by high-quality lowland black spruce and tamarack swamp (USFS 2011h).

Adjacent to Tract 1 to the south and east are privately owned lands within St. Louis County's Multiple Use Non-Shoreland 4 (MUNS-4) zoning district. This designation allows for a diverse array of development, such as residential, light industry, commercial, livestock, sanitary landfill, airport, and utility facilities, among others (St. Louis County 2011).

As part of the Land Exchange Proposed Action, the non-federal lands were the subject of Phase I ESAs. Potential areas of legacy contamination were discovered on Tract 1. These areas were investigated and remediated through removal and disposal of potentially contaminated soil and materials. Any remnant contamination (limited to two instances where less than 5 gallons of used oil were spilled) is expected to degrade in situ (NTS 2011).

Existing Land Use

Tract 1 includes Hay Lake, identified as a wild rice water by the MDNR, Little Rice Lake, and an unnamed lake (see Figure 4.3.1-2). Approximately eight miles of the upper Pike River flow through Tract 1. An electrical transmission line crosses Sections 19, 20, 21, and a portion of Section 16 (USFS 2011b). CR 715 forms part of the eastern boundary of the tract.

A small boat landing and primitive parking area provide access to the Pike River adjacent to CR 715. Several trails also emanate from CR 715, some with bridges crossing the upper Pike River; all of these trails are gated or bermed. There is evidence that a sand/gravel pit near CR 715 has been used as a dumping site in the recent past, but has been fully remediated and cleared of trash and debris (NTS 2011). The gravel pit area is gated, but there is evidence that it has been used as a shooting range. There are also numerous deer stands on the parcel (Lisson and Gawtry 2011).

Property Rights, Title, and Mineral Resources

PolyMet currently owns surface rights to Tract 1. The tract is subject to a mortgage in favor of Iron Range Resources, which would be satisfied at closing of the Land Exchange Proposed Action (USFS 2011c). Title to this parcel has been reviewed and approved by the USDA Office of General Counsel so long as certain recommended affirmative title insurance is provided (USFS 2011c).

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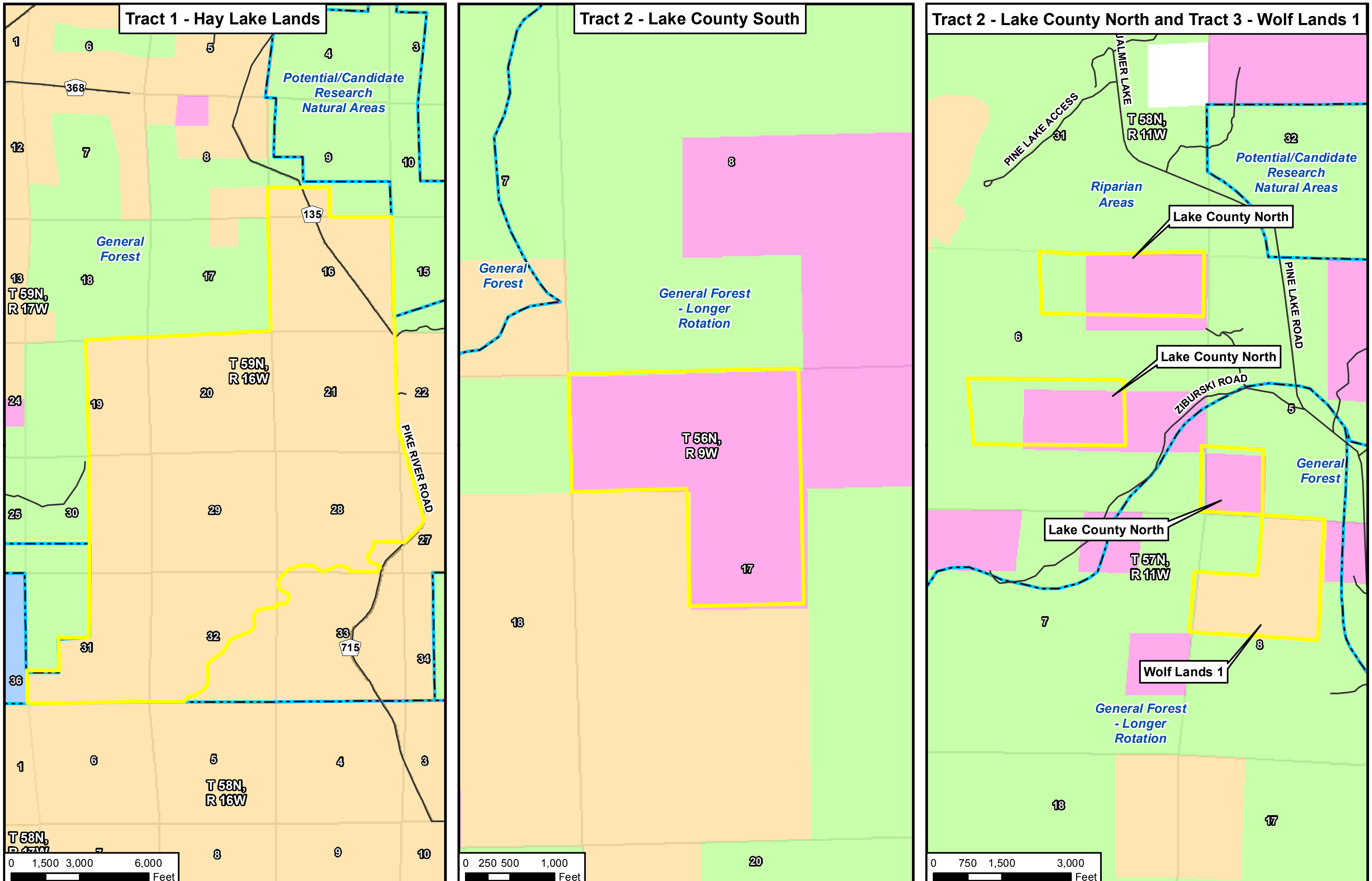

Non-federal Lands	National Forest Ownership
Section Boundary	County Ownership
1 Section Label	State of Minnesota Ownership
Management Area	Other Ownership

Minnesota Department of Natural Resources

US Army Corps of Engineers St. Paul District

Forest Service U.S. Department of Agriculture

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N W E S

Figure 4.3.1-2
Ownership of Tracts 1, 2, and 3
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Minnesota

June 2015

130

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Tract 1 was assessed for mineral resource potential as part of the Feasibility Analysis completed in 2009 (USFS 2009c). The geology of the area is mostly granitic rocks with the southwestern-most part underlain by metamorphosed basalts, gabbros, and sedimentary rocks. The mineral potential for the tract was determined to be limited, as granitic rocks are not known to host mineral deposits. The MDNR core library index showed no drilling on or near Tract 1. Additional investigation in 2011 indicates potential for aggregate production from the northeastern corner of the tract along the Pike River. Tract 1 appears to have a low potential for exploration or development of bedrock or surficial deposits (Barr 2011c).

Legacy Pollution

The legacy pollution data review described in Section 4.3.1 found that hazardous materials may be present on Tract 1, specifically along Pike River Drive in the northeastern portion of the tract, and between Hay Lake and CR 715, west of the Pike River. The Phase I ESA for Tract 1 described several areas where releases of hazardous materials may exist due to unauthorized dumping. The EDR report and MPCA database also identified three unauthorized or unpermitted dump sites on Tract 1. The southernmost dump, west of the Pike River, is named Unauthorized Dump-Biwabik. The two remaining dump sites, Unauthorized Dump-2 and Unnamed Dump-Biwabik/2, are north of the first dump site and adjacent to CR 715. These types of dumps are typically old farm, homestead, or municipal disposal sites that accepted household waste. There are no records of inspection or enforcement actions at these sites in the MPCA database (NTS 2010a; EDR 2009a; MPCA 2012d); however, a subsequent Phase II investigation found no evidence of spills or contamination, and found that legacy pollution had been resolved at the site (NTS 2011).

4.3.1.2.2 Tract 2 ‑ Lake County Lands

Tract 2 comprises four parcels in Lake County, southeast of Seven Beaver Lake, totaling 381.9 acres with a perimeter of approximately 7 linear miles. No hazardous material issues were identified at Tract 2 (EDR 2011a; EDR 2011b; MPCA 2012d).

Land Use Regulation

All Lake County parcels fall within Lake County's Forest-Recreation zoning district (Nelson, Pers. Comm., October 10, 2011). The Forest-Recreation district provides for remote residential development distant from public services. It is intended to prevent the destruction of natural or man-made resources, maintain large tracts for forest recreation purposes, provide for the continuation of forest management and production programs, and foster recreational uses and other compatible activities.

The Lake County North parcels are surrounded by land within two Superior National Forest Management Areas (see Figure 4.3.1-2): the General Forest – Longer Rotation Management Area (see Section 4.2.1.2) and the Riparian Emphasis Area Management Area. Lands in the Riparian Emphasis Area are located along rivers and lakes that receive moderate to low levels of recreation use. This designation promotes the restoration, protection, and enhancement of areas sensitive to degradation. Lands surrounding Seven Beaver Lake and adjacent to Tract 2 are the headwaters area of the St. Louis River, and are designated as a Riparian Emphasis Area Management Area.

The Lake County South parcel is largely bordered by lands in the General Forest – Longer Rotation Management Area. Adjacent parcels to the southwest are privately owned land; parcels to the northeast are county land in the Forest-Recreation zoning district.

Existing Land Use

A trail provides access to the Lake County South parcels, but access to the trail is relatively difficult (Lisson and Gawtry 2011). There is evidence of clearcut timber activity on the Lake County North parcels.

There is limited access to the Lake County South parcel due to wetlands and private land restrictions, and little evidence of active use (Lisson and Gawtry 2011).

Property Rights, Title, and Mineral Resources

Tract 2 parcels are tax forfeit lands that are being purchased in the name of Lake-Forest Enterprise, Inc. on a land contract from Lake County. An assignment on file with Andresen and Butterworth, PA assigns all right, title, and interest in these lands to PolyMet (USFS 2011c).

A review of mineral resources on Tract 2 indicates a low potential for exploration or development of bedrock or surficial deposits (Barr 2011c). A title commitment review found that one 40-acre parcel has one-half mineral interest outstanding and that all other minerals will be reserved by the State of Minnesota and subject to the Secretary's Rules and Regulations. Within the Lake County South parcel, one 40-acre parcel is subject to mineral reservation that includes the right to sink, cave, disturb, or remove surface material. Another parcel has one-half outstanding mineral interest with the right to remove but "doing no injury to the surface or else paying for damages." The third and final 40-acre parcel and the remaining one-half mineral interest would be reserved by the State of Minnesota and would be subject to the Secretary's Rules and Regulations (USFS 2011c).

4.3.1.2.3 Tract 3 – Wolf Lands

The Wolf Lands consist of four separate parcels in Lake County totaling 1,575.8 acres with a perimeter of approximately 14 linear miles. No hazardous material issues were identified at Tract 3 (EDR 2011b; EDR 2011c; EDR 2011d; EDR 2011e; MPCA 2012d).

Land Use Regulation

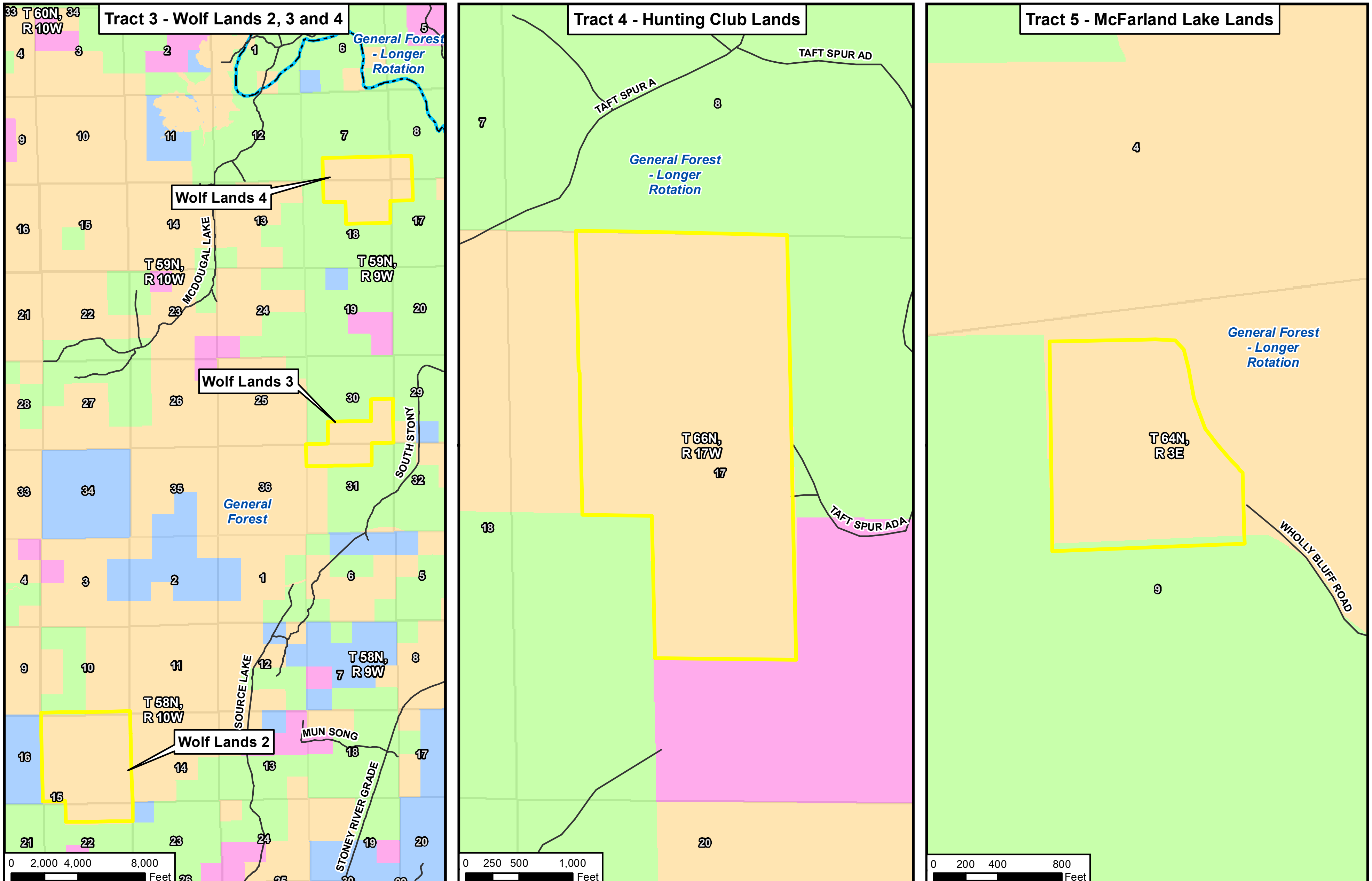
All Tract 3 parcels are within Lake County's Forest-Recreation zoning district, defined in Section 4.3.1.2.3 (Nelson, Pers. Comm., October 10, 2011).

Wolf Lands 1, the southernmost parcel, is largely bordered by Superior National Forest land in the General Forest-Longer Rotation Management Area. Adjacent parcels to the southwestern and northeastern corners owned by Lake County are also within the Forest-Recreation district (see Figure 4.3.1-2).

Wolf Lands 2 is bordered to the north and south by Superior National Forest land in the General Forest Management Area. Adjacent parcels to the east are privately owned, in Lake County's Forest-Recreation district. Adjacent parcels to the west and southeast are state-owned land (see Figure 4.3.1-3).

Wolf Lands 3 is adjacent to Superior National Forest land in the General Forest Management Area. Small privately owned parcels to the east and west are within Lake County's Forest-Recreation district (see Figure 4.3.1-3). A timber harvest agreement currently encumbers parts of this parcel (USFS 2011c).

214 -Page Intentionally Left Blank-



Non-federal Lands
Section Boundary
1 Section Label
Management Area
National Forest Ownership
County Ownership
State of Minnesota Ownership
Other Ownership

US Army Corps of Engineers
St. Paul District

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N W E S

Figure 4.3.1-3
Ownership of Tracts 3, 4, and 5
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Minnesota

June 2015

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Wolf Lands 4 is surrounded by Superior National Forest land in the General Forest Management Area (see Figure 4.3.1-3).

Existing Land Use

Access to Wolf Lands 1 and 2 is limited by the distance from roads and the presence of wetlands surrounding Wolf Lands 2. There is no evidence of any active land use on either of these parcels (Lisson and Gawtry 2011).

Wolf Lands 3 is accessible from a trail off of Forest Road 393. There is evidence of ongoing timber harvesting on this parcel (Lisson and Gawtry 2011).

Wolf Lands 4 is accessible via overland hiking from Forest Road 106, but there is no evidence of active land use (Lisson and Gawtry 2011).

Property Rights, Title, and Mineral Resources

Tract 3 is being purchased in the name of Lake-Forest Enterprise, Inc., through options from Wolf Lands, Inc. An assignment on file with Andersen and Butterworth, PA assigns all right, title, and interest in these lands to PolyMet (USFS 2011c).

There appears to be low potential for exploration or development of bedrock or surficial deposits on the Wolf Lands parcels. There is a moderate potential for aggregate development within Wolf Lands 2, but the parcel's wetland areas and limited access may restrict this opportunity (Barr 2011c).

Within Wolf Lands 1, there is an undivided three-quarter mineral interest reserved by Anton T. Anderson; all remaining mineral interests are held by Kimberly Clark with the right to cave, disturb, damage, or remove the surface while accepting liability for surface damage. The title commitment review indicated that this represents a poor condition of title but may be immaterial because the mineral development potential is low. In addition, there is no timber reservation or agreement in place (USFS 2011c).

Within Wolf Lands 2, 3, and 4, mineral interests are reserved by Duluth & Iron Range Railroad Co. along with the right to sink, cave, disturb, and remove the surface. The title commitment review indicated that this represents a poor condition of title that may be immaterial because the mineral development potential is low.

There are no active timber reservations or agreements in place for the Wolf Lands parcels.

4.3.1.2.4 Tract 4 – Hunting Club Lands

Tract 4 is a single parcel southwest of Crane Lake in St. Louis County. It is composed of 160.0 acres, with a perimeter of approximately 2 linear miles. No hazardous material issues were identified at Tract 4 (EDR 2011f; MPCA 2012d).

Land Use Regulation

Tract 4 is within St. Louis County's Forest Agricultural Management (FAM-1) zoning district. This district is intended to promote the forestry and agricultural industries, as well as recreational uses (St. Louis County 2011). Adjacent parcels on the west and southeast are also in this county zoning district. Adjacent parcels to the southwest, north, and east are Superior National Forest lands in the General Forest– Longer Rotation Management Area (see Figure 4.3.1-3).

Existing Land Use

Tract 4 is accessible by trail from a gravel road northwest of the property. The tract includes portions of two small unnamed lakes. There is no evidence of active land use.

Property Rights, Title, and Mineral Resources

There is low potential for exploration or development of bedrock or surficial deposits within Tract 4 (Barr 2011c). The only title exception is the property's enrollment in the Sustainable Forest Incentive Act Covenant dated September 3, 2002. This status normally includes an 8-year commitment for enrollment (USFS 2011c). The Sustainable Forest Incentive Act Covenant still applies to Tract 4 according to the updated Commitment for Title Insurance for this parcel. The covenant means the property is not and will not be:

- Used for residential purposes;
- Used for agricultural purposes;
- Enrolled in the Reinvest in Minnesota program or in a state or federal conservation reserve or easement reserve program;
- Enrolled in the Minnesota Agricultural Property Tax Law;
- Subject to agricultural land preservation controls or restrictions or the Metropolitan Agricultural Preserves Act; or
- Improved with a structure, pavement, sewer, permanent campsite, or any road (other than a township road), that are used for purposes not prescribed in the forest management plan for the property.

This covenant may need to be extinguished in order for the United States to accept title. The acceptability of the covenant will be determined by the USDA, Office of General Counsel, if a decision is made to proceed with the Land Exchange Proposed Action.

4.3.1.2.5 Tract 5 – McFarland Lake Lands

Tract 5 is a single parcel approximately 3 miles from the US-Canada border in Cook County. It covers approximately 30.8 acres, with a perimeter of approximately one linear mile. No hazardous material issues were identified on Tract 5 (NTS 2010b; EDR 2009b; MPCA 2012d).

Land Use Regulation

Tract 5 is in an unincorporated area in Cook County's Forest/Agriculture Residential (FAR 2) zoning district. This designation is characterized by a mix of forestry, agriculture, residential, and recreational uses (Cook County 2011). Adjacent privately owned parcels to the north and southeast are also within this county zoning designation. The tract is bordered on the west and south by Superior National Forest lands within the General Forest – Longer Rotation Management Area (see Figure 4.3.1-3).

Existing Land Use

Tract 5 was formerly owned and used by Wheaton College. A bunkhouse, fire ring, outhouse, and cistern are present, although these structures are not in active use and would be removed prior to the completion of the Land Exchange Proposed Action. The tract's eastern boundary is formed by McFarland Lake, an entry point to the BWCAW. Access to the property is by water from a landing off CR 16, or by a walking trail from the end of CR 16 (Lisson and Gawtry 2011).

Property Rights, Title, and Mineral Resources

PolyMet owns the surface rights for this tract. The tract is subject to a mortgage in favor of Iron Range Resources, which would be satisfied at closing of the Land Exchange Proposed Action (USFS 2011c).

The tract was assessed for mineral potential and encumbrances as part of the Feasibility Analysis completed in 2009. The geology underlying the tract is composed of gabbro and sedimentary rocks. Studies of the mineral potential in this area are rare because of the proximity to the BWCAW, but this type of formation has not shown mineral potential elsewhere in the county. The MDNR core library index shows no drilling in or near the area. There are no nearby gravel operations that would indicate any potential for surficial materials (USFS 2009c).

There appears to be low potential for exploration or development of bedrock or surficial deposits within Tract 5 (Barr 2011c). Mineral rights to Tract 5 are outstanding, but deeds do not appear to waive the right to subjacent support (USFS 2011c) (i.e., mineral exploration and extraction may not compromise the "lay of the land" by weakening underground support of the surface).

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4.3.2 Water Resources

The federal lands are similar to the Mine Site area previously discussed, but excludes the privately-owned land bordering Dunka Road to the south of the Mine Site. Section 4.2.2 presents a discussion of the existing conditions on the federal lands. The water resources of the federal lands are briefly described in Section 4.3.2.1. Water resources of the non-federal lands are described in Section 4.3.2.2.

4.3.2.1 Federal Lands

4.3.2.1.1 Land Exchange Proposed Action

The Land Exchange Proposed Action consists of exchanging 6,495.4 acres of federal lands (see Figure 3.3-1) for 7,075.0 acres of non-federal lands. Most of the Mine Site is composed of federal lands, with a small portion located south of Dunka Road being non-federal lands. The Land Exchange Proposed Action also includes federal lands located north and west of the Mine Site.

Groundwater

Groundwater resources in and near the Mine Site are discussed in detail in Section 4.2.2.2.1. In general, the glacial aquifer within the Land Exchange Proposed Action federal lands is typically very thin (less than 30 ft) with limited yield; there are no large-scale regional aquifers (MPCA 1995). The Duluth Complex, which immediately underlies the glacial material, is the least fractured of the bedrock units in the area, and therefore has the poorest aquifer characteristics.

Surface Water

Surface water resources in and near the Mine Site are discussed in detail in Section 4.2.2.2.2. Surface water resources within the Land Exchange Proposed Action federal lands include Mud Lake (PW-148P), and 3.8 miles of the Partridge River and 0.7 miles of Yelp Creek (see Table 4.3.2-1), also a MDNR-designated public water resource. There are no known wild rice beds within these public waters.

Table 4.3.2-1 Summary of Surface Water and Wild Rice Beds for Federal Lands

	Federal Lands	
	Land Exchange Proposed Action	**Land Exchange Alternative B**
Public Water Lakes, ac. (mi. shore)	30.5 (0.9)	Approximately 8.9 (0.2)
Public Water Streams, mi. stream	4.5	4.5
Wild Rice Beds, ac.	--	--

Sources: PW data from MDNR 2012j; Wild Rice data from MDNR 2008c.

4.3.2.1.2 Land Exchange Alternative B

Land Exchange Alternative B: Smaller Federal Parcel lands are somewhat smaller than the Land Exchange Proposed Action, totaling 4,752.6 acres, which excludes the far western portion of the Land Exchange Proposed Action federal land area (see Figure 3.3-1). The Land Exchange Alternative B consists of exchanging 4,752.6 acres of federal lands for 4,926.3 acres of non-federal lands.

<u>Groundwater</u>

Groundwater resources of the Land Exchange Alternative B: Smaller Federal Parcel lands are essentially the same as those of the Land Exchange Proposed Action.

<u>Surface Water</u>

Surface water resources of the Land Exchange Alternative B: Smaller Federal Parcel lands are essentially the same as those of the Land Exchange Proposed Action, with the exception that the northwest boundary of the Land Exchange Alternative B bisects Mud Lake, including only about 30 percent of its shoreline.

4.3.2.2 Non-federal Lands

Water resources considered in this evaluation of the five non-federal land tracts proposed for exchange include the following:

- Quality and flow of groundwater;
- Quality and flow of surface water; and
- Quantity of wild rice beds.

4.3.2.2.1 Regional Groundwater Resources

<u>Regional Groundwater Water Quality</u>

There are no known, site-specific groundwater quality data for any of the non-federal Land Exchange Proposed Action lands. However, there were two studies that collected surficial groundwater quality data throughout the region that may be used to generally characterize potential groundwater quality at the exchange sites. The MPCA studied groundwater quality throughout the state, and published several documents that describe the general condition of the groundwater resource in northeast Minnesota. They note that glacial aquifers in this part of the state are commonly thin and limited in their extent and yield; there are no large-scale regional aquifers (MPCA 1995). The Regional Copper-Nickel Study (Seigel and Ericson 1980) generally focused on the area around the Duluth Complex, so data from that study may not be as broadly applicable.

In addition, between 1992 and 1996, the MPCA's Ground Water Monitoring and Assessment Program sampled 21 wells completed in surficial sand and gravel aquifers and 64 completed in buried, confined sand and gravel aquifers within MPCA Region 1, which encompasses seven counties in northeastern Minnesota including St. Louis County (MPCA 1999a). The MPCA study concluded that groundwater quality across the region is generally good. Concentrations of major cations and anions were lower in surficial and buried drift aquifers compared to similar aquifers statewide, while concentrations of trace metals were higher. They noted that since geology controls groundwater quality in the region, trace inorganic constituents commonly found in the bedrock, such as beryllium, manganese, boron, arsenic, and selenium may have naturally elevated concentrations locally. Of the 85 surficial and buried aquifer samples that were collected, MPCA recorded five exceedances of the state drinking water criteria for beryllium, four for manganese, and one for boron. There were no exceedances noted for arsenic or selenium.

Although these data may not be directly applicable to any one of the Land Exchange Proposed Action lands, they can be used to draw general conclusions about the probable range of water quality. Table 4.2.2-6 summarizes Mine Site groundwater quality data and compares it with the MPCA (i.e., Northeast MN Baseline) and copper-nickel (i.e., Cu-Ni Baseline) study data for surficial aquifers. The range of values across the region for the five constituents of concern noted by the MPCA was generally comparable to the ranges monitored at the Mine Site, with the exception of manganese, which was higher for some of the regional samples.

Probable Groundwater Source Areas for the Exchange Lands

As suggested by the MPCA study for the northeast region, all of the exchange tracts, with the possible exception of the Tract 1, appear to be characterized by thin glacial aquifers with limited yield. Source areas of surficial groundwater also appear to be limited, usually within a mile or two of each tract.

The general applicability of the regional, surficial data to the exchange lands is somewhat dependent on the potential for local anthropogenic (man-made) contamination of groundwater. A cursory evaluation of the surficial groundwater source area for each parcel is made in the groundwater discussion for each of the tracts below.

4.3.2.2.2 Surface Water Resources

The five tracts drain either south to the Lake Superior Watershed or north to the Hudson Bay Watershed. Except for timber harvest, they are all generally undisturbed with native forest cover. Little, if any, hydrologic or water quality data has been collected for any of the tracts. The surface water resources of each tract are described below. Table 4.3.2-2 summarizes the surface water and wild rice beds of each tract.

Table 4.3.2-2 Summary of Surface Water and Wild Rice Beds for all Land Exchange Proposed Action Tracts

	Non-federal Lands					Non-federal Totals
	Tract 1 – Hay Lake Lands	**Tract 2 – Lake County Lands**	**Tract 3- Wolf Lands**	**Tract 4 – Hunting Club Lands**	**Tract 5 – McFarland Lake Lands**	
Public Water Lakes, ac. (mi. shore)	125.7 (2.8)	--	--	--	0 (0.2)	**125.7 (3.0)**
Public Water Streams, mi. stream	8.1	--	1.0	--	--	**9.1**
Wild Rice Beds, acres.	125.7	--	--	--	--	**125.7**

Sources: PW data from MDNR 2012j; Wild Rice data from MDNR 2008c.

4.3.2.2.3 Tract 1 – Hay Lake Lands

Groundwater

This tract would appear to be the most susceptible of all the tracts to anthropogenic influences since it is located only a few miles away from the Mesabi Iron Range and several local communities. However, a natural topographic and bedrock divide separates most of the Mesabi Iron Range mining activities from the tract, meaning that surficial groundwater flow to the tract is isolated from most mining and community influences. One mining feature within the same watershed (Pike River) is ArcelorMittal Steel's Tailings Basin, located about 0.5 miles to the west. The general topography of the area suggests that groundwater flow from the Tailings Basin is to the northeast, away from the Hay Lake lands. Limited surface water quality data from Hay Lake and Rice Lake indicate that sulfate concentrations vary between less than 1.0 and 3.6 mg/L (Barr 2012a), indicating no influence from the Tailings Basin.

Three piles of household waste and soil with minor oil impacts were removed from the Hay Lake tract by PolyMet. Confirmation soil sampling and analyses indicated all impacted soils were removed, and found no evidence that contamination had migrated to groundwater (NTS 2011).

Surface Water

Hay Lake lands drain to the Pike River, which flows into Lake Vermilion near Tower, Minnesota (see Figure 4.3.2-1). The lands contain two MDNR-designated public water lakes—Hay Lake (PW 69-579P) and Rice Lake (PW 69-578W). Hay Lake is 96.2 acres with 1.9 miles of shoreline; Rice Lake is 29.5 acres with about 1 mile of shoreline. This tract also contains about 8 miles of the Pike River, an MDNR-designated public water stream. Hay Lake, Rice Lake, and the Pike River, all of which contain wild rice beds, lie within the Hay Lake lands. These are the only waterbodies within the proposed non-federal land exchange tracts known to contain wild rice beds. These waterbodies were included in four annual wild rice surveys performed from 2009 to 2012 (Barr 2011a; 2012a; 2013m); survey results were similar for 2009-2011 with no apparent trends in density or distribution. Hay Lake was found to have small, low density wild rice beds (density factor 1 of 5) across the entire lake. Rice Lake was found to have many beds across the entire lake with density factor ratings of 3 to 5. Pike River was also found to have beds with density factor ratings of 3 to 5 across the entire river near Rice Lake, with near-bank beds further upstream. The survey performed in 2012 found lower densities of wild rice beds. Hay Lake, Rice Lake, and the Pike River all had density factor ratings of 1. The decreases in density in Rice Lake and the Pike River were consistent with a decrease in wild rice bed density across all areas surveyed in 2012.

ArcelorMittal Steel's Tailings Basin is located about 2 miles northwest of Hay Lake (see Figure 4.3.2-1). Seepage from the basin flows north into Wouri Creek, which is also a tributary to Pike River. Three water quality samples taken from Hay Lake during the summer of 2009 all had a sulfate concentration of 1.1 mg/L, and one sample taken in 2010 had a sulfate concentration less than 1 mg/L (Barr 2011a), suggesting that seepage from the ArcelorMittal Steel's Tailings Basin is not reaching the lake. Water clarity was estimated at 6 to 12 ft based on 1999-2001 satellite imagery. Sulfate concentrations in Rice Lake and in the Pike River just downstream of Rice Lake were measured annually from 2009 to 2012 during the wild rice surveys. Sulfate concentrations in Rice Lake ranged from 2.1 to 2.4 mg/L. Sulfate concentrations in the Pike River just downstream of Rice Lake ranged from 2.1 to 3.6 mg/L (Barr 2013l). There are no other known water quality data for this tract.

4.3.2.2.4 Tract 2 – Lake County Lands

Groundwater

The Lake County lands are located near the headwaters of small, tributary streams with local source areas for groundwater. There are no known land-use activities within the source areas that suggest the potential for detrimental effects to groundwater quality.

Surface Water

This tract contains four parcels; three are located in close proximity to each other with a fourth parcel located about 14 miles to the southeast (see Figure 4.3.2-2 and Figure 4.3.2-3). There are no DNR-designated public waters within Tract 2. The three clustered parcels flow to the southwest through a series of small streams that are tributaries to the Cloquet River. The Cloquet River drains into the St. Louis River, which ultimately drains into Lake Superior. The Lake County South parcel flows to a tributary of the Beaver River (MDNR-designated public water stream), which ultimately drains into Lake Superior. There are no known water quality data for this tract.

4.3.2.2.5 Tract 3 – Wolf Lands

Groundwater

The Wolf Lands are located near the headwaters of small, tributary streams with local source areas for groundwater. There are no known land-use activities within the source areas that suggest the potential for detrimental effects to groundwater quality.

Surface Water

This tract consists of four parcels (see Figure 4.3.2-3, Figure 4.3.2-4, Figure 4.3.2-5, and Figure 4.3.2-6). Wolf Lands 1 is located immediately adjacent to the Lake County lands, contains no protected waters, and discharges to the same Cloquet River tributary as the Lake County lands.

Wolf Lands 2 is located adjacent to two creeks that are tributaries to Greenwood Lake; Mary Ann Creek is located to the west and an unnamed creek is located to the southeast. Greenwood Lake flows northerly to the Stony River. There are no public waters within this parcel.

Coyote Creek flows within the northern portion of Wolf Lands 3 and bifurcates Wolf Lands 4. Coyote Creek is a tributary and a MDNR-designated public water stream to McDougal Lake, which eventually flows into Stony River. Wolf Lands 3 contains 0.1 mile and Wolf Lands 4 contains 0.9 mile of Coyote Creek. There are no known water quality data for this tract.

4.3.2.2.6 Tract 4 – Hunting Club Lands

Groundwater

The Hunting Club lands are located near the headwaters of small, tributary streams with local source areas for groundwater. There are no known land-use activities within the source areas that suggest the potential for detrimental effects to groundwater quality.

Surface Water

This entire tract drains into an unnamed tributary of the Vermilion River, which flows north to Crane Lake (see Figure 4.3.2-7). There are no DNR-designated public waters within this land. There are no known water quality data for this tract.

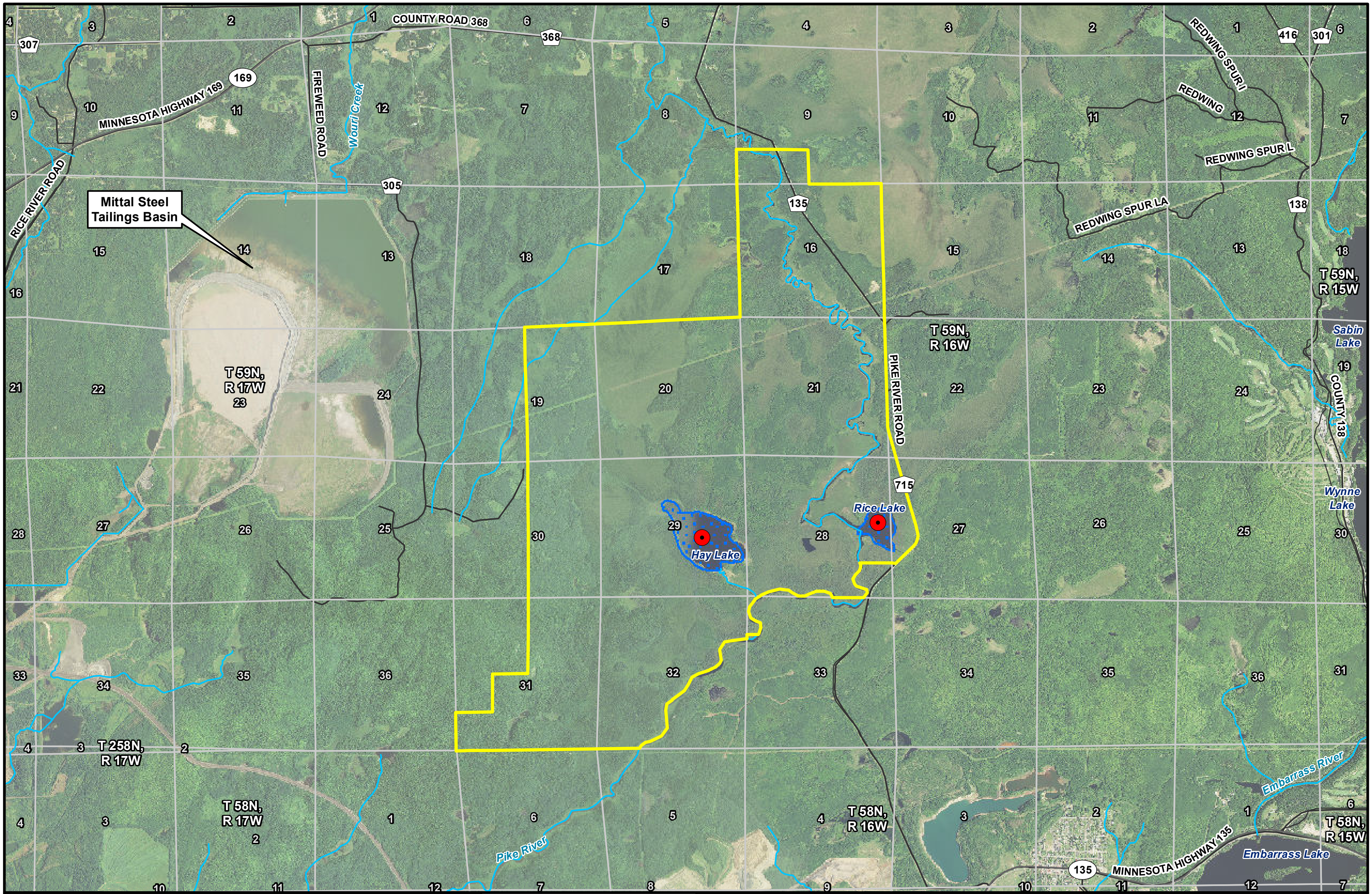
4.3.2.2.7 Tract 5 – McFarland Lake Lands

Groundwater

The McFarland Lake lands may have the most limited groundwater resource of all the tracts due to very shallow glacial material over bedrock. Source areas for groundwater flow to the tract appear to be limited to the tract itself and a small, undeveloped drainage 0.5 mile northwest of the tract. There are no known land-use activities within the source area that could potentially affect groundwater quality.

Surface Water

This tract is tributary to McFarland Lake (MDNR PW 027P), which drains into the border lakes of the BWCAW (see Figure 4.3.2-8). It contains about 0.2 mile of McFarland Lake shoreline. There is no known water quality data for this tract or for McFarland Lake, other than 13 secchi disk (water clarity) readings taken from 1989 through 2008. The average secchi disk reading was 16.1 ft, which is near the high end of the typical range for water clarity in this region of Minnesota. This secchi disk reading indicates that McFarland Lake is about mid-way between oligotrophic and mesotrophic, which suggests that the lake has relatively low nutrient enrichment.



Non-federal Lands
Wild Rice Location
Wild Rice Lake
Stream/River
Section Boundary
1 Section Label
Road

US Army Corps of Engineers St. Paul District

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0 0.325 0.65 1.3 Miles

Figure 4.3.2-1
Surface Water
Tract 1 - Hay Lake Lands
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

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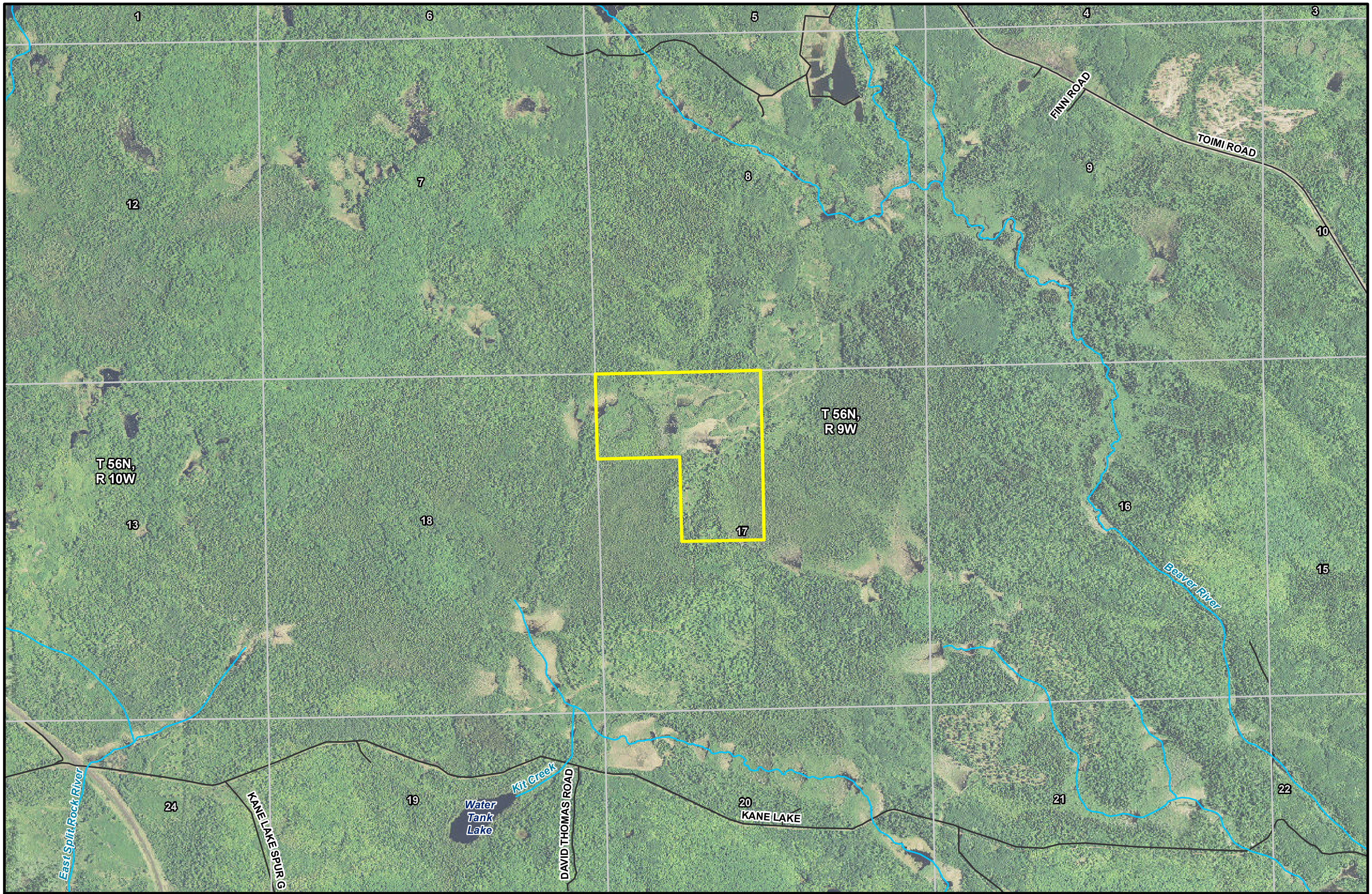

Non-federal Lands
Wild Rice Location
Wild Rice Lake
Stream/River
Section Boundary
Section Label
Road

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0 0.125 0.25 0.5 Miles

Figure 4.3.2-2
Surface Water
Tract 2 - Lake County South Lands
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

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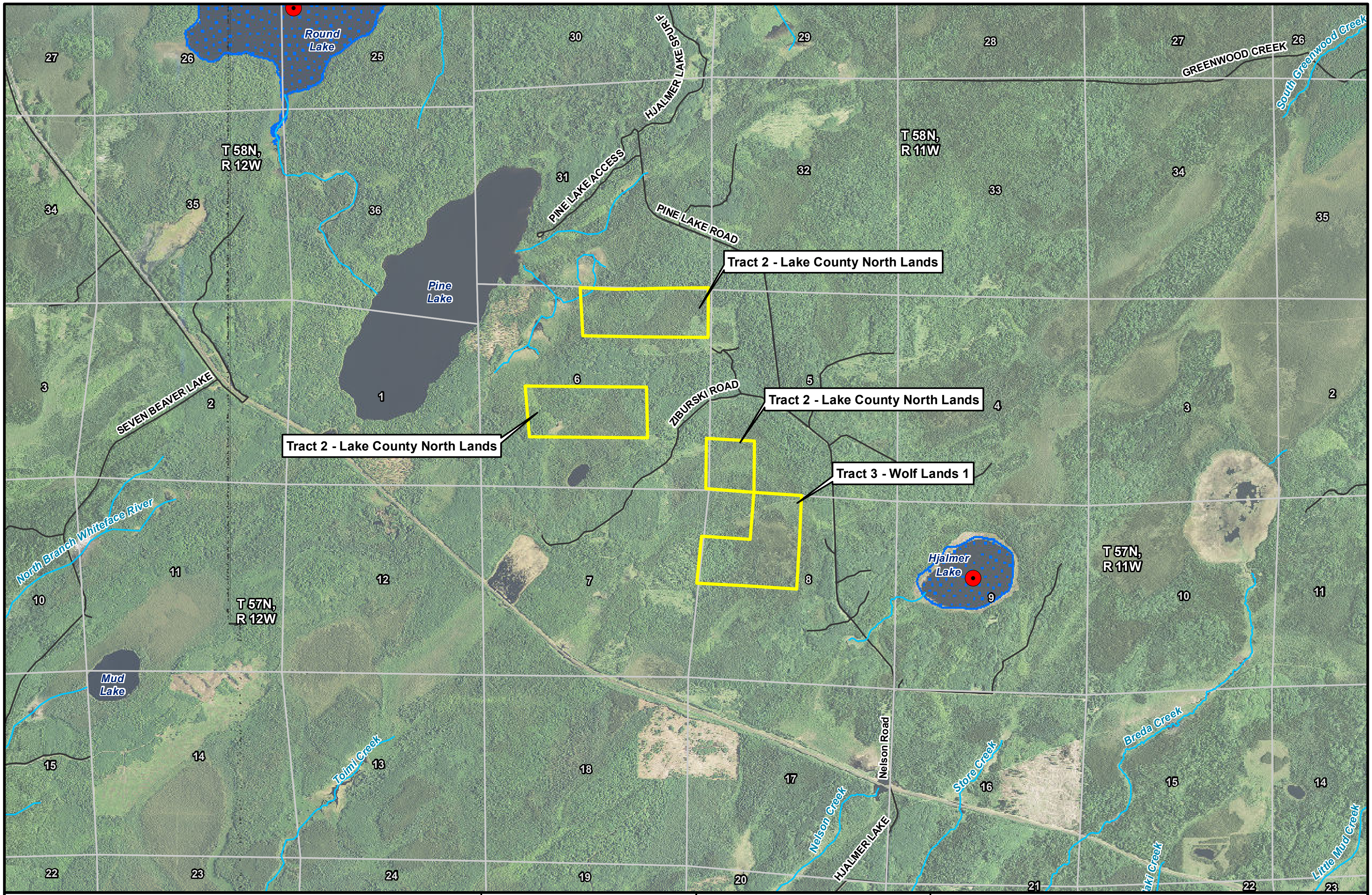

Non-federal Lands
Wild Rice Location
Wild Rice Lake
Stream/River
Section Boundary
Section Label
Road

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US Army Corps of Engineers St. Paul District

0 0.25 0.5 1 Miles

Figure 4.3.2-3

Surface Water

Tract 2 - Lake County North Lands and Tract 3 - Wolf Lands 1

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Minnesota

June 2015

202

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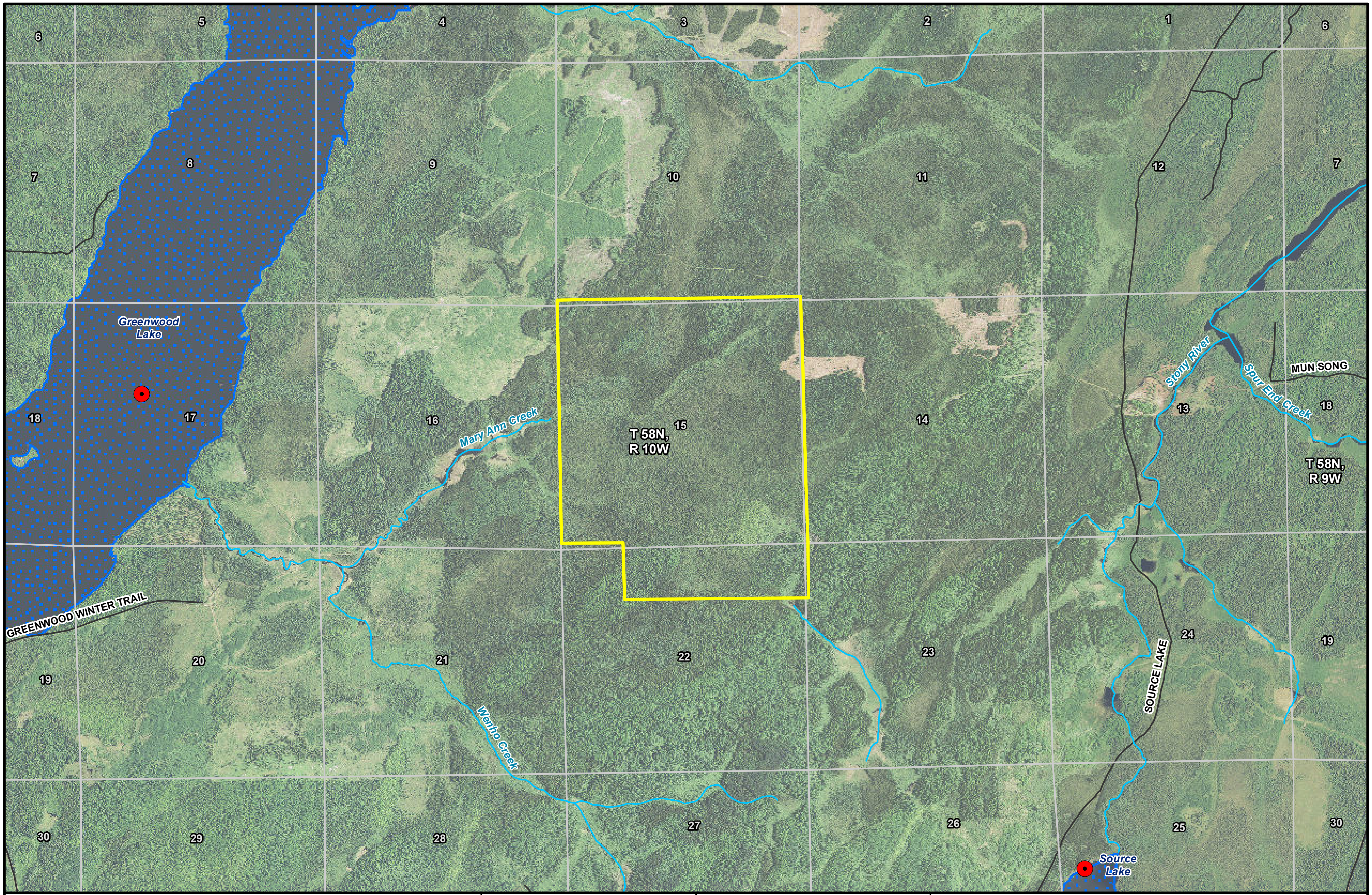

Non-federal Lands
Wild Rice Location
Wild Rice Lake
Stream/River
Section Boundary
1 Section Label
Road

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N
W E
S

0 0.175 0.35 0.7 Miles

Figure 4.3.2-4

Surface Water

Tract 3 - Wolf Lands 2

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Minnesota

June 2015

204

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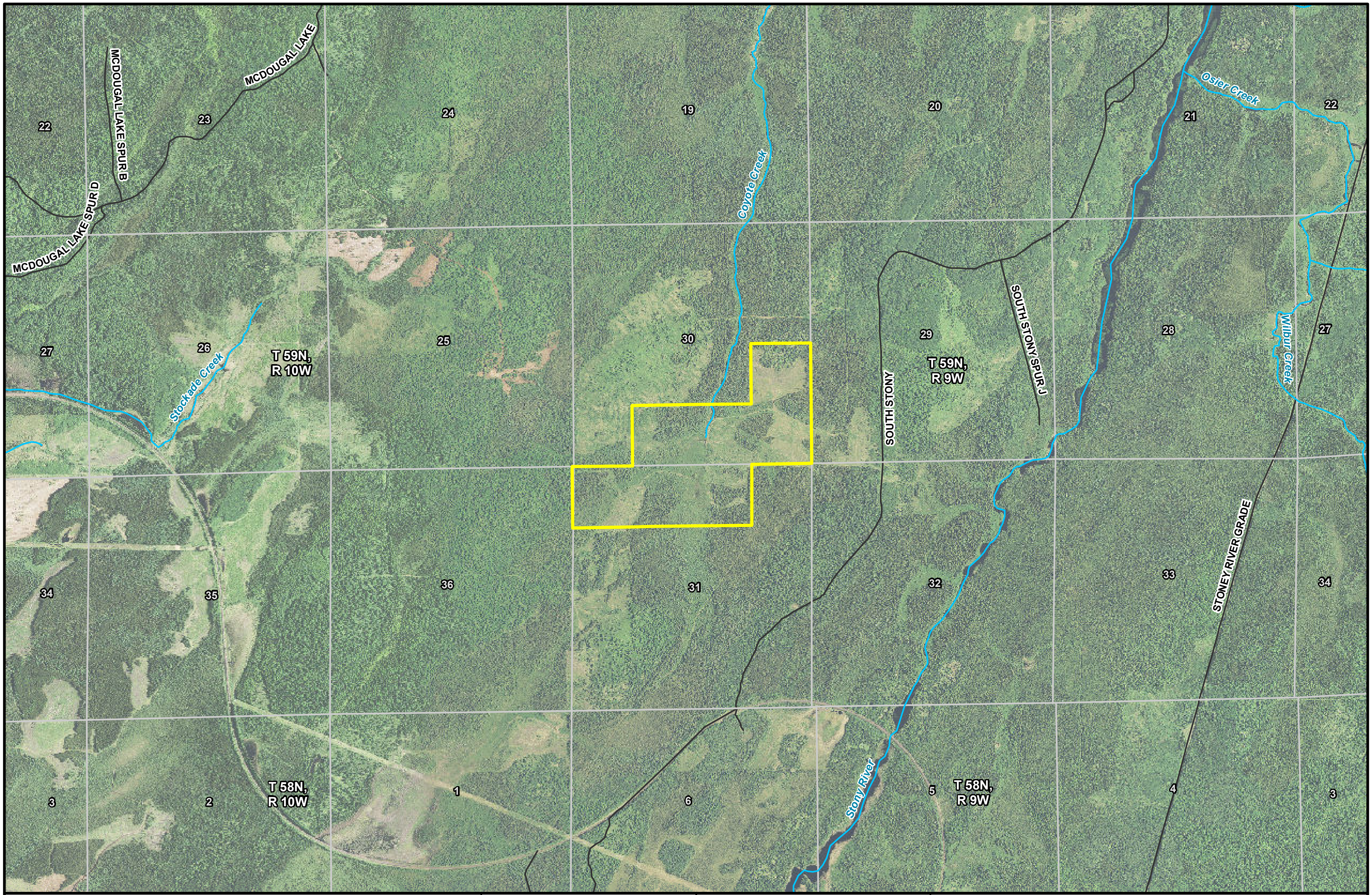

Non-federal Lands
Wild Rice Location
Wild Rice Lake
Stream/River
Section Boundary
Section Label
Road

US Army Corps of Engineers
St. Paul District

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N W E S

0 0.175 0.35 0.7 Miles

Figure 4.3.2-5
Surface Water
Tract 3 - Wolf Lands 3
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

206

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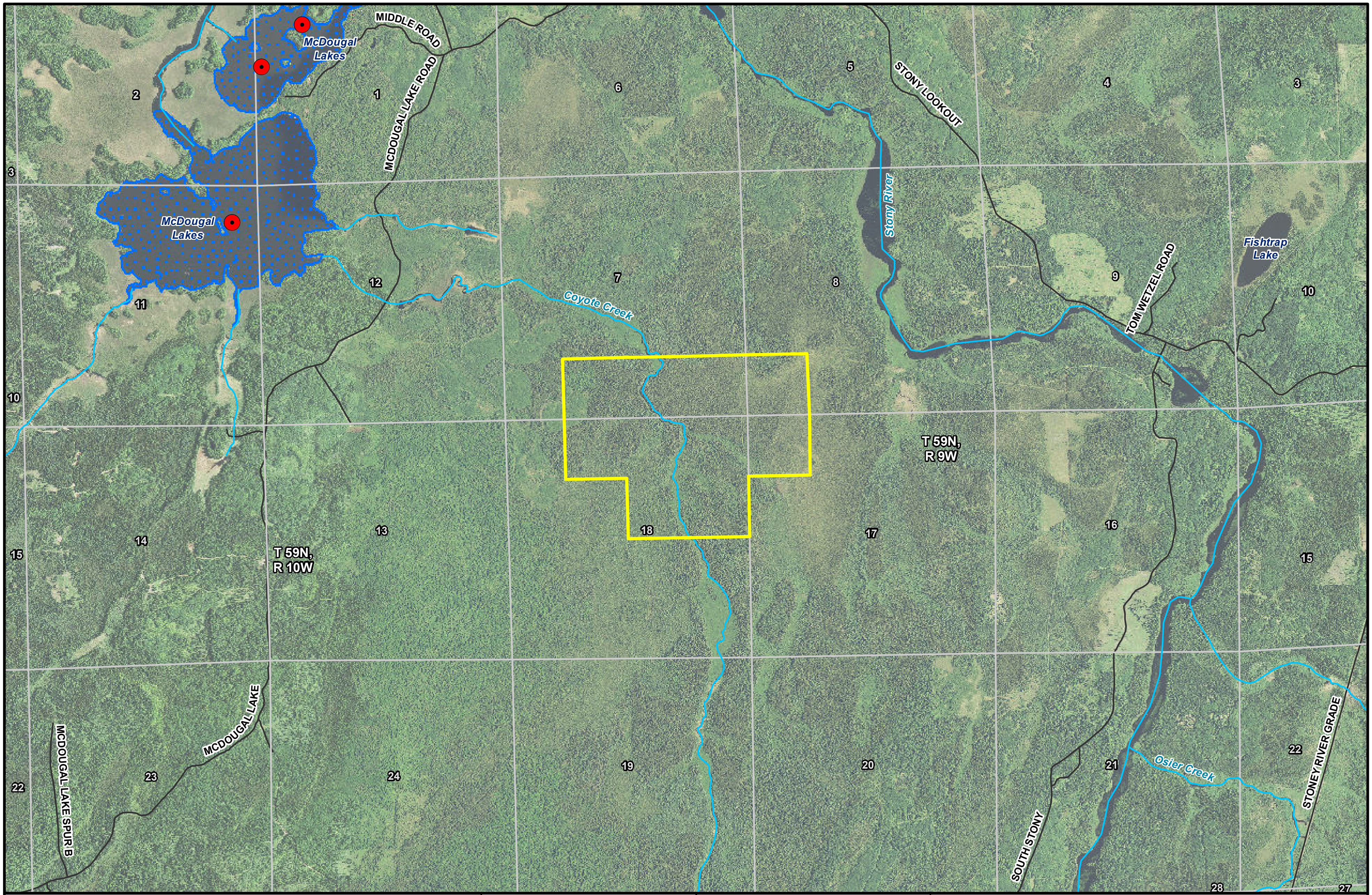

Non-federal Lands
Wild Rice Location
Wild Rice Lake
Stream/River
Section Boundary
1 Section Label
Road

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N W E S

0 0.175 0.35 0.7 Miles

Figure 4.3.2-6
Surface Water
Tract 3 - Wolf Lands 4
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

208

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Non-federal Lands
Wild Rice Location
Wild Rice Lake
Stream/River
Section Boundary
1 Section Label
Road

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N
W E
S

0 0.25 0.5 1 Miles

Figure 4.3.2-7
Surface Water
Tract 4 - Hunting Club Lands
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

210

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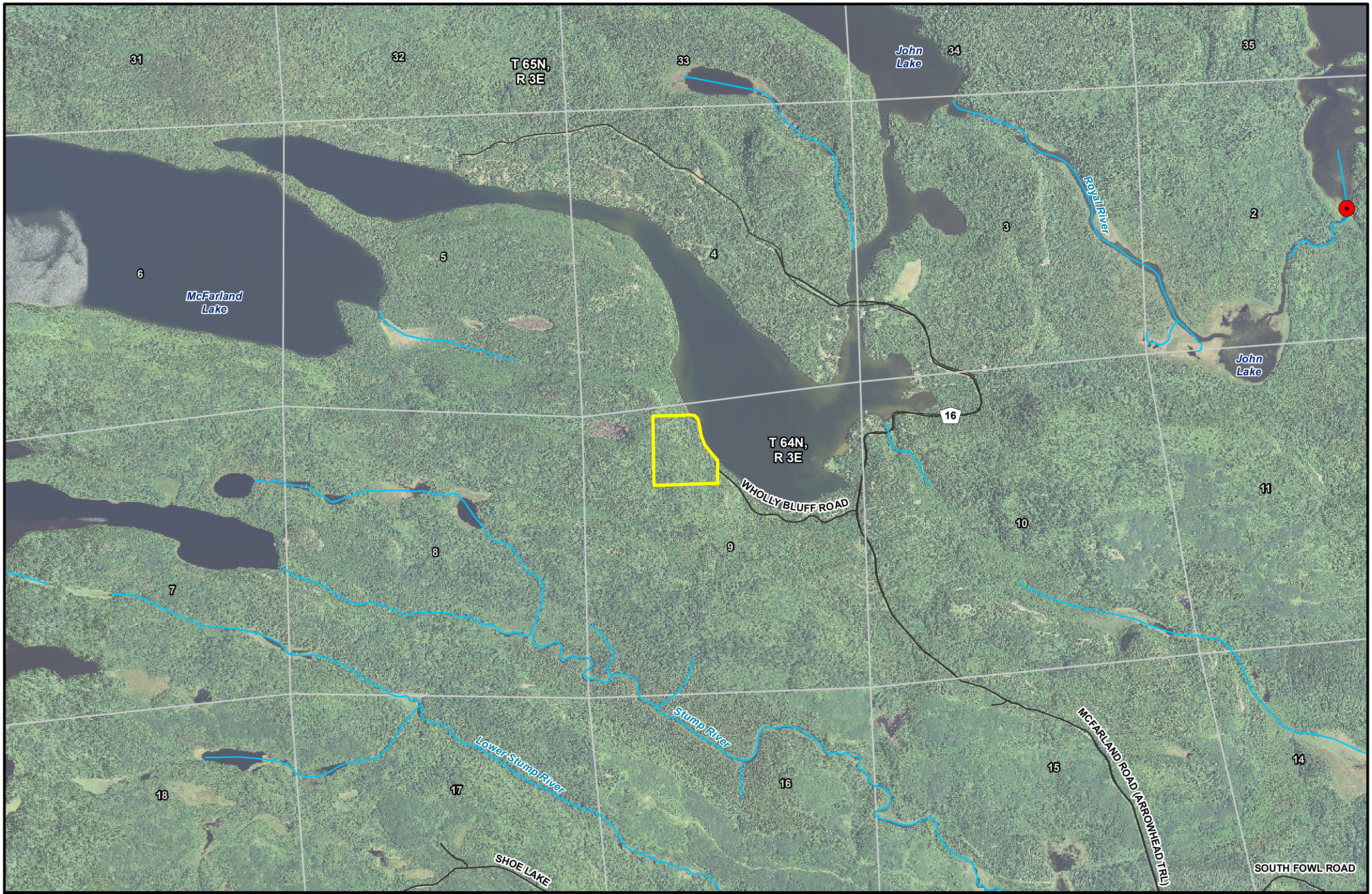

Non-federal Lands
Wild Rice Location
Wild Rice Lake
Stream/River
Section Boundary
Section Label
Road

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N W E S

0 0.15 0.3 0.6 Miles

Figure 4.3.2-8
Surface Water
Tract 5 - McFarland Lake Lands
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

212

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4.3.3 Wetlands

4.3.3.1 Federal Lands

The federal lands, both the Land Exchange Proposed Action and Land Exchange Alternative B boundaries, are located in the Partridge River Watershed, about 3 miles south of the Laurentian Divide (see Figures 4.3.3-1 and 4.2.2-1). As previously stated, the Partridge River is located in the East St. Louis River Watershed, which discharges into Lake Superior. Much of the federal lands consist of wetlands and the Land Exchange Proposed Action boundary includes a portion of the One Hundred Mile Swamp. The One Hundred Mile Swamp (see Figure 4.3.3-1) is a large wetland of approximately 3,028 acres that was aerially surveyed by the MDNR as part of a larger study (MDNR 1997); however, no delineated boundary exists for the One Hundred Mile Swamp. The following sections provide baseline information on the Land Exchange Proposed Action and Land Exchange Alternative B boundaries.

4.3.3.1.1 Land Exchange Proposed Action

Wetland Delineation and Classification

Wetland characterization, mapping, and surveys for the federal lands were conducted between 2004 and 2010. The wetland delineation and classification is the same as described in Section 4.2.3.1.1. The federal lands within the Land Exchange Proposed Action encompass 6,495.4 acres (see Figure 4.3.3-1).

A wetland delineation of the federal lands surrounding the Mine Site was subsequently conducted in August 2004, June 2005, and July 2006. Between 2007 and 2010, additional wetlands within the federal lands adjacent to the Mine Site were identified from aerial photographic interpretation and field studies. In August 2008, additional upland and wetland habitat surveys were conducted on the areas outside the Mine Site on the adjoining federal lands. Initially, potential wetland locations were determined by reviewing CIR aerial photographs, USGS topographic maps, and wetland maps previously prepared. Aerial photographs and field maps were then used in the field to verify cover types. Upon completion of field studies, cover types were mapped as habitat polygons. Polygons were digitized using GIS and overlaid onto habitat maps created from aerial photographs. These maps and the associated GIS database were used to determine the approximate acreage of each wetland type.

During the field surveys, data was collected related to the overall functions and values of the wetlands within the federal lands associated with the Mine Site (see Section 4.2.3.1.3) and of representative wetlands within the federal lands adjacent to the Mine Site. Wetland functions and values were rated using the guidelines in the MnRAM, Versions 3.0-3.2.

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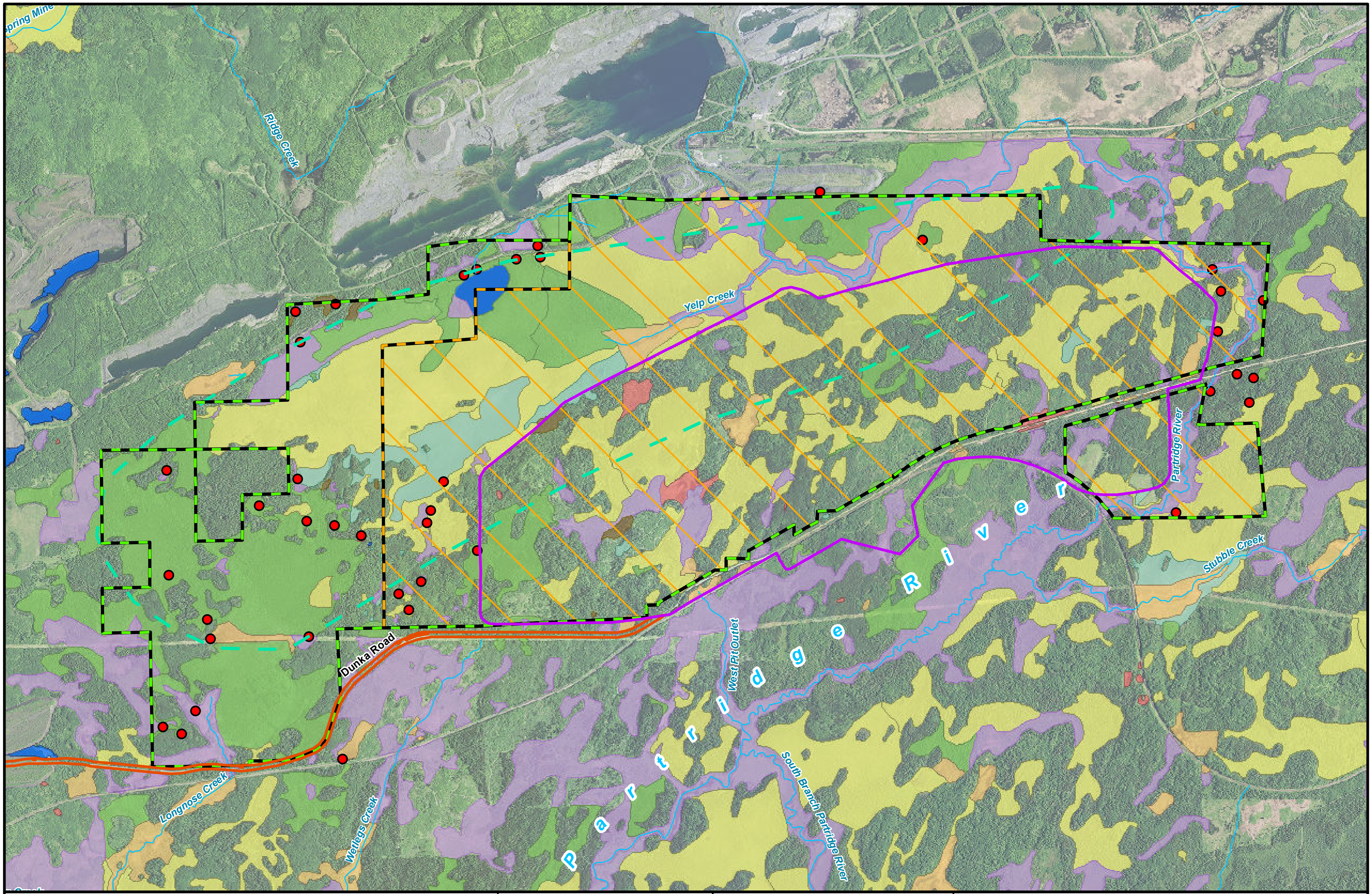

Mine Site
Federal Lands
Alternative B: Smaller Federal Parcel
Transportation and Utility Corridor
Stream/River
One Hundred Mile Swamp (Approximate Boundary)
Wetland Assessment Site

Eggers & Reed Wetland Types

Coniferous Bog
Coniferous Swamp
Deep Marsh & Shallow Marsh
Hardwood Swamp
Open Bog
Sedge Meadow & Wet Meadow
Shrub Swamps (Alder Thicket & Shrub-Carr)
Shallow, Open Water & Lake

US Army Corps of Engineers
St. Paul District

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N
W E
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0 0.25 0.5 1 Miles

Figure 4.3.3-1

Wetland Community Types Federal Lands and Alternative B: Smaller Federal Parcel

NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

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Hydrology, Wetland Vegetation, and Community Types

The hydrology, wetland vegetation, and community types of the federal lands within the Land Exchange Proposed Action include those elements within the Mine Site boundary (see Section 4.2.3.1.2), as well as the adjoining federal lands to the northwest. The hydrology, wetland vegetation, and community types are discussed below.

Bogs in the federal lands consist of leatherleaf and bog Labrador-tea, with scattered speckled alder, swamp birch, tamarack, and, in some areas, cattail and sedges. Sphagnum moss was observed to cover 80 to 90 percent of the bogs. Other species encountered during the field work include: black spruce, tamarack, blueberry, small fruited bog cranberry, willows, purple pitcher plant, marsh cinquefoil, cottongrass, round sundew, starflower, bunchberry, and Solomon's seal (AECOM 2011a).

Shrub swamp communities on the adjoining federal lands surrounding the Mine Site were observed to consist of a dense cover of speckled alder. These wetlands typically include sapling balsam fir, jack pine, black spruce, willow, and the occasional American mountain-ash. Dominant low shrubs include bog Labrador-tea, leatherleaf, lowbush blueberry, prickly rose, raspberry, and red-osier dogwood. Mountain maple saplings were also present during the field work in a few wetlands. Herbaceous layer species include club and sphagnum mosses, woolly sedge, bluejoint, horsetail, wood fern, bunchberry, bluebead lily, starflower, and creeping snowberry (AECOM 2011a).

The forested swamp communities (coniferous swamps and hardwood swamps) for the federal lands surrounding the Mine Site are also dominated by black spruce and northern white cedar, with scattered tamarack. Deciduous and mixed forest wetlands are uncommon; aspen is the dominant deciduous species found in these forests. Much of One Hundred Mile Swamp consists of mature (80-plus years) black spruce and northern white cedar. Bog Labrador-tea, leatherleaf, and blueberry are prevalent, as is spruce regeneration. In some areas with dense stands of spruce, few shrubs were seen during field surveys, but sphagnum and club mosses often covered nearly 100 percent of the ground. More open stands may have an understory comprised of shrubs and scattered sapling white cedar, tamarack, and black spruce, along with speckled alder and willow. Common species include bluebead lily, Solomon's seal, horsetail, starflower, and creeping snowberry. Some areas also have cottongrass and bog laurel. An area in the southern portion of One Hundred Mile Swamp has a large number of purple pitcher plants. Forest and shrub cover typically range from 40 to 70 percent, while moss and other understory vegetation cover from 60 to 90 percent of the ground (AECOM 2011a).

There were several ponds/inland fresh meadow (emergent) wetlands identified on the federal lands surrounding the Mine Site that were created by logging activities, road construction, or beaver dams, or were natural depressions or associated with the Partridge River. These wetlands were often dominated by bluejoint, sedges, and cattails. Water depths were several feet in deeper areas. Spruce and other trees associated with the wetland were often killed when flooded as a result of the rising water level. Willows, tamarack, and speckled alder were often found along the border of these wetlands, but comprised less than 20 percent of the cover. Wild iris is common in some inland fresh meadow wetlands, as was horsetail, burreed, spikerush, and woolly sedge (AECOM 2011a).

The wetland assessment identified 200 wetlands covering 4,164.4 acres (64 percent) within the 6,495.4 acre federal lands boundary (see Figure 4.3.3-1). Table 4.3.3-1 below summarizes the wetland areas within the federal lands represented by each Eggers and Reed (1997; 2014) wetland community type. A large portion of the wetlands within the federal lands are located in the floodplains of Yelp Creek and the Partridge River or one of their associated tributaries. The most common wetland types within the federal lands are coniferous bogs (approximately 47 percent), coniferous swamps (31 percent), and shrub swamps (approximately 13 percent), which includes alder thickets and shrub-carrs.

Other wetland community types present within the federal lands include open bog, shallow marsh, hardwood swamp, open water, and sedge/wet meadows. Section 4.2.3.1.2 provides a discussion on the hydrology, wetland vegetation, and community types of the federal lands.

Table 4.3.3-1 Wetland Acreage by Wetland Community Type for the Federal Lands within the Land Exchange Proposed Action and within the Land Exchange Alternative B

	Land Exchange Proposed Action		**Land Exchange Alternative B**	
Eggers and Reed Class[1]	**Acres**	**%**	**Acres**	**%**
Coniferous bog	1,961.4	47	1,677.0	59
Coniferous swamp	1,287.8	31	476.1	17
Deep marsh	0.0	0	0.0	0
Hardwood swamp	21.1	<1	13.7	<1
Open bog	209.5	5	175.0	6
Open water (includes shallow, open water, and lakes)	30.8	1	8.6	<1
Sedge/wet meadow	35.7	1	34.9	1
Shallow marsh	97.0	2	80.9	3
Shrub swamp (includes alder thicket and shrub-carr)	521.1	13	394.7	14
Total	4,164.4	100	2,860.9	100

Note:
[1] Eggers and Reed 1997; 2014.

Wetland Functional Assessment

The Land Exchange Proposed Action federal lands include the Mine Site area as well as the adjoining federal lands to the northwest. The wetland function and values assessment for the Mine Site is described in 4.2.3.1.3 and wetlands function and values for the federal lands surrounding the Mine Site are provided below.

During the surveys conducted for the federal lands surrounding the Mine Site, the primary wetland functions rated by MnRAM 3.2 were evaluated based on a review of the following: 1) wetland soil, hydrology, and vegetation; 2) outlet characteristics; 3) watershed and adjacent upland land uses and conditions; 4) erosion and sedimentation; and 5) human disturbances (AECOM 2011a). The Eggers and Reed (1997; 2014) classification system was used to classify wetland communities for the wetland function and value evaluation. Landscape factors were typically evaluated on a larger scale. Sixty-three questions given in MnRAM 3.2 were addressed for the August 2008 field surveys, and all factors were evaluated for each wetland surveyed. Based on this assessment methodology, wetlands were rated high, medium, or low.

The wetland functions that were typically most applicable to the federal lands include the following:

- Maintenance of characteristic hydrologic regime;
- Maintenance of wetland water quality;
- Vegetative diversity/integrity;
- Maintenance of characteristic wildlife habitat structure;
- Downstream water quality;
- Groundwater interaction; and
- Aesthetics/recreation/education/cultural.

During 2008, 40 wetlands, or portions of wetlands, were evaluated for their functions and values at representative wetland locations within the federal lands outside the Mine Site boundary (see Figure 4.2.3-2 and Table 4.3.3-2); nearly all wetlands were rated with a high value (approximately 93 percent) for wetland functions based on minimal or no current disturbance. Only a small subset (approximately 7 percent) of the wetlands was disturbed wetlands (AECOM 2011d). Vegetation diversity/integrity was high for 93 percent of the wetlands because they have been minimally altered by recent anthropogenic factors and had a relatively constant supply of water. Wetland vegetation around the Mine Site needed no active management and provided quality habitat for fish and wildlife. The overall rating was based on the highest rated community for vegetation diversity and integrity, rather than the average or weighted value for community vegetation diversity and integrity. MnRAM 3.2 guidance states that this is the appropriate measure for assessing wetland quality for regulatory purposes (AECOM 2011a).

Wildlife habitat was rated high for most wetlands on the basis of natural wildlife corridors and upland communities relatively untouched by recent human disturbances or effects. Wildlife habitat was rated lower in areas where there were few plant communities (AECOM 2011d).

Fish habitat was rated as not applicable for most wetlands, primarily because they did not have enough standing water throughout the year to support fish. Other characteristics associated with the rating include isolated wetlands that are not permanently flooded, or forested wetlands where the water table was below the surface for all or part of the year (AECOM 2011d).

Amphibian habitat was rated high for most wetlands, primarily because they stayed inundated long enough in most years to allow amphibians to successfully reproduce. Amphibian habitat was rated not applicable for some wetlands if conditions needed to support amphibian reproduction did not occur at the site. Forested wetlands with little or no standing water during the mating season would likely not support amphibians (AECOM 2011d).

Aesthetic, recreational, educational, and cultural values were rated medium. All wetlands were aesthetically pleasing and could be used for recreation, education, and cultural purposes. However, road access to the federal lands surrounding the Mine Site is only available via a private mining road and is not easily accessible to the general public (AECOM 2011d). Access to the federal lands is discussed in Section 4.3.1.

Table 4.3.3-2 Wetland Functions and Values Assessment for the Federal Lands Surrounding the Mine Site, 2008

	Functional Value Ratings (%)								
Wetland Functions and Value Rating	**Vegetation Diversity/ Integrity**	**Hydrology**	**Flood Attenuation**	**Downstream Water Quality**	**Wetland Water Quality**	**Wildlife Habitat**	**Fish Habitat**	**Amphibian Habitat**	**Aesthetics/ Education/ Cultural**
High	93	98	2	95	93	93	38	55	0
Moderate	7	2	98	5	7	7	2	7	100
Low	0	0	0	0	0	0	0	5	0
Not Available or Applicable	0	0	0	0	0	60	60	33	0
Total	100	100	100	100	100	160	100	100	100

Source: AECOM 2011a.

Floodplains

Floodplains are lowland areas adjacent to lakes, wetlands, and rivers that are prone to being inundated by water during a flood. Floodplains carry and store water and help to attenuate water flows. Floodplains also provide important habitat for fish and wildlife; filter sediments, nutrients, and pollutants from the water; and are important for public uses, such as fishing and hunting.

There are several definitions people use to estimate the limits of a floodplain. These include an ecological definition, a zoning or regulatory definition, and a hydrologic definition based upon the frequency of flood inundation. Ecologically defined floodplains are considered and described as wetlands. Federal EO 11988, Section 2(a)(1), states that the "[d]etermination [of a floodplain] shall be made according to a Department of Housing and Urban Development (HUD) floodplain map or a more detailed map of an area, if available. If such maps are not available, the agency shall make a determination of the location of the floodplain based on the best available information."

A Flood Insurance Rate Map (FIRM) developed by the Federal Emergency Management Agency (FEMA) for most of St. Louis County estimates the floodplain areas of inundation. The areas identified on the FIRM are considered "mapped floodplains." The mapped floodplains can be the result of a detailed hydrologic investigation associated with a 100-year (1 percent chance) return frequency flood elevation or an approximation based upon topography of floodplains. Wetlands were not generally mapped as floodplains by FEMA because they had relatively less development pressure with less need for regulation and establishment of insurance rates. Smaller streams with a contributing drainage area of less than 1 square mile were not prioritized by FEMA for mapping. In addition, some areas adjacent to lakes were not mapped because the land use was managed by shoreland ordinances.

The Land Exchange Proposed Action federal lands are within a portion of St. Louis County that is unmapped by FEMA. Therefore, there is no FEMA estimate of the areas of inundation and there are no FEMA-mapped floodplains on the federal lands. However, a hydrologic model (XP-SWMM) was developed as part of the hydrologic analysis needed for the design of the NorthMet Project Proposed Action. The area of inundation associated with the 500-year (or 0.2 percent chance) floodplain of the Partridge River was estimated as part of this analysis. This estimate of the floodplain area in the federal lands was used for the effects analysis.

Floodplain importance was determined by measuring the number of acres of floodplain per acre of parcel as an index to the relative importance of floodplains on the parcels. The unmapped floodplain area on the federal lands associated with the Partridge River and Yelp Creek, estimated using the XP-SWMM, was estimated to total 1,889.4 acres of floodplain (500-year floodplain) (see Figure 4.3.3-2). The ratio of the number of acres of floodplain per acre of parcel for the federal lands is 0.3. The proposed mining activity associated with the NorthMet Project Proposed Action would be managed by the MDNR Permit to Mine to manage the flood damage potential for upstream and downstream property owners.

Frontage of Waterways

Lakes, streams, and rivers/creeks and their associated riparian habitat provide important habitat for fish and wildlife and provide for additional recreational and social functions and values for humans. Lake, stream, and river/creek frontage and associated habitat are not typically evaluated during a wetland assessment, and were not considered during the wetland assessment field studies conducted for the NorthMet Project Proposed Action. However, the linear distance of lake and river/stream frontage for the federal lands was determined using GIS, and the length of frontage per acre of parcel was calculated as an index of the relative importance of frontage on the parcels.

Mud Lake, the dominant lake feature on the federal lands, is located within the One Hundred Mile Swamp and is 30.5 acres in size. Mud Lake was determined to have a frontage of approximately 4,550 ft. The length of lake frontage per acre of federal lands is 0.7 ft.

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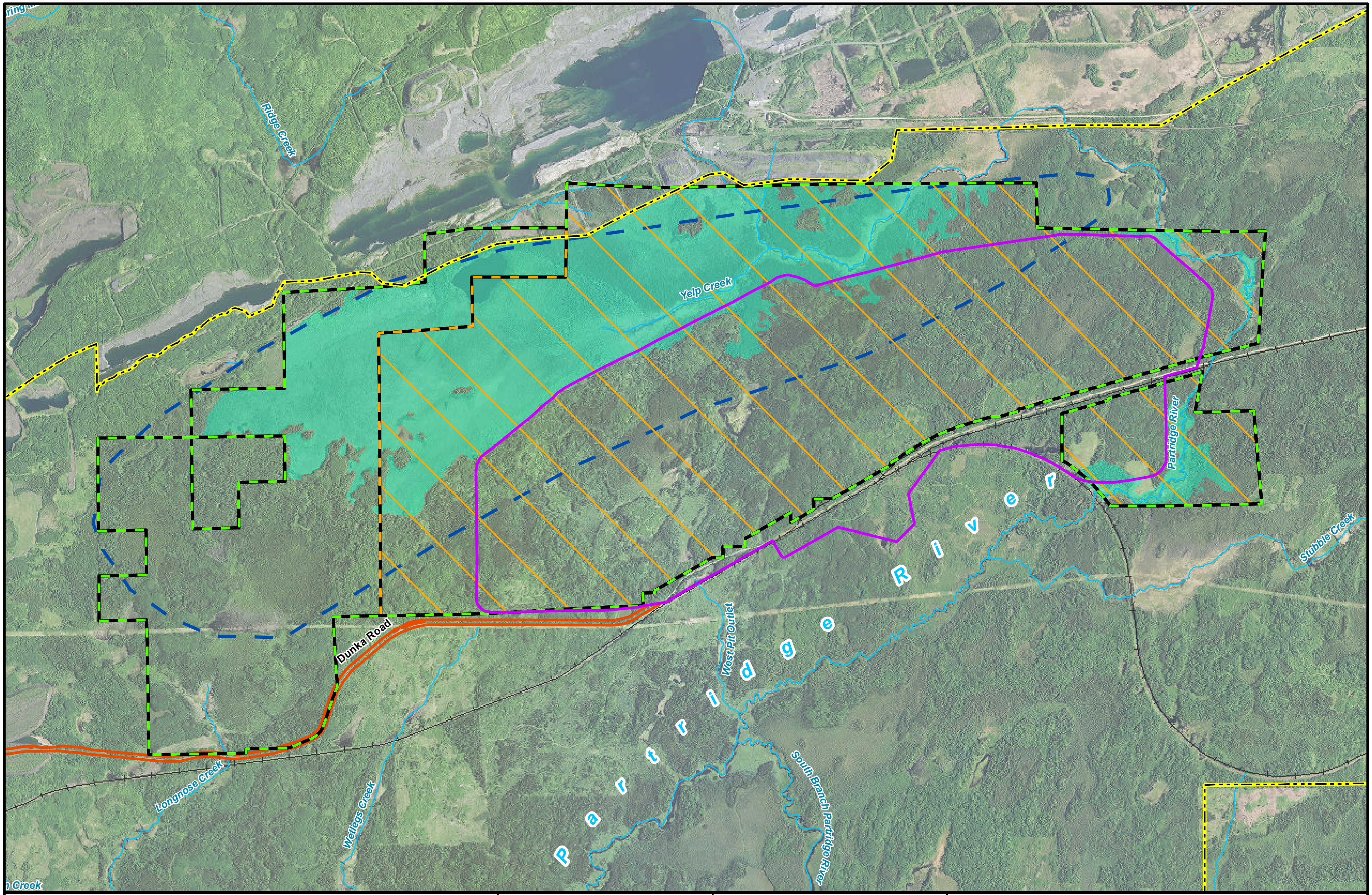

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Figure 4.3.3-2
Floodplain Boundaries Federal Lands and Alternative B: Smaller Federal Parcel
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

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Yelp Creek flows out of the One Hundred Mile Swamp, while Yelp Creek and the Partridge River flow through portions of the federal lands. Collectively, the creek and river are 5.3 miles in length. Since both sides of the river provide riparian habitat, the length of the river on the federal lands was doubled to determine the importance of river frontage. It was determined that there were 55,968.0 linear ft of creek/river frontage on the federal lands. The length of creek/river frontage per acre of federal lands is 8.6 ft.

4.3.3.1.2 Land Exchange Alternative B

Wetland Delineation and Classification

Land Exchange Alternative B is a reduced area of the Land Exchange Proposed Action federal lands boundary, and the wetland delineation and classification is the same as described in Section 4.3.3.1.1. The Land Exchange Alternative B is 4,752.6 acres (see Figure 4.3.3-1).

Hydrology, Wetland Vegetation, and Community Types

The hydrology, wetland vegetation, and community types of the smaller federal parcel are a subset of the Land Exchange Proposed Action federal lands, and the hydrology, wetland vegetation, and community types are the same as described above in Section 4.3.3.1.1. The wetland assessment identified 143 wetlands covering 2,860.9 acres (60 percent) within the 4,752.6 acre smaller federal parcel boundary (see Figure 4.3.3-1). Table 4.3.3-1, above, summarizes the wetland areas within the Land Exchange Alternative B parcel represented by each Eggers and Reed (1997; 2014) wetland community type. A large portion of the wetlands within the Alternative B: Smaller Federal Parcel is located in the floodplains of Yelp Creek and the Partridge River or one of their associated tributaries. The most common wetland types within the Land Exchange Alternative B include coniferous bogs (approximately 59 percent), coniferous swamps (17 percent), and shrub swamps (approximately 14 percent), which includes alder thickets and shrub-carrs.

Other wetland community types present within the Land Exchange Alternative B include open bog, hardwood swamps, shallow marsh, and sedge/wet meadows. The sedge/wet meadows may receive some portion of its hydrology from groundwater. The shallow marsh community generally results from artificial impoundment by beaver dams, roads, and railroads and is primarily dependent on surface waters for hydrology.

Wetland Functional Assessment

Land Exchange Alternative B is a subset of the Land Exchange Proposed Action federal lands, and the wetland function and values assessment is the same as described in Section 4.3.3.1.1.

Floodplains

The Land Exchange Alternative B federal lands are within a portion of St. Louis County that is unmapped by FEMA. Therefore, there is no FEMA estimate of the areas of inundation and there are no FEMA-mapped floodplains on the federal lands. However, a hydrologic model (XP-SWMM) was developed as part of the hydrologic analysis needed for the design of the NorthMet Project Proposed Action. The area of inundation associated with the 500-year (or 0.2 percent chance) floodplain of the Partridge River was estimated as part of this analysis. This estimate of the floodplain area in the federal lands was used for the effects analysis. The unmapped floodplain area on the federal lands associated with the Partridge River and Yelp Creek, estimated using the XP-SWMM, was estimated to total 1,412.9 acres of floodplain (500-year floodplain) (see Figure 4.3.3-2). The ratio of the number of acres of floodplain per acre of parcel for the Land Exchange Alternative B is 0.3.

Frontage of Waterways

A portion of Mud Lake, 8.9 acres, is located within the Land Exchange Alternative B. The portion of Mud Lake was determined to have a frontage of approximately 1,200 ft. The length of lake frontage per acre of the Land Exchange Alternative B is 0.3 ft.

As with the Land Exchange Proposed Action, Yelp Creek flows out of the One Hundred Mile Swamp, while Yelp Creek and the Partridge River flow through portions of the Land Exchange Alternative B. Collectively, the creek and river are 5.3 miles in length in the Land Exchange Alternative B, corresponding to 55,968.0 linear ft of creek/river frontage (counting both sides of the water feature). The length of creek/river frontage per acre of the Land Exchange Alternative B is 11.8 ft.

4.3.3.2 Non-federal Lands

4.3.3.2.1 Non-federal Lands

The Land Exchange Proposed Action must comply with two EOs that are related to wetlands and floodplains. EO 11990 was signed by President Jimmy Carter on May 24, 1977 “in order to avoid to the extent possible the long and short term adverse impacts associated with the destruction or modifications of wetlands….” This order applies to land exchanges such that, as much as practicable, the exchange does not result in the loss of wetland resources. EO 11988 was signed by President Jimmy Carter on May 24, 1977 “in order to avoid to the extent possible the long and short term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct or indirect support of floodplain development wherever there is a practicable alternative…” This order applies to land exchanges such that, as much as practicable, the exchange does not result in an increase in the flood damage potential.

The USFS policy is that the following three conditions satisfy the requirements of EOs 11990 and 11988 (FSH 5409.13 § 33.43c):

1. The value of the wetlands or floodplains for properties received and conveyed is equal (balancing test) and the land exchange is in the public interest.
2. Reservations or restrictions are retained on the unbalanced portion of the wetlands and floodplains on the federal lands when the land exchange is in the public interest but does not meet the balancing test.
3. The federal property is removed from the exchange proposal when the conditions described in the preceding paragraphs 1 or 2 cannot be met.

The USFS is also required, by both EOs 11990 and 11988, to reference in a conveyance those uses that are restricted under identified federal, state, or local wetland and floodplain regulations. In Minnesota, the CWA (USACE/EPA/MPCA), Protected Waters Permit Program (MDNR), and the WCA; Board of Water and Soil Resources regulate certain activities in wetlands. Floodplain management ordinances are administered at the local (county) level.

In addition to the evaluating wetlands in accordance with these EOs (acres for acres of wetland and no increase in flood hazards), analysis for the Land Exchange Proposed Action includes information on wetland community types as well as the ecological floodplain. Furthermore, the analysis evaluates the net change of shoreline frontage along rivers, streams, and lakes. Although such analysis is not required by EO 11990, it is consistent with the USFS's strategic goal to sustain and enhance outdoor recreation opportunities and with the management direction to protect water resources.

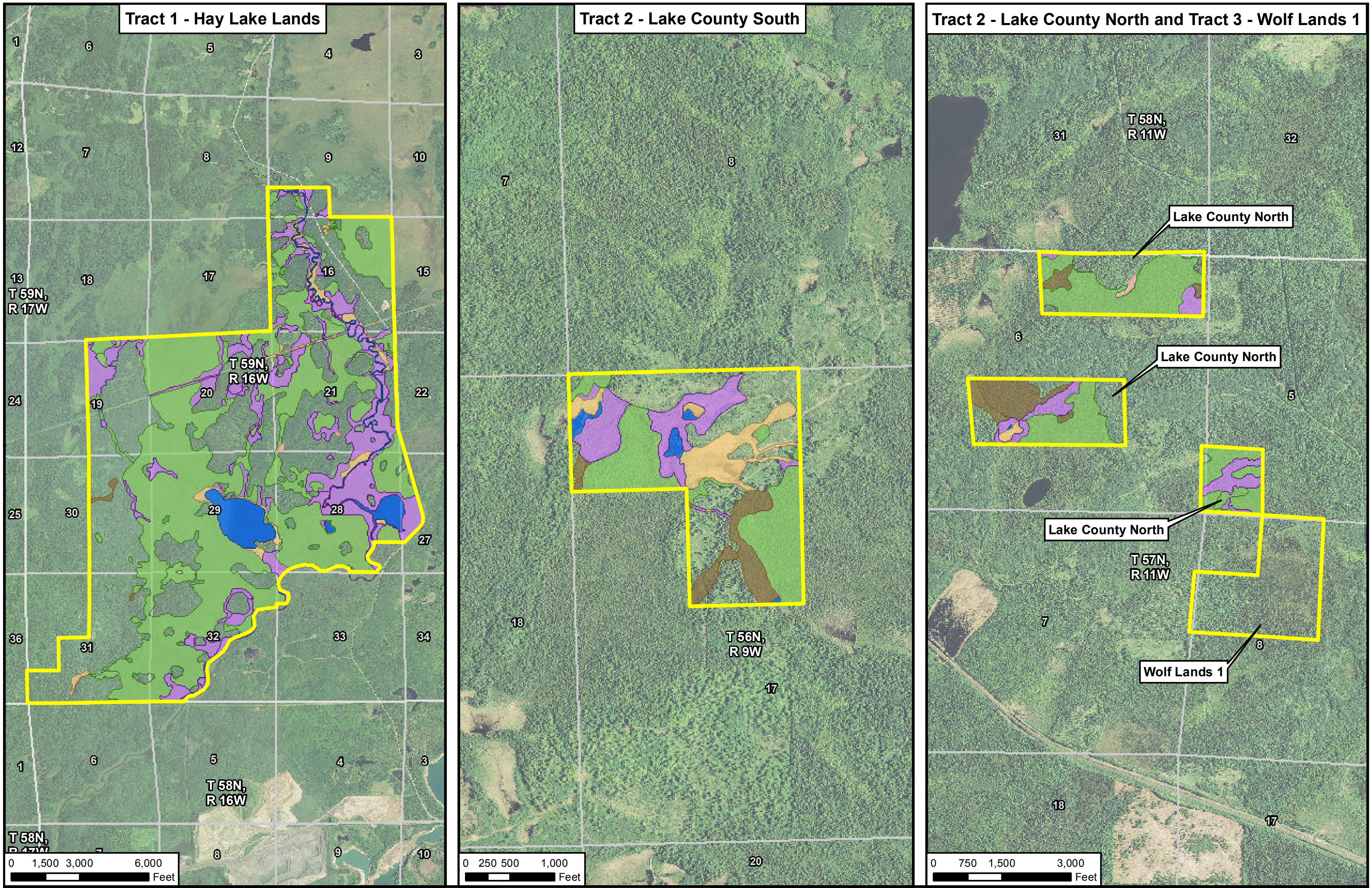
Wetland Delineation and Classification

Wetland boundaries and community types for the non-federal lands were identified from aerial photographic interpretation and field studies; no federal or state delineation protocols were used, as it was primarily a habitat assessment (AECOM 2011b; AECOM 2011c). Infrared and true color aerial photographs and topographic maps of the parcels were reviewed to identify areas that could have wetlands based on vegetative characteristics and topography. In addition, wetlands identified by the NWI were overlaid onto aerial photographs to assist in wetland identification. Field studies were conducted subsequent to the initial desktop study in June 2009 for the Hay Lake Lands and McFarland Lands (AECOM 2011b) and in November 2010 for the Hunting Club Lands, Lake County Lands, and Wolf Lands (AECOM 2011c); this was done to better delineate wetland boundaries on the parcels using the same methods as used for the federal lands surrounding the Mine Site. Mapping information from the field work was then used to modify the NWI wetland types and boundaries.

Wetland surveys were conducted along transects located on primary roads (parcel access and logging) and secondary access routes (skid trails, stream corridors, wetlands, other natural corridors) in order to maximize the amount of area covered during the survey period. Additional surveys were conducted off of the primary and secondary access routes in an effort to better determine wetland boundaries and types (AECOM 2011b; 2011c).

The boundaries of wetlands were determined based on aerial photograph interpretation and NWI mapping, with some refining of wetland boundaries during field studies. Wetland boundaries were determined in the field based on hydrologic and vegetative characteristics and were more accurate where survey routes crossed or were near wetland boundaries. Approximate wetland boundaries and wetland types based on habitat mapping are shown on Figures 4.3.3-3 and 4.3.3-4. Surveys covered nearly all portions of the parcels, although not all wetlands were field surveyed (AECOM 2011b; AECOM 2011c).

During the field surveys in June 2009 and November 2010, data were collected using the guidelines in MnRAM 3.2 (BWSR 2008) related to the functions and values of representative wetlands within the tracts (AECOM 2011b; AECOM 2011c). The primary wetland functions were evaluated based on a review of the 1) wetland soil, hydrology, and vegetation; 2) outlet characteristics; 3) watershed and adjacent upland land uses and conditions; 4) erosion and sedimentation; and 5) human disturbances. The Eggers and Reed (1997; 2014) classification system was used to classify wetland communities for the wetland function and value evaluation. Landscape factors were typically evaluated on a larger scale. For instance, soil and vegetation conditions within the watershed were usually similar for large groups of wetlands. The anthropogenic factors were also typically similar across broad areas. Based on the responses to questions addressed by MnRAM 3.2 and the assessment of special features, a function value of high, medium, or low was given for each primary function (AECOM 2011b; AECOM 2011c). See below for more information on MnRAM scoring for the non-federal lands.



Non-federal Lands
Section Boundary
1 Section Label

Eggers & Reed Wetland Types
- Shrub Swamps (Alder Thicket & Shrub-Carr)
- Coniferous Swamp
- Hardwood Swamp
- Open Bog
- Shallow, Open Water & Lake
- Shallow Marsh & Deep Marsh

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N W E S

Figure 4.3.3-3
Wetland Community Types
Tract 1, Tract 2, and Tract 3
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

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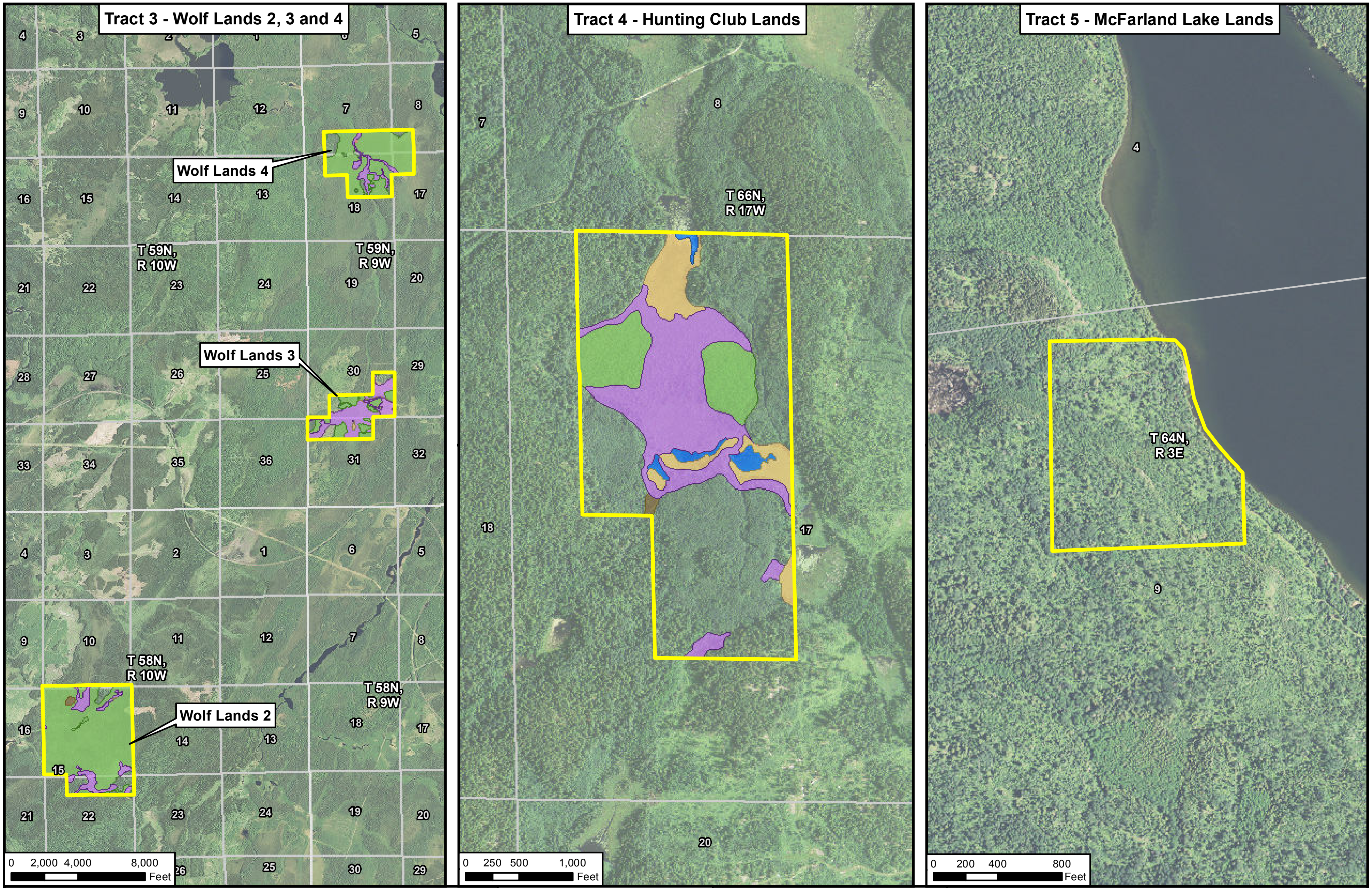

Non-federal Lands

Section Boundary

1 Section Label

Eggers & Reed Wetland Types

Shrub Swamps (Alder Thicket & Shrub-Carr)

Coniferous Swamp

Hardwood Swamp

Open Bog

Shallow, Open Water & Lake

Shallow Marsh & Deep Marsh

Minnesota Department of Natural Resources

US Army Corps of Engineers St. Paul District

Forest Service U.S. Department of Agriculture

This document is a working document. This document may change over time as a result of new information, further deliberation, or other factors not yet known to the Co-lead Agencies.

N W E S

Figure 4.3.3-4

Wetland Community Types

Tract 3, Tract 4, and Tract 5

NorthMet Mining Project and Land Exchange PFEIS

Minnesota

June 2015

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Hydrology, Wetland Vegetation, and Community Types

Habitat and wetland community types within the five tracts were found to be consistent with habitats in much of the Mesabi Iron Range and northeastern Minnesota, including coniferous, deciduous, and mixed coniferous and deciduous forests, and a variety of wetland habitats. Generally, the parcels consisted of a mosaic of slightly elevated upland areas surrounded by wetland areas.

The surveys identified that the majority of the tracts' total area consists of wetlands (66 percent; 4,669.9 acres). Individual tracts with a higher percentage of upland areas include the Hunting Club parcel (60 percent upland), Hay Lake (41 percent upland), and McFarland Lake (100 percent upland) (see Table 4.3.3-3). The most common wetland types within the five non-federal tracts are coniferous swamps (approximately 69 percent) and shrub swamps (approximately 23 percent), which includes both alder thickets and shrub-carr wetlands. Wetland types based on Eggers and Reed (1997; 2014) classification system for the non-federal lands are presented in Table 4.3.3-4 below (AECOM 2011b; AECOM 2011c).

Table 4.3.3-3 Total Wetland and Upland Acreage for the Non-federal Lands

Tract	Wetland Acres [1]	Upland Acres [1]	Total Acres [1]	% of Wetlands	% of Upland
Tract 1 – Hay Lake	2,930.8	1,995.6	4,926.4	59	41
Tract 2 – Lake County					
Lake County North	209.3	55.9	265.2	79	21
Lake County South	73.6	43.4	117.0	63	37
Tract 3 – Wolf Lands					
Wolf Lands 1	90.4	35.4	125.8	72	28
Wolf Lands 2	706.2	61.5	767.7	92	8
Wolf Lands 3	233.2	44.3	277.5	84	16
Wolf Lands 4	362.8	41.9	404.7	90	10
Tract 4 - Hunting Club	63.6	96.5	160.1	40	60
Tract 5 – McFarland Lake	0.0	30.8	30.8	0	100
Total	4,669.9	2,405.3	7,075.2	66	34

Note:
[1] Total acres may be more or less than presented due to rounding.

Table 4.3.3-4 Total Wetland Acreage by Wetland Type for the Non-federal Lands

Eggers and Reed Class[1]	Total Non-federal Lands Acres	%
Coniferous swamp[2]	3,242.4	69
Hardwood swamp[3]	58.0	1
Open bog	7.1	<1
Open water (includes shallow, open water, and lakes)	182.5	4
Shallow marsh[4]	117.5	3
Shrub swamp (includes alder thicket and shrub-carr)	1,062.4	23
Total	4,669.9	100

Notes:
[1] Eggers and Reed 1997; 2014.
[2] Field data for coniferous bogs and coniferous swamps was combined.
[3] Coniferous tree species may be present within some hardwood swamps.
[4] Shallow marsh areas may contain deep marshes.

Wetlands Functional Assessment

Wetland functions and values for the non-federal lands were determined during the June 2009 and November 2010 field surveys. Wetland functions and values were evaluated at 64 sites within the five non-federal tracts (AECOM 2011b; AECOM 2011c; AECOM 2011d). The wetlands on the five non-federal lands share characteristics similar to those found on the federal lands. All wetlands on the non-federal lands were rated high for most wetland functions and values.

During the field surveys, data were collected related to the functions and values of representative wetland locations. A few survey locations were for individual wetlands, while for larger wetland complexes several locations were surveyed. An attempt was made to survey a variety of wetland types across the entire parcel (AECOM 2011b; AECOM 2011c). Survey locations for the wetland functions and values assessment are shown on Figures 4.3.3-3 through 4.3.3-4.

Table 4.3.3-5 summarizes the functional value ratings for the 64 wetlands that were evaluated for primary wetland functions rated by MnRAM 3.2. Wetlands were rated high for nearly all wetland functional values. Vegetation diversity/integrity was rated high for all wetlands. The overall rating for vegetation diversity/integrity was based on the highest rated community for vegetation diversity and integrity, rather than the average or weighted value for community vegetation diversity and integrity. MnRAM 3.2 guidance states that this is the appropriate measure for assessing wetland quality for regulatory purposes.

According to MnRAM scores (AECOM 2011b; AECOM 2011c), the following ratings were determined:

- Wetland hydrology and water quality were rated high for all wetlands, and high for all wetlands except three for downstream water quality. Most wetlands on Tracts 1 and 5 provide moderate to high flood attenuation value and most wetlands on Tracts 2, 3, and 4 provide moderate flood attenuation value, with two wetlands rated high for this function.
- Wildlife habitat was rated high for all but one wetland, as natural wildlife corridors and upland communities are relatively untouched by recent human disturbances or effects. There are no barriers to wildlife movement. Wildlife habitat was rated moderate in an area where there are few plant communities and large amounts of water.
- Fish habitat was rated high for wetlands that provide fish habitat. Fish habitat was rated as not applicable for some wetlands where the wetland does not have enough standing water throughout the year to support fish. Some other characteristics that might limit wetland value for fish would include isolated wetlands that are not permanently flooded, or forested wetlands where the water table is below the surface for all or part of the year.
- Amphibian habitat was rated high for most wetlands. This indicated that the wetland stays inundated long enough in most years to allow amphibians to successfully reproduce. Amphibian habitat was rated medium for some wetlands if ideal conditions needed to support amphibian reproduction do not occur at the parcels. Forested wetlands with little or no standing water or not enough woody vegetation during the mating season would likely not support amphibians. Wetlands with predatory fish may also not support amphibians. Other wetlands were rated not applicable for amphibian habitat, indicating that the parcel is not inundated long enough in most years to support successful breeding.

- Aesthetic, recreational, educational, and cultural values were rated medium for all but one wetland. All wetlands are aesthetically pleasing, and could be used for recreation, education, and cultural purposes. However, access by the general public access is limited to overland by foot or on snowmobile/all-terrain vehicle from Pike River Road or from USFS roads. A few wetlands have human influences on the viewshed due to close proximity to Pike River Road; however, due to their remote locations, most of the wetlands have little human influence on the viewshed.

Table 4.3.3-5 Wetland Functional Value Assessment for the Non-federal Lands

	Functional Value Ratings (%)								
Wetland Functions and Value Rating	**Vegetation Diversity/ Integrity**	**Hydrology**	**Flood Attenuation**	**Downstream Water Quality**	**Wetland Water Quality**	**Wildlife Habitat**	**Fish Habitat**	**Amphibian Habitat**	**Aesthetics/ Education/ Cultural**
High	100	100	8	97	100	98	55	69	2
Moderate	0	0	92	3	0	2	0	9	98
Low	0	0	0	0	0	0	0	6	0
Not Available or Applicable	0	0	0	0	0	0	45	16	0
Total	100	100	100	100	100	100	100	100	100

Sources: AECOM 2011b; AECOM 2011c.

4.3.3.2.2 Tract 1 – Hay Lake Lands

Hydrology, Wetland Vegetation, and Community Types

Tract 1 is moderately hilly and consists primarily of second- or third-growth deciduous and coniferous forest uplands and emergent, shrub swamp, and forested wetlands. This parcel is adjacent to the Superior National Forest (AECOM 2011b). The wetland assessment identified 2,930.8 acres of wetlands within Tract 1 (approximately 59 percent of the land area) (see Figure 4.3.3-3 and Table 4.3.3-6). The most common wetland types within Tract 1 are coniferous swamps (approximately 67 percent) and shrub swamps (approximately 24 percent), which includes both alder thickets and shrub-carr wetlands.

Table 4.3.3-6 Total Wetland Acreage by Wetland Type for Tract 1

	Total Hay Lake	
Eggers and Reed Class[1]	**Acres**	**%**
Coniferous swamp[2]	1,953.9	67
Hardwood swamp[3]	8.0	<1
Open bog	2.1	<1
Open water (includes shallow, open water, and lakes)	176.6	6
Shallow marsh[4]	84.1	3
Shrub swamp (includes alder thicket and shrub-carr)	706.1	24
Total	2,930.8	100

Notes:
[1] Eggers and Reed 1997; 2014.
[2] Field data for coniferous bogs and coniferous swamps was combined.
[3] Coniferous tree species may be present within some hardwood swamps.
[4] Shallow marsh areas may contain deep marshes.

Wetlands on Tract 1 consist primarily of early successional coniferous swamps, shrub wetlands, and open water wetlands. Hay Lake, Rice Lake, an unnamed lake, and the Pike River are the dominant water features. Large bogs dominate much of the east-central portion of Tract 1. Several wetlands were created or enlarged due to impoundment of streams by beaver dams. Raised water levels resulted in stands of dead and dying spruce along portions of the Pike River (AECOM 2011b).

Bogs within Tract 1 are dominated by leatherleaf and bog Labrador-tea, with scattered young speckled alder, bog birch, tamarack, and in some areas, narrow-leaved cattail and sedges. Sphagnum and club moss often cover 80 to 90 percent of the bog. Scattered (less than 5 percent) black spruce (some dead) and immature tamarack are found in the tree layer. Lowbush blueberry, small-fruited bog cranberry, bog rosemary, and small willows are also common. Other species encountered include cottongrass, wild iris, wild raspberry, bunchberry, and northern bog orchid (AECOM 2011b).

Emergent wetlands are primarily limited to disturbed areas on Tract 1, floodplains associated with the Pike River, wetlands associated with abandoned logging roads, transmission line ROWs, and beaver ponds. These emergent wetlands are often dominated by Canada bluejoint grass, various sedge species, and narrow-leaved cattail (70 to 80 percent cover) and generally are characterized by water depths of 1 ft or greater. Spruce, tamarack, and northern white cedar associated with these wetlands are often killed when flooded due to the rising water level behind beaver dams. Willows, tamarack, red-osier dogwood, and speckled alder are often found along the border of these wetlands, but comprised less than 30 percent of the total cover. Wild iris is encountered in some wetlands, as is horsetail, bur reed, spikerush, water arum, broad-leaved arrowhead, and woolly sedge (AECOM 2011b).

Shrub swamp wetlands usually consist of a dense (60 to 90 percent) cover of speckled alder, meadowsweet, and bog birch, with alder often 6 ft or taller in height. Some of the wetlands have scattered black spruce, tamarack, and willow saplings, but tree cover does not exceed 25 percent. Dominant low shrubs are bog Labrador-tea, leatherleaf, lowbush blueberry, prickly rose, wild raspberry, and red-osier dogwood. Mountain maple saplings are also present in a few wetlands. Herbaceous layer species include club and sphagnum mosses, woolly sedge, Canada bluejoint grass, horsetail, bunchberry, and clintonia (AECOM 2011b).

Forested wetlands (coniferous and hardwood swamps) are dominated by black spruce and tamarack, with some scattered northern white cedar, red pine, and black ash also present. Coniferous wetland forests are the most common habitat type on the parcel; deciduous and mixed forest wetlands are uncommon. In some areas with dense stands of spruce, few shrubs are seen, but sphagnum and club mosses often cover nearly 100 percent of the ground. Some open stands have an understory comprised of shrubs and scattered sapling northern white cedar, tamarack, and black spruce, along with speckled alder and willow. Mountain maple is also encountered among tree species on Tract 1, primarily in deciduous and mixed forests. Common species encountered in the shrub layer include specked alder, leatherleaf, bog Labrador-tea, lowbush blueberry, and bog birch. Species found near the ground include clintonia, bracken fern, horsetail, bunchberry, wild raspberry, cottongrass, wild sarsaparilla, wild strawberry, and false lily-of-the-valley. Forest and shrub cover typically range from 30 to 60 percent, while moss and other understory vegetation cover ranges from 50 to 90 percent (AECOM 2011b).

Wetland Functional Assessment

Table 4.3.3-7 summarizes the 30 wetland functional value ratings that were obtained for Tract 1 for the primary wetland functions rated by MnRAM 3.2. Tract 1 wetlands were rated high for nearly all wetland functional values with the exception of flood attenuation and aesthetic, recreational, educational, and cultural values.

Table 4.3.3-7 Wetland Functional Value Assessment for Tract 1

	Functional Value Ratings (%)								
Wetland Functions and Value Rating	**Vegetation Diversity/ Integrity**	**Hydrology**	**Flood Attenuation**	**Downstream Water Quality**	**Wetland Water Quality**	**Wildlife Habitat**	**Fish Habitat**	**Amphibian Habitat**	**Aesthetics/ Education/ Cultural**
High	100	100	13	93	100	97	53	87	0
Moderate	0	0	87	7	0	3	0	3	100
Low	0	0	0	0	0	0	0	10	0
Not Available or Applicable	0	0	0	0	0	0	47	0	0
Total	100	100	100	100	100	100	100	100	100

Source: AECOM 2011b.

Floodplains

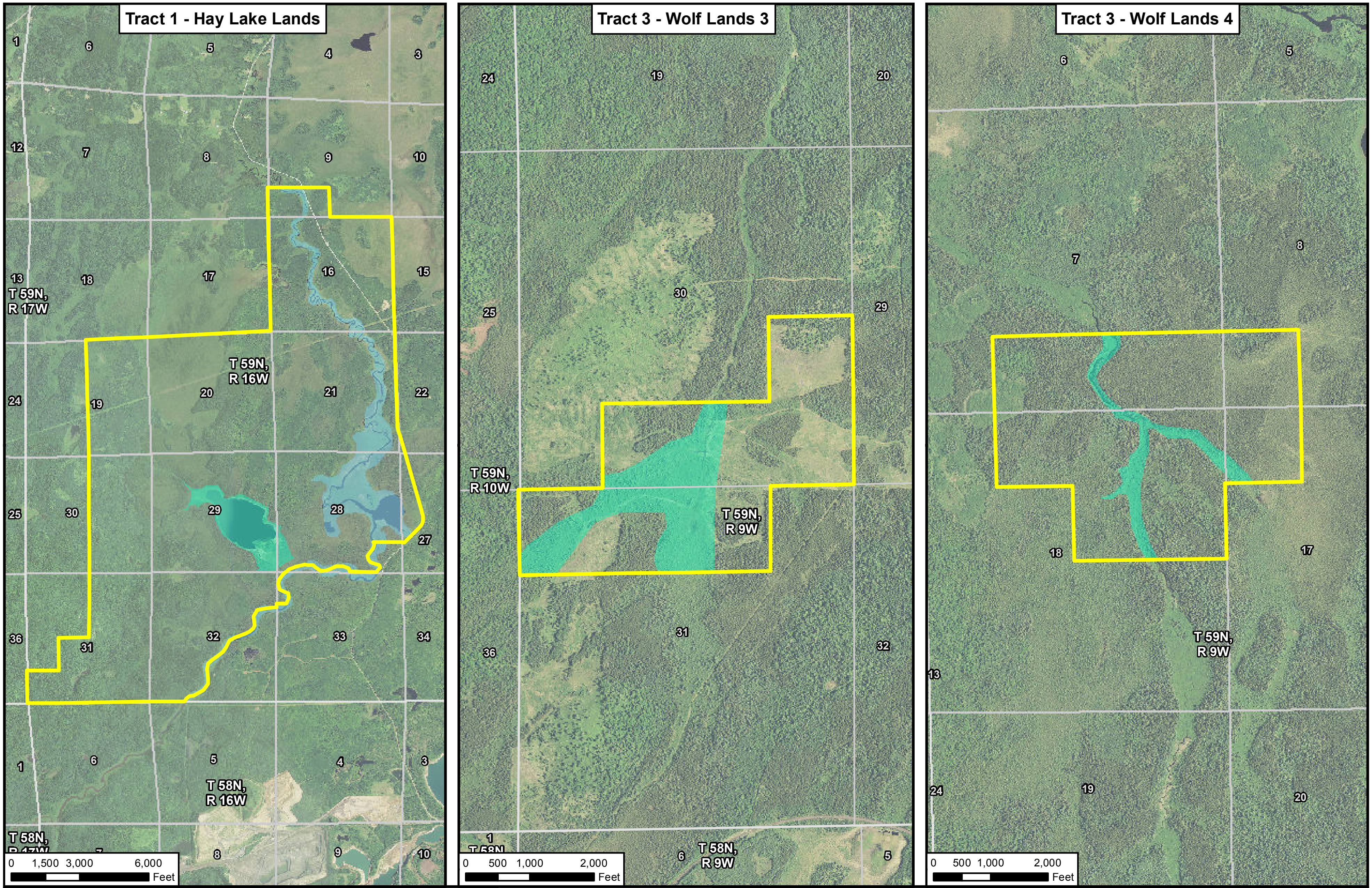
Non-federal and non-state-owned lands mapped as floodplains are regulated by a county floodplain overlay zoning district. In St. Louis County, the mapped floodplains are regulated by the County Floodplain Ordinance. The only non-federal parcel with a mapped floodplain identified in the existing effective FEMA FIRM is located in St. Louis County for Tract 1 along the Pike River. The mapped floodplain was not part of a detailed study area along the Pike River and the area of floodplain has been estimated on the FIRM. Tract 1 also has unmapped floodplains associated with Hay Lake itself (Figure 4.3.3-5) (AECOM 2011d). The mapped floodplain has been estimated to be approximately 376.2 acres, while the unmapped area including and near Hay Lake has been estimated to be approximately 175.0 acres. The total floodplain associated with Tract 1 is approximately 551.2 acres. The ratio of the number of acres of floodplain per acre of parcel for Tract 1 is 0.11.

Frontage of Waterways

Within Tract 1, Hay Lake, 96.2 acres, has a frontage of 9,894.4 ft. Rice Lake, 29.5 acres, has a frontage of 4,829.6 ft. An unnamed lake between Hay Lake and Rice Lake is 3.9 acres in area and has a frontage of approximately 1,700 ft.

The Pike River flows from the southern boundary to the northern boundary of Tract 1 and is 8.1 miles in length. Riparian habitat is found on both sides of the river for 5.7 miles, and on only one side for 2.4 miles where the river formed the boundary of the parcel. The linear distance of river frontage for Tract 1 is approximately 72,864 linear ft (AECOM 2011d).

The length of lake and river frontage per acre on Tract 1 was calculated to be 3.5 ft per acre and 15.3 ft per acre, respectively.



Non-federal Lands
Section Boundary
1 Section Label
Mapped Floodplain
Unmapped Floodplain

US Army Corps of Engineers
St. Paul District

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Figure 4.3.3-5
Floodplain Boundaries
Tract 1 and Tract 3
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

494

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4.3.3.2.3 Tract 2 – Lake County Lands

Hydrology, Wetland Vegetation, and Community Types

Tract 2 consists of 381.9 acres located in Lake County and is comprised of two parcels. Tract 2 identified 282.9 acres of wetlands (74 percent of Tract 2) (see Figure 4.3.3-3 and Table 4.3.3-8). The most common wetland types within Tract 2 are coniferous swamps (approximately 59 percent); shrub swamps (approximately 18 percent), which includes both alder thickets and shrub-carr wetlands; and hardwood swamps, which includes some coniferous swamps (approximately 16 percent). The two parcels (Lake County North and Lake County South) are nearly level and consist predominantly of second- and third-growth mixed deciduous and coniferous forest uplands and bog, emergent, shrub, and forested wetlands. Much of the Lake County South parcel has been recently logged (AECOM 2011c; AECOM 2011d).

Lake County North

The Lake County North parcel consists of 265.0 acres, of which 209.3 acres are identified as wetlands (approximately 79 percent) (see Figure 4.3.3-3 and Table 4.3.3-8). The most common wetland types within the Lake County North parcel are coniferous swamps (approximately 65 percent); shrub swamps (approximately 17 percent), which includes alder thickets and shrub-carr wetlands; and hardwood swamps, which includes some coniferous swamps (approximately 17 percent).

Table 4.3.3-8 Total Wetland Acreage by Wetland Type for Tract 2

	Lake County North		Lake County South		Total Lake County	
Eggers and Reed Class[1]	**Acres**	**%**	**Acres**	**%**	**Acres**	**%**
Coniferous swamp[2]	135.0	65	32.4	44	167.4	59
Hardwood swamp[3]	34.7	17	9.9	13	44.6	16
Open bog	1.8	1	0.0	0	1.8	1
Open water (includes shallow, open water, and lakes)	0.2	<1	2.5	3	2.7	1
Shallow marsh[4]	2.5	1	12.3	17	14.8	5
Shrub swamp (includes alder thicket and shrub-carr)	35.1	17	16.5	22	51.6	18
Total	209.3	100	73.6	100	282.9	100

Notes:
[1] Eggers and Reed 1997; 2014.
[2] Field data for coniferous bogs and coniferous swamps was combined.
[3] Coniferous tree species may be present within some hardwood swamps.
[4] Shallow marsh areas may contain deep marshes.

The Lake County North parcel has moderate topography, with the terrain generally sloping toward the southwest toward Pine Lake. This parcel consists of two smaller subparcels to the north and a single, small subparcel to the south that is adjacent to the Wolf Lands 1 parcel (see Figure 4.3.3-3). The subparcels are comprised of mostly wetland habitat, except for an area of upland habitat in the northern portion of the northern subparcel and in portions of the southern subparcel. Portions of the subparcels have recently been logged. Wetland habitat consists mostly of immature coniferous forest, with lesser amounts of mature mixed forest and shrubland (AECOM 2011c).

The Lake County North parcel encompasses several wetland types, including forested wetlands comprised of coniferous swamps and hardwood swamps, shrub swamps, and open bog/palustrine emergent wetlands, open water, and shallow marshes (collectively, emergent wetlands). Forested wetlands are comprised primarily of sapling northern white cedar and black spruce with lesser amounts of tamarack, although several drainages also contain black ash. Northern white cedar is predominant in the more southerly portions of the northern two subparcels, while black spruce is more common in the northern and northwestern portion of these two subparcels. Shrub wetland habitat is associated with several drainages, a beaver pond, a bog area, and recently logged areas, while emergent wetland habitat is found near the beaver pond and in recently logged areas. Shrub wetlands within the Lake County North parcel are dominated by speckled alder. Vegetation in the emergent wetlands consists of various sedge species and Canada bluejoint grass, with scattered black spruce, northern white cedar, tamarack, and speckled alder (AECOM 2011c).

Canopy cover in forested wetlands ranges from 50 to 80 percent and most canopy trees are 6 to 10 inches dbh. The midstory consists of balsam fir and black spruce (approximately 40 percent cover), while speckled alder, leatherleaf, and bog Labrador-tea are found in the shrub layer (40 percent cover) and club moss and sphagnum moss cover most of the ground (AECOM 2011c).

In general, the southern subparcel consists of forested wetland stands of immature black spruce and northern white cedar with northern white cedar to 20 inches dbh and black spruce to 14 inches dbh. Canopy cover is 50 percent, while the midstory cover is 60 percent and comprised of sapling balsam fir. The nearly continuous ground cover is dominated by sphagnum moss and club moss. Another immature forested wetland in the northern subparcel includes black ash trees to 16 inches dbh (AECOM 2011c).

Shrub and emergent wetland habitats are also found on the subparcels. Shrub wetland habitat is associated with several drainages, a beaver pond, a bog area, and recently logged areas, while emergent wetland habitat is found near the beaver pond and in recently logged areas. Shrub wetlands are dominated by speckled alder (to 80 percent cover). Two wetlands are classified as shrub wetlands because speckled alder covered 70 percent of the area, but the wetlands also have open bog characteristics since bog Labrador-tea also covers 70 to 80 percent of the wetlands, and sphagnum moss covers most of the ground. Scattered sapling black spruce, northern white cedar, and red-osier dogwood are also found in these wetlands. Vegetation in the emergent wetlands consists of various sedge species and Canada bluejoint (40 percent cover), with scattered black spruce, northern white cedar, tamarack, and speckled alder (AECOM 2011c).

Lake County South

The Lake County South parcel consists of 116.9 acres, of which 73.6 acres are identified as wetlands (approximately 63 percent) (see Figure 4.3.3-3 and Table 4.3.3-8). The most common wetland types within the Lake County South parcel are coniferous swamps (approximately 44 percent); shrub swamps (approximately 22 percent), which includes both alder thickets and shrub-carr wetlands; shallow marshes (approximately 17 percent); and hardwood swamps (approximately 13 percent).

Lake County South is relatively flat in the northwestern section, rises in elevation to the northeast, and then falls in elevation to the southeast. Water flows from west to east. At the time of the survey, a series of beaver dams and ponds dominated the landscape, as did areas that had been recently logged. Although shrubland dominates upland habitats, several habitat types comprise wetland habitats within this parcel (AECOM 2011c).

Forested wetlands dominate the western and southeastern portions of the parcel and are comprised of black spruce and northern white cedar. However, tamarack is found in some forest stands and black ash is an important component of several drainages. The overstory cover is about 50 to 70 percent, while the midstory coverage of balsam fir and black spruce is about 20 percent. Speckled alder, leatherleaf, bog Labrador-tea, and red-osier dogwood are common shrubs (to 80 percent cover), while sphagnum moss covers most of the ground. Forests in the northwestern section contain a dense mix of northern white cedar and black spruce with scattered black ash in the canopy (50 percent cover), and black spruce, northern white cedar, balsam fir, and speckled alder in the midstory and shrub layer (80 percent cover). Five beaver ponds were found on the parcel creating wetlands, which are comprised of open water with scattered dead spruce. These open-water wetlands are surrounded by emergent wetlands dominated by various sedge species, narrow-leaved cattail, woolgrass, and Canada bluejoint grass, or by dense stands of speckled alder in more shallow areas (AECOM 2011c).

Wetland Functional Assessment

Table 4.3.3-9 summarizes the 13 wetland functional value ratings (8 Lake County North and 5 Lake County South) that were obtained for Tract 2 for the primary wetland functions rated by MnRAM 3.2. Tract 2 wetlands were rated high for nearly all wetland functional values with the exception of flood attenuation and aesthetic, recreational, educational, and cultural values.

Table 4.3.3-9 Wetland Functional Value Assessment for Tract 2

Wetland Functions and Value Rating	Functional Value Ratings (%)								
	Vegetation Diversity/ Integrity	Hydrology	Flood Attenuation	Downstream Water Quality	Wetland Water Quality	Wildlife Habitat	Fish Habitat	Amphibian Habitat	Aesthetics/ Education/ Cultural
Lake County North									
High	100	100	0	100	100	100	63	63	0
Moderate	0	0	100	0	0	0	0	0	100
Low	0	0	0	0	0	0	0	0	0
Not Available or Applicable	0	0	0	0	0	0	37	37	0
Total	100	100	100	100	100	100	100	100	100
Lake County South									
High	100	100	0	100	100	100	60	60	20
Moderate	0	0	100	0	0	0	0	0	80
Low	0	0	0	0	0	0	0	0	0
Not Available or Applicable	0	0	0	0	0	0	40	40	0
Total	100	100	100	100	100	100	100	100	100

Source: AECOM 2011c.

Floodplains

Lake County has an older Flood Hazard Boundary Map developed by the HUD to estimate the areas of frequent inundation. FEMA rescinded the map in 1985 and is not considered to be an effective FEMA FIRM map; therefore, it is not used as part of the management of flood-prone areas. Lake County does not have a floodplain overlay ordinance; therefore, there are no "regulatory floodplains" within Lake County. While the floodplains identified using the older map are not considered to be the effective FEMA FIRM maps of flood-prone areas, they can offer an approximation of floodplains within the county for the effects analysis.

Mapped floodplain identification for the effects analysis of non-federal lands in Lake County was done using this older, rescinded map and it was determined that Tract 2 has no mapped or unmapped floodplains.

Frontage of Waterways

Tract 2 does not include any streams, rivers, creeks, or lakes.

4.3.3.2.4 Tract 3 – Wolf Lands

Hydrology, Wetland Vegetation, and Community Types

Tract 3 consists of a total of 1,575.8 acres located in Lake County and is comprised of four individual parcels. A total of 1,392.6 acres (88 percent) of wetlands were identified within Tract 3 (see Figures 4.3.3-3 and 4.3.3-4, and Table 4.3.3-10). The most common wetland types within the Wolf Lands are coniferous swamps (approximately 79 percent) and shrub swamps (approximately 20 percent), which includes alder thickets and shrub-carr wetlands. The four parcels are nearly level and consist predominantly of second- and third-growth mixed deciduous and coniferous forested uplands and bog, emergent, shrub, and forested wetlands. Much of the area of the parcels comprising the Wolf Lands has been recently logged (AECOM 2011c; AECOM 2011d).

Table 4.3.3-10 Total Wetland Acreage by Wetland Type for Tract 3

Eggers and Reed Class[1]	Wolf Lands 1		Wolf Lands 2		Wolf Lands 3		Wolf Lands 4		Total Wolf Lands	
	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
Coniferous swamp[2]	75.4	84	627.4	89	82.6	35	320.3	88	1,105.7	79
Hardwood swamp[3]	0.0	0	5.0	1	0.0	0	0.0	0	5.0	<1
Open bog	3.0	3	0.0	0	0.0	0	0.2	<1	3.2	<1
Open water (includes shallow, open water, and lakes)	0.0	0	0.4	<1	0.0	0	0.0	0	0.4	<1
Shallow marsh[4]	0.0	0	0.4	<1	5.2	2	0.0	0	5.6	<1
Shrub swamp (includes alder thicket and shrub-carr)	12.0	13	73.0	10	145.4	63	42.3	12	272.7	20
Total	90.4	100	706.2	100	233.2	100	362.8	100	1,392.6	100

Notes:
[1] Eggers and Reed 1997; 2014.
[2] Field data for coniferous bogs and coniferous swamps was combined.
[3] Coniferous tree species may be present within some hardwood swamps.
[4] Shallow marsh areas may contain deep marshes.

Wolf Lands 1

The Wolf Lands 1 parcel consists of 122.8 acres, of which 90.4 acres are mapped as wetlands (approximately 72 percent) (see Figure 4.3.3-3 and Table 4.3.3-10). The most common wetland types within this parcel are coniferous swamps (approximately 84 percent) and shrub swamps (approximately 13 percent), which includes alder thickets and shrub-carr wetlands.

Most of the upland habitat consists of mature mixed forest, while most wetland habitats consist of coniferous forest. The parcel is relatively flat but slopes gently downward toward the southwest. The Wolf Lands 1 parcel is adjacent to Lake County North (AECOM 2011c). The eastern half of the parcel is wetland, while upland comprises most of the western portion of the parcel. Pine Lake is about 0.5 mile northwest of the parcel (AECOM 2011c).

Immature forested wetland communities on the parcel are comprised primarily of black spruce, with scattered northern white cedar and tamarack. More mature forested wetlands have characteristics of more open bogs, as tree cover is sparse at about 30 percent, while 80 percent of the area is covered by bog Labrador-tea and leatherleaf, and sphagnum moss covers most of the ground. In more immature forests, tree cover ranges from 60 to 80 percent, with a canopy dominated by 6 to 10 inches dbh black spruce, with tamarack and northern white cedar also present. The midstory consists of balsam fir and black spruce (about 40 percent cover), while speckled alder, leatherleaf, bog Labrador-tea, and red-osier dogwood dominate the shrub layer (40 percent cover) and club moss and sphagnum moss cover most of the ground (AECOM 2011c).

Wolf Lands 2

The Wolf Lands 2 parcel consists of 767.9 acres, of which 706.2 acres are mapped as wetlands (approximately 92 percent) (see Figure 4.3.3-4 and Table 4.3.3-10). The most common wetland types within Wolf Lands 2 are coniferous swamps (approximately 89 percent) and shrub swamps (approximately 10 percent), which includes both alder thickets and shrub-carr wetlands.

The Wolf Lands 2 parcel, which slopes toward the southwest, can generally be characterized by gently undulating terrain. Overland water flows to the southwest and to Mary Ann Creek, Wenho Creek, and Greenwood Lake. The Wolf Lands 2 parcel consists primarily of forested wetlands comprised of black spruce and northern white cedar, with a black ash component in a few drainages; shrubland comprised of speckled alder is also common on the parcel. Most upland habitat consists of mixed forest. Several drainages are dominated by speckled alder, while emergent wetland habitat is associated with beaver ponds. Black spruce is the dominant tree in wetlands in the northern and eastern portions of the parcel, while northern white cedar is more prevalent in other portions of the parcel (AECOM 2011c).

Forested wetlands are of three types: black spruce dominant, a mix of black spruce and northern white cedar, or northern white cedar dominant. Canopy trees range from four to eight inches dbh, with total canopy cover from 70 to 80 percent. The midstory consists of sapling black spruce, northern white cedar, and balsam fir. Midstory cover is patchy, ranging from 10 to 40 percent. Bog Labrador-tea comprises 10 to 30 percent of the low shrub cover, while sphagnum moss often covers more than 80 percent of the ground. In areas with a dense canopy, the midstory and ground cover are poorly developed (AECOM 2011c).

Several drainages are dominated by shrub swamp vegetation. These parcels generally have a sparse overstory, with approximately 20 percent aerial cover of black spruce, northern white cedar, and tamarack. Speckled alder and sapling trees usually cover 60 percent or more of the midstory, while low shrub cover consists of bog Labrador-tea (40 to 60 percent cover) (AECOM 2011c).

Beaver dams and ponds were found in the southeastern portion of the parcel during the field survey. Typically, open water is adjacent to the dams, with emergent wetland surrounding the open water and shrub wetlands upstream of the dams (AECOM 2011c).

Wolf Lands 3

The Wolf Lands 3 parcel consists of 277.4 acres, of which about 233.2 acres are mapped as wetlands (approximately 84 percent) (see Figure 4.3.3-4 and Table 4.3.3-10). The most common wetland types within the Wolf Lands 3 parcel are shrub swamps (approximately 63 percent), which includes alder thickets and shrub-carr wetlands, and second most common are coniferous swamps (approximately 35 percent).

The Wolf Lands 3 parcel is relatively flat. Coyote Creek begins its flow north within the parcel. Uplands consist of mostly shrubland and deciduous forest, while wetlands are dominated by shrub wetland and coniferous forested wetland habitats (AECOM 2011c). About half of the parcel had been recently logged. Logged wetlands are dominated by grasses, forbs, and low-growing shrubs, including red-osier dogwood and speckled alder. In the unlogged areas, forested wetlands are comprised primarily of black spruce. In the northern portion of the parcel, black spruce is co-dominant with tamarack; in the rest of the parcel, tamarack is present in the canopy but in much lower quantity (AECOM 2011c).

In shrub swamp wetlands, speckled alder covers from 20 to 80 percent of the area. In some areas, bog Labrador-tea covers 80 to 90 percent of the ground, especially in areas with a dense cover of speckled alder. In areas with a lower density of speckled alder, grasses, forbs, and ferns are the dominant vegetation, but due to snow cover at the time of survey, it was not possible to determine percent ground cover or species composition. Scattered sapling black spruce and paper birch are also seen on logged wetlands. Woody debris from the recent logging operations is abundant in logged areas (AECOM 2011c).

In the unlogged areas, wetland forests are comprised of black spruce. In the northern part of the parcel, the black spruce is co-dominant with tamarack; in the rest of the parcel, tamarack is present in the canopy but in much lower amounts. Total canopy cover ranges from 60 to 80 percent, with canopy trees ranging from 4 to 10 inches dbh. The midstory consists of balsam fir and black spruce (20 to 30 percent cover), while the shrub layer is dominated by bog Labrador-tea (80 percent), over a ground layer of nearly continuous (80 percent cover or more) sphagnum moss with scattered grasses and forbs (AECOM 2011c).

Coyote Creek is bordered by an emergent sedge meadow wetland complex comprised of sedges, narrow-leaved cattail, and Canada bluejoint (collectively about 90 percent cover). There is also scattered sapling tamarack and northern white cedar, as well as scattered patches of speckled alder and bog Labrador-tea. The emergent wetland is bordered by dense (80 percent cover) speckled alder. Water depth in the emergent and shrub wetlands is approximately 18 to 24 inches (AECOM 2011c).

Logging roads on the parcel have become emergent wetland habitat dominated by narrow-leaved cattail, woolgrass, Canada bluejoint, scattered sedges, and speckled alder. Herbaceous vegetation covers about 70 to 80 percent of the wetland area, while alder shrubs cover approximately 10 percent of the wetlands (AECOM 2011c).

Wolf Lands 4

The Wolf Lands 4 parcel consists of 404.7 acres of which 362.8 acres are mapped as wetlands (approximately 90 percent) (see Figure 4.3.3-4 and Table 4.3.3-10). The most common wetland types within the Wolf Lands 4 parcel are coniferous swamps (approximately 88 percent) and shrub swamps (approximately 12 percent).

Coyote Creek bisects the parcel, while the Stony River is about 2,000 ft northwest of the parcel. Timber harvests recently occurred along the western border of the parcel. Upland habitats consist primarily of mature deciduous forest, while forested and shrub wetland community types dominate wetland habitats (AECOM 2011c).

Wetland types include coniferous forest, shrub wetlands, and emergent. Black spruce forests are the most prevalent community type in the northern half of the parcel, while northern white cedar is more prevalent in the southern half of the parcel. Emergent wetland communities that include various species of sedge, Canada bluejoint grass, and shrub wetlands comprised primarily of speckled alder are found in floodplains that border Coyote Creek. Shrub wetlands also occur in two drainages to Coyote Creek in the southeastern portion of the parcel and in a drainage to the Stony River in the northeastern portion of the parcel (AECOM 2011c).

Coniferous wetlands composed of black spruce and black spruce/northern white cedar are dominated by trees ranging from four to eight inches dbh, with a patchy canopy cover of about 50 percent. Scattered tamaracks are also found in these wetlands. The low shrub layer is nearly continuous (80 to 90 percent cover), and is comprised of leatherleaf, bog Labrador-tea, and other vegetation. Sphagnum and club mosses cover most of the ground. Other forests have a more developed midstory, with 60 percent cover by black spruce, northern white cedar, tamarack, and speckled alder, and a similarly dense shrub layer, with 60 to 70 percent cover by leatherleaf and bog Labrador-tea (AECOM 2011c).

Shrub wetlands are dominated by speckled alder (60 to 80 percent cover), with scattered black spruce, tamarack, and northern white cedar in the overstory. Leatherleaf and bog Labrador-tea cover about 40 to 50 percent of the shrub layer (AECOM 2011c).

Wetland Functional Assessment

Table 4.3.3-11 summarizes the 18 wetland functional value ratings (three for Wolf Lands 1, six for Wolf Lands 2, six for Wolf Lands 3, and three for Wolf Lands 4) that were obtained for Tract 3 for the primary wetland functions rated by MnRAM 3.2. Tract 3 wetlands were rated high for nearly all wetland functional values with the exception of flood attenuation on Wolf Lands 2, 3, and 4; amphibian habitat on Wolf Lands 3; and aesthetic, recreational, educational, and cultural values for all four sub-parcels.

Table 4.3.3-11 Wetland Functional Value Assessment for Tract 3

Wetland Functions and Value Rating	Functional Value Ratings (%)								
	Vegetation Diversity/ Integrity	**Hydrology**	**Flood Attenuation**	**Downstream Water Quality**	**Wetland Water Quality**	**Wildlife Habitat**	**Fish Habitat**	**Amphibian Habitat**	**Aesthetics/ Education/ Cultural**
Wolf Lands 1									
High	100	100	100	100	100	100	67	67	0
Moderate	0	0	0	0	0	0	0	0	100
Low	0	0	0	0	0	0	0	0	0
Not Available or Applicable	0	0	0	0	0	0	33	33	0
Total	100	100	100	100	100	100	100	100	100
Wolf Lands 2									
High	100	100	20	100	100	100	33	33	0
Moderate	0	0	80	0	0	0	0	0	100
Low	0	0	0	0	0	0	0	0	0
Not Available or Applicable	0	0	0	0	0	0	67	67	0
Total	100	100	100	100	100	100	100	100	100
Wolf Lands 3									
High	100	100	0	100	100	100	50	33	0
Moderate	0	0	100	0	0	0	0	33	100
Low	0	0	0	0	0	0	0	17	0
Not Available or Applicable	0	0	0	0	0	0	50	17	0
Total	100	100	100	100	100	100	100	100	100
Wolf Lands 4									
High	100	100	0	100	100	100	33	100	0
Moderate	0	0	100	0	0	0	0	0	100
Low	0	0	0	0	0	0	0	0	0
Not Available or Applicable	0	0	0	0	0	0	67	0	0
Total	100	100	100	100	100	100	100	100	100

Source: AECOM 2011c.

Floodplains

As previously indicated, there are no mapped floodplains in Lake County; therefore, there are no mapped floodplains on the Wolf Lands tracts. However, the extent of unmapped floodplains along Coyote Creek for Tract 3 was made based upon topography and estimated to be 112.2 acres (see Figure 4.3.3-5). Wolf Lands 3 was estimated to have 32.8 acres of floodplains and Wolf Lands 4 was estimated to have 79.4 acres. The ratio of the number of acres of floodplain per acre of parcel is 0.1 and 0.2, respectively (AECOM 2011d).

Frontage of Waterways

Coyote Creek begins in Wolf Lands 3, flows north into Wolf Lands 4, and continues north of Wolf Lands 4. The creek is 0.1 mile in length in Wolf Lands 3, and 0.9 miles in length in Wolf Lands 4. Riparian habitat is found on both sides of the river. The linear distance of river frontage for Wolf Lands 3 and Wolf Lands 4 is 1,056.0 and 9,504 linear ft, respectively. The length of river frontage per acre on Wolf Lands 3 and Wolf Lands 4 was calculated to be 3.8 and 23.5 ft, respectively.

4.3.3.2.5 Tract 4 – Hunting Club Lands

Hydrology, Wetland Vegetation, and Community Types

Tract 4 consists of 160.2 acres, of which 63.6 acres are mapped as wetland (approximately 40 percent) (see Figure 4.3.3-4 and Table 4.3.3-12). The most common wetland types within Tract 4 are shrub swamps (approximately 50 percent), which includes alder thickets and shrub-carr wetlands; coniferous swamps (approximately 24 percent); and shallow marshes (approximately 20 percent). The parcel is nearly level and consists predominantly of second- and third-growth deciduous and mixed deciduous and coniferous forested uplands and emergent, shrub, and forested wetlands (AECOM 2011c).

Table 4.3.3-12 Total Wetland Acreage by Wetland Type for Tract 4

	Total Hunting Club	
Eggers and Reed Class[1]	**Acres**	**%**
Coniferous swamp[2]	15.4	24
Hardwood swamp[3]	0.4	1
Open bog	0.0	0
Open water (includes shallow, open water, and lakes)	2.8	5
Shallow marsh[4]	13.0	20
Shrub swamp (includes alder thicket and shrub-carr)	32.0	50
Total	63.6	100

Notes:
1 Eggers and Reed 1997; 2014.
2 Field data for coniferous bogs and coniferous swamps was combined.
3 Coniferous tree species may be present within some hardwood swamps.
4 Shallow marsh areas may contain deep marshes.

A wetland complex bisects the parcel and drains to the north and then northeast. From this low area, the land slopes upward to the east and west. Several beaver dams were found during field surveys along the creek on or near the parcel. The parcel consists primarily of wetland shrublands, with lesser amounts of emergent and shrub wetlands and upland deciduous forests (AECOM 2011c).

Beaver ponds and dams are the dominant wetland features on the parcel. Open water habitat is typical near the dams. Emergent vegetation, consisting of Canada bluejoint grass, narrow-leaved cattail, and various sedge species, are found in water from 12 to 24 inches deep, while speckled alder shrub wetlands are located near ponds at water depths from 6 to 18 inches. A large black spruce forest is located in the middle of the parcel. Overstory cover is about 60 percent, with most of the cover resulting from black spruce, with scattered tamarack occasionally present. The midstory consists of speckled alder (50 percent cover), while leatherleaf and bog Labrador-tea (80 percent cover) and sphagnum moss (about 80 percent cover) are found below the speckled alder (AECOM 2011c).

Wetland Functional Assessment

Table 4.3.3-13 summarizes the three wetland functional value ratings that were obtained for Tract 4 for the primary wetland functions rated by MnRAM 3.2. Tract 4 wetlands were rated high for nearly all wetland functional values with the exception of flood attenuation, amphibian habitat, and aesthetic, recreational, educational, and cultural values.

Table 4.3.3-13 Wetland Functional Value Assessment for Tract 4

	Functional Value Ratings (%)								
Wetland Functions and Value Rating	**Vegetation Diversity/ Integrity**	**Hydrology**	**Flood Attenuation**	**Downstream Water Quality**	**Wetland Water Quality**	**Wildlife Habitat**	**Fish Habitat**	**Amphibian Habitat**	**Aesthetics/ Education/ Cultural**
High	100	100	0	100	100	100	100	33	0
Moderate	0	0	100	0	0	0	0	33	100
Low	0	0	0	0	0	0	0	0	0
Not Available or Applicable	0	0	0	0	0	0	0	33	0
Total	100	100	100	100	100	100	100	99	100

Source: AECOM 2011c.

Floodplains

Tract 4 is located within St. Louis County, where there are no mapped floodplains identified on the county’s FIRM. There were no unmapped floodplains associated with Tract 4.

Frontage of Waterways

Tract 4 does not include any streams, rivers, creeks, or lakes.

4.3.3.2.6 Tract 5 – McFarland Lake Lands

Hydrology, Wetland Vegetation, and Community Types

Tract 5 is a single parcel of 30.8 acres. The entire parcel is mapped as upland. The parcel is approximately 3 miles west of the U.S.-Canada border. This parcel is mostly on a hill slope and consists of second- and third-growth deciduous and coniferous forested uplands. There are no wetlands located on Tract 5. This parcel is surrounded by the Superior National Forest. McFarland Lake borders Tract 5 and provides lake habitat (AECOM 2011b).

Wetland Functional Assessment

No wetlands are associated with Tract 5; therefore, there are no functional assessment values.

Floodplains

Cook County has an older Flood Hazard Boundary Map developed by the HUD to estimate the areas of frequent inundation. FEMA rescinded the map in 1985 and is not considered to be an effective FEMA FIRM map; therefore, it is not used as part of the management of flood-prone areas. Cook County does not have a floodplain overlay ordinance; therefore, there are no "regulatory floodplains" within Cook County. While the floodplains identified using the older map are not considered to be the effective FEMA FIRM maps of flood-prone areas, they can offer an approximation of floodplains within the county for the effects analysis.

Mapped floodplain identification for the effects analysis of non-federal lands in Cook County was done using this older, rescinded map and it was determined that Tract 5 has no mapped or unmapped floodplains.

Frontage of Waterways

Tract 5 borders McFarland Lake. The parcel has a lake frontage of approximately 990 ft along McFarland Lake. The length of lake frontage per acre on Tract 5 was calculated to be 32.1 ft.

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4.3.4 Vegetation

Rulemaking was conducted with the intent to update the list of ETSC species (*Minnesota Rules*, parts 6134.0100 to 6134.0400), with new listings becoming effective on August 19, 2013 (MDNR 2013h). This FEIS considers any new listings, or changes in the previous listings, associated with the updated list. A BE has been prepared that contains further information about RFSS. The BE is included in Appendix D and is posted on the USFS website (http://www.fs.usda.gov/goto/superior/northmet).

4.3.4.1 Federal Lands

The federal lands include a large tract of mostly forested land, up to 6,495.4 acres in size. The tract is located in the west-central part of the Superior National Forest (PolyMet 2015a).

4.3.4.1.1 Land Exchange Proposed Action

<u>Cover Types</u>

Cover types consist of several categories of classification, including MDNR GAP land cover types, specific plant community survey results, MBS Sites of Biodiversity Significance, SNAs, USFS Management Areas, USFS ELTs, USFS MIH types, and USFS landscape ecosystems.

Habitat Types

The federal land cover types are similar to the Mine Site described in Section 4.2.4.2.1 (see Figure 4.2.4-1). Specific acreages for MDNR GAP land cover types on the federal lands are presented in Table 4.3.4-1 below. In the past, portions of the federal lands have been logged to varying degrees, depending on the management area allocation. The MDNR GAP land cover types below may not fully represent the extent of mixed forest types, since the cover type level below is fairly specific, so there may be more mixed forest types than indicated.

Table 4.3.4-1 Federal Lands Cover Types

Cover Types	Total Acres	Percent of Area
Lowland coniferous forest[1]	2,978.6	46
Upland coniferous forest[2]	1,618.9	25
Upland deciduous forest[3]	1,091.8	17
Shrubland	645.6	10
Disturbed	63.8	1
Aquatic environments	60.1	1
Upland conifer-deciduous mixed forest[4]	20.9	<1
Lowland deciduous forest[5]	9.5	<1
Cropland/grassland	6.2	<1
Total	**6,495.4**	**100**

Source: MDNR 2006b.

Notes:
[1] Includes lowland black spruce, lowland northern white cedar, and tamarack forest cover types.
[2] Includes pine and spruce/fir forest cover types.
[3] Includes aspen/aspen-white birch, maple/basswood, and oak forest cover types.
[4] Includes all mixed coniferous-deciduous forest cover types.
[5] Includes black ash forest cover types.

Plant Community Surveys

Wetlands are dominated by immature black spruce and northern white cedar, with scattered tamarack (*Larix laricina*) and aspen (AECOM 2011d). There are several areas of open water, including Mud Lake, the Partridge River, Yelp Creek, and scattered small ponds. Bogs are dominated by leatherleaf (*Chamaedaphne calyculata*) and bog-Labrador tea (*Ledum groenlandicum*). Uplands are dominated by immature mixed pine-hardwood forests, including jack pine, black spruce, trembling aspen (*Populus tremuloides*), paper/white birch (*Betula papyrifera*), and balsam fir. Grassland/shrubland habitat is uncommon and is primarily associated with the transmission line ROW in the western portion and recent logging in the southeastern portion of the federal lands. Disturbed areas are associated with roads and landings, waste rock storage areas immediately north of the federal lands, and a rail route along the southern portion of the federal lands.

The majority of forest stand trees on the federal lands are characterized as immature, or 12 inches dbh or less, which corresponds to trees from 10 to 60 years in age (AECOM 2011d). For both coniferous and deciduous trees, the largest ones are approximately 18 to 20 inches dbh, but a 24-inch dbh red pine was found on the federal lands. Much of the One Hundred Mile Swamp north and west of the Mine Site consists of mature (80-plus years in age) black spruce and northern white cedar.

Of the wetlands that are located on the federal lands, the majority are determined to have high overall quality due to minimal or no current disturbance (AECOM 2011a). Of the wetlands that are located on the Mine Site, the majority (92 percent) is rated as having a high overall wetland quality and 8 percent are of moderate overall wetland quality. Wetlands on the federal lands are rated high for nearly all wetland functions, based on the MnRAM 3.2 criteria (AECOM 2011d). Vegetation diversity and integrity are rated moderate to high for all wetlands because recent human contact and alteration are minimal and the wetlands have a relatively constant supply of water. See Section 4.3.3 for a more detailed discussion on wetlands.

Minnesota Biological Survey

The majority (6,142.7 acres) of the federal lands consist of MBS Sites of High Biodiversity Significance, including the One Hundred Mile Swamp site (53 percent of federal lands) and the Upper Partridge River site (41 percent of federal lands). The Upper Dunka Peatlands site (less than 1 percent of federal lands) is a Site of Moderate Biodiversity Significance and is also located on the federal lands (see Figure 4.2.4-1) (MDNR 2008a). These sites are located in the Laurentian Uplands subsection.

Three vegetation communities, white pine-red pine forest (FDn43a; less than 1 percent of federal lands), black spruce-Jack pine woodlands (FDn32c; 17 percent of federal lands), and rich black spruce swamps (FPn62a; 5 percent of federal lands) have been characterized by the MBS as "imperiled," "imperiled/vulnerable," and "vulnerable" native plant communities, respectively (MDNR 2008b). Black ash-conifer swamps (WFn64a), black spruce bogs (APn80a), graminoid bogs (APn90b1), poor tamarack-black spruce swamps (APn81b), and white cedar swamps (FPn63a) are ranked as "apparently secure" in Minnesota based on abundance, distribution, trends, and threats. Aspen-birch forests: balsam fir subtype (FDn43b1), alder swamps (FPn73a), poor black spruce swamps (APn81a), rich tamarack-alder swamps (FPn82a), willow-dogwood shrub swamps (WMn82a), and low shrub poor fens (APn91a) are all considered "widespread and secure."

Scientific and Natural Areas

Similar to the Mine Site, there are no lands designated or nominated for designation as SNAs on the federal lands (MDNR 2006c; Wilson, MDNR, Pers. Comm., February 14, 2012).

Culturally Important Plants

Natural resources culturally important to the Bands are discussed in Section 4.2.9.3.3.

Management Areas

The USFS manages its forests by assigning various management area allocations. The federal lands are currently managed under the General Forest – Longer Rotation Management Area (95 percent) and the General Forest Management Area (5 percent) (see Table 4.3.4-2) (USFS 2011j). Section 4.3.1 describes the management areas in detail.

Table 4.3.4-2 Management Areas for the Federal Lands

Category	Federal Lands Acres	Federal Lands Percent
General Forest	355.3	5
General Forest – Longer Rotation	6,140.1	95
Potential/Candidate Research Natural Areas	0.0	0
Riparian Areas	0.0	0

Source: USFS 2011j.

Ecological Land Types

USFS ELT data for the federal lands are not fully developed, but provide data for over half of the parcel. The federal lands contain five different categories of ELTs, including Lowland Loamy

Moist (ELT 1), Lowland Loamy Wet (ELT 2), Lowland Organic Acid to Neutral (ELT 6), Upland Deep Loamy Dry Coarse (ELT 13), and Upland Shallow Loamy Dry (ELT 16). Almost all of the federal lands are included within the Big-Bird Lake Moraine LTA, with the small remaining portion included in the Mesabi Range LTA.

Management Indicator Habitats

As mentioned previously, the USFS also tracks MIH types. The most abundant MIH type on the federal lands is lowland black spruce-tamarack forest (MIH 9; 3,060.2 acres), but upland forest (MIH 1; 1,330.0 acres) and upland conifer forest (MIH 5; 1,252.4 acres) is also present (see Table 4.3.4-3) (USFS 2010b). Aquatic habitats (MIH 14) are not tracked on the federal lands, though several open water features occur on the federal lands (see Figure 4.2.4-3). Though not considered MIH types, the federal lands contain 492.3 acres of lowland shrub habitat and 185.5 acres of lowland emergent wetlands, as well. The remaining acres present on the federal lands have no corresponding MIH classification.

The USFS Forest Stand data also contain information about forest stand ages. The majority of the federal lands consist of mature (3,854.2 acres) forest stands, with smaller amounts of immature (1,539.2 acres) stands and young (271.1 acres) stands (USFS 2011i). Additionally, the USFS tracks large (greater than 300 acres) contiguous patches of mature upland forest (MIH 13) on the Superior National Forest. There are currently no patches of mature upland forest over 300 acres on the federal lands (USFS 2012c). However, since smaller patches will grow over time into larger contiguous patches, the USFS predicts that in 2020, there would be two patches (707.8 acres and 322.1 acres) over 300 acres on the federal lands (USFS 2012d).

Table 4.3.4-3 MIH Types and Age Classes (Acres) for the Federal and Non-federal Lands

MIH Type	Total of Federal Lands[1]	Total of Non-federal Lands[2]	Tract 1 – Hay Lake	Tract 2 – Lake County North	Tract 2 – Lake County South	Tract 3 – Wolf 1	Tract 3 – Wolf 2	Tract 3 – Wolf 3	Tract 3 – Wolf 4	Tract 4 - Hunting Club	Tract 5 - McFarland Lake
MIH 1	1,330.0	2,694.5	2,366.0	49.1	2.1	43.8	56.8	40.9	20.4	89.3	26.1
MIH 5	1,252.4	79.9	54.2	1.1	0.0	0.0	7.9	0.0	0.0	12.7	4.0
MIH 9	3,060.2	3,308.5	1,817.6	193.7	46.2	72.2	626.6	186.2	348.9	17.1	0.0
MIH 14	0.0	226.7	206.2	0.5	3.3	0.0	0.5	0.9	4.3	10.3	0.7
Lowland Shrub	492.3	332.2	113.3	20.6	6.4	9.7	76.0	48.6	31.0	26.6	0.0
Lowland Emergent	185.5	385.7	365.0	0.0	15.6	0.0	0.0	0.9	0.0	4.2	0.0
Upland Grass	0.0	43.3	0.0	0.0	43.3	0.0	0.0	0.0	0.0	0.0	0.0
Age Class											
Young	271.1	778.2	533.8	24.4	43.3	2.2	7.6	130.4	9.5	27.0	0.0
Immature	1,539.2	3,539.7	3,259.8	74.6	0.8	76.1	68.7	21.8	5.4	32.5	0.0
Mature	3,854.2	1,824.6	460.2	144.9	47.6	37.8	615.1	74.9	354.3	59.7	30.1

Sources: USFS 2010b; USFS 2011i.

Note:
[1] Determined based on: AECOM 2011c; AECOM 2011b; USFS 2010b; USFS 2011i.

Landscape Ecosystems

In order for the USFS to sustainably and ecologically manage National Forest System lands, it must consider areas based on historical and current ecosystem functions. The USFS tracks and manages the Superior National Forest and other National Forest System lands on several levels, but to maintain a broader ecosystem view it uses a landscape ecosystem basis. A landscape ecosystem is an area that shares similar habitat composition, structure, and functions and occurs naturally on the landscape (USFS 2004a). The federal lands are located within three landscape ecosystem types, including Jack Pine-Black Spruce, Lowland Conifer, and Mesic Red and White Pine (see Table 4.3.4-4).

The Jack Pine-Black Spruce landscape ecosystem occupies 3,000.1 acres of the federal lands (represents less than 0.01 percent of Jack Pine-Black Spruce landscape ecosystem). It is dominated by both jack pine and black spruce, but aspen and paper birch are also occasionally present (USFS 2004a). Typically, jack pine dominates areas after fire disturbances and black spruce dominates areas after wind disturbances.

The Lowland Conifer landscape ecosystem occupies 3,460.3 acres of the federal lands (represents 0.01 percent of Lowland Conifer landscape ecosystem). It is dominated by one or all three species of black spruce, tamarack, and northern white cedar (USFS 2004a). Typically, black spruce occupies acidic organic soils, northern white cedar occupies neutral sites, and tamarack occupies areas between both types. Fire disturbances are more frequent than wind disturbances.

The Mesic Red and White Pine landscape ecosystem occupies less than one acre of the federal lands (represents less than 0.01 percent of Mesic Red and White Pine landscape ecosystem). It is dominated by mixed stands of red pine, white pine, aspen, paper birch, northern white cedar, white spruce, and balsam fir (USFS 2004a). Severe fire disturbances typically result in aspen/birch stands with red and white pine also present. Succession generally reduces the aspen/birch component, which leaves pines as the dominant species. White spruce and balsam fir typically regenerate in the understory.

Table 4.3.4-4 Landscape Ecosystem Types (Acres) on Federal and Non-federal Lands[1, 2]

Landscape Ecosystem Type	Total of Federal Lands	Total of Non-Federal Lands	Tract 1 – Hay Lake	Tract 2 – Lake County North	Tract 2 – Lake County South	Tract 3 - Wolf 1	Tract 3 – Wolf 2	Tract 3 – Wolf 3	Tract 3 - Wolf 4	Tract 4 - Hunting Club	Tract 5 - McFarland Lake
Dry-Mesic Red and White Pine	0.0	682.9	589.2	0.0	0.0	0.0	0.0	0.0	0.0	93.7	0.0
Mesic Red and White Pine	0.1	558.8	528.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30.8
Jack Pine-Black Spruce	3,000.1	983.5	983.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lowland Conifer	3,460.3	4,455.0	2,835.3	227.6	80.2	84.3	653.2	217.7	356.7	0.0	0.0
Mesic Birch-Aspen-Spruce-Fir	0.0	302.1	0.9	37.4	0.0	41.5	114.7	59.7	47.9	0.0	0.0
Lowland Hardwood	0.0	66.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	66.5	0.0
Sugar Maple	0.0	36.7	0.0	0.0	36.7	0.0	0.0	0.0	0.0	0.0	0.0

Source: USFS 2011g.

Notes:
[1] Total acres may be more or less than presented elsewhere due to rounding or GIS layers used.
[2] Data may not have complete coverage of parcels.

Invasive Non-native Plants

The federal lands have the same invasive non-native species as the Mine Site since they occupy the same area. Section 4.2.4.2.2 provides a list of invasive non-native species likely located on the federal lands.

Threatened and Endangered Plant Species

Endangered, Threatened, and Special Concern Plant Species

No federally listed threatened and endangered plant species are known to occur on the federal lands. The federal lands contain the same state-listed ETSC plant species as the Mine Site, with the exception of *Botrychium campestre*, which is located south of the federal lands on the Mine Site; an additional species, *Pyrola minor*, is found north of the Mine Site on the federal lands. Section 4.2.4.2.3 provides a list and discussion of the ETSC species on the federal lands.

Ten state-listed ETSC plant species are known to occur on the federal lands. Based on a review of the MDNR NHIS and field investigations (AECOM 2009b; Barr 2007i; Johnson-Groh 2004; Pomroy and Barnes 2004; Walton 2004), one state endangered species, and nine state species of special concern have been identified on the federal lands (see Table 4.3.4-5 and Figure 4.2.4-2). Some colonies of species listed for the Mine Site may be located outside of the federal lands but within the Mine Site. As a result, numbers of individuals may be smaller than the Mine Site.

Rulemaking was conducted with the intent to update the list of ETSC species (*Minnesota Rules*, parts 6134.0100 to 6134.0400), with new listings becoming effective on August 19, 2013 (MDNR 2013h). This FEIS considers any new listings, or changes in the previous listings, associated with the updated list.

Table 4.3.4-5 Endangered, Threatened, and Special Concern Plant Species Identified on the Federal Lands [5]

Common Name	Scientific Name	State Status[1]	No. of Populations[2]	No. of Individuals[2,3]	Habitat and Location
Pale moonwort[4]	*Botrychium pallidum*	SC	1	2	Full to shady exposure, edge of alder thicket, along Dunka Road.
Ternate, or St. Lawrence, grapefern[4]	*Botrychium rugulosum* (*ternatum*)	SC	1	4	Early successional habitats, fields, open woods, forests, and along Dunka Road.
Least grapefern[4]	*Botrychium simplex*	SC	3	905	Full to shady exposure, edge of alder thicket, forest roads, along Dunka Road.
Floating marsh marigold[4]	*Caltha natans*	E	1	29	Shallow water in ditches and streams, alder swamps, shallow marshes, beaver ponds, and Partridge River mudflat.
Neat spikerush[4]	*Eleocharis nitida*	SC	1	~486 ft^2	Full exposure, moist ditches along Dunka Road, wet area between railroad grades, and railroad ditch.
Bog rush[4]	*Juncus stygius* var. *americanus*	SC	1	Unknown	Open-patterned peatlands, rich and poor fens, northern spruce bog within the One Hundred Mile swamp.
Club-spur orchid	*Platanthera clavellata*	SC	1	Unknown	Black spruce and/or tamarack swamps, northern spruce bog within the One Hundred Mile swamp.
Small shinleaf[4]	*Pyrola minor*	SC	1	10	Rich black spruce swamps, cedar swamps, on Sphagnum hummocks in forested peatlands within the One Hundred Mile swamp.
Lapland buttercup	*Ranunculus lapponicus*	SC	1	~919 ft^2	On and adjacent to Sphagnum hummocks in black spruce stands, up to 60 percent shaded with alder also dominant.
Torrey's manna-grass	*Torreyochloa pallida*	SC	1	~25 ft^2	In muddy soil along shore and in water within shallow channels, beaver ponds, shallow marshes, along Partridge River.

Sources: AECOM 2009b; Barr 2007i; Johnson-Groh 2004; MDNR 2005; MDNR 2011k; MDNR 2014d; Pomroy and Barnes 2004; Walton 2004.

Notes:
[1] E - Endangered, T - Threatened, SC - Species of Special Concern.
[2] Note that the number of populations may differ from those given in the NHIS data because of populations found during other surveys.
[3] Where the number of individuals could not be determined without damaging the population, then patch size was used as a representative abundance measure.
[4] These species are also RFSS as tracked by the USFS.
[5] Data included here were provided by the Division of Ecological Resources, MDNR, and were current as of August 5, 2014. These data are not based on an exhaustive inventory of the state. The lack of data for any geographic area shall not be construed to mean that no significant features are present.

<u>Species Life Histories</u>

The species life histories are provided in Section 4.2.4.2.3 for all species except the additional one listed below.

Small shinleaf (*Pyrola minor*) is listed as a species of special concern in Minnesota and as an RFSS in the Superior National Forest. The species was first reported in Lake County in 1914 near the North Kawishiwi River. It has since only been documented in Cook, St. Louis, Lake (Bell Museum of Natural History 2011), and Carlton counties (NatureServe 2014b). *P. minor* is a circumpolar species occurring across Canada and the western United States in boreal and alpine habitats (MDNR 2011k). It usually occurs in conifer swamps, including black spruce and northern white cedar swamps, and black spruce-balsam fir woodlands. Small shinleaf can also be found along moist ecotones between wetlands and uplands or between streams and slopes. It is a perennial evergreen forb species that is rhizomatous and flowers in mid-July. It may be semi-tolerant to disturbance, since healthy populations exist along well-traveled portage routes and at sites that have experienced timber harvesting around 20 years prior (MDNR 2011k). Threats to *P. minor* include climate change, since it is a circumpolar species, and competition from non-native species.

Regional Foresters Sensitive Species

Seven state-listed ETSC plant species that occur on the federal lands (*Botrychium pallidum*, *Botrychium rugulosum*, *Botrychium simplex*, *Caltha natans*, *Eleocharis nitida*, *Juncus stygius*, and *Pyrola minor*) are also RFSS plants. A species description for *Pyrola minor* is provided above, and for the other six ETSC species in Section 4.2.4.2.3. The other RFSS plants that are likely located on the federal lands using MIH types and suitable habitat as indicators are discussed in Section 4.2.4.2.3.

4.3.4.1.2 Land Exchange Alternative B

<u>Cover Types</u>

A smaller portion of the federal lands (up to 4,752.6 acres) would be exchanged into private ownership under this alternative.

Habitat Types

The Alternative B: Smaller Federal Parcel contains similar MDNR GAP land cover types as the federal lands, but smaller acreages of them, with lowland coniferous forest making up the majority of the parcel and cropland/grassland occupying the least amount (see Table 4.3.4-6). The MDNR GAP land cover types below may not fully represent the extent of mixed forest types, since the cover type level below is fairly specific, so there may be more mixed forest types than indicated.

Table 4.3.4-6 Alternative B: Smaller Federal Parcel Cover Types

Cover Types	Total Acres	Percent of Area
Lowland coniferous forest[1]	2,064.8	43
Upland coniferous forest[3]	1,366.1	29
Upland deciduous forest[4]	804.7	17
Shrubland	436.9	9
Disturbed	29.1	1
Aquatic environments	26.3	1
Upland conifer-deciduous mixed forest[5]	17.8	<1
Lowland deciduous forest[2]	4.7	<1
Cropland/grassland	2.2	<1
Total	**4,752.6**	**100**

Source: MDNR 2006b.

Notes:
[1] Includes lowland black spruce, lowland northern white cedar, and tamarack forest cover types.
[2] Includes black ash forest cover types.
[3] Includes pine and spruce/fir forest cover types.
[4] Includes aspen/aspen-white birch, maple/basswood, and oak forest cover types.
[5] Includes all mixed coniferous-deciduous forest cover types.

Minnesota Biological Survey

Lands as part of the Alternative B: Smaller Federal Parcel would be mostly classified as MBS Sites of High Biodiversity Significance, including the Upper Partridge River (56 percent of Alternative B: Smaller Federal Parcel lands) and the One Hundred Mile Swamp (40 percent of Alternative B: Smaller Federal Parcel lands) (see Figure 4.2.4-1) (MDNR 2008a). Less than 1 percent of Alternative B: Smaller Federal Parcel would contain the Upper Dunka Peatlands MBS Site of Moderate Biodiversity Significance. These sites are located in the Laurentian Uplands subsection.

The Alternative B: Smaller Federal Parcel would also contain "imperiled," "imperiled/vulnerable," and "vulnerable" native plant communities, including white pine-red pine forests (FDn43a; less than 1 percent), rich black spruce swamp (FPn62a; 6 percent), and black spruce-Jack pine woodlands (FDn32c; 23 percent), respectively (MDNR 2008b). Black ash-conifer swamps (WFn64a), black spruce bogs (APn80a), graminoid bogs (APn90b1), poor tamarack-black spruce swamps (APn81b), and white cedar swamps (FPn63a) are ranked as "apparently secure" and are located in the Alternative B: Smaller Federal Parcel lands. Aspen-birch forests: balsam fir subtype (FDn43b1), alder swamps (FPn73a), poor black spruce swamps (APn81a), rich tamarack-alder swamps (FPn82a), willow-dogwood shrub swamps (WMn82a), and low shrub poor fens (APn91a) are all considered "widespread and secure" and are also on the Alternative B: Smaller Federal Parcel.

Scientific and Natural Areas

There are no SNAs located on or near the Alternative B: Smaller Federal Parcel lands.

Culturally Important Plants

Similar to the federal lands, natural resources culturally important to the Bands are discussed in Section 4.2.9.3.3.

Management Areas

The Alternative B: Smaller Federal Parcel lands are currently managed under the General Forest – Longer Rotation Management Area (93 percent) and the General Forest Management Area (7 percent; see Table 4.3.4-7) (USFS 2011j). Section 4.3.1 describes the management areas in detail.

Table 4.3.4-7 Management Areas for the Land Exchange Alternative B Lands

Category	Land Exchange Alternative B Lands	
	Acres	Percent
General Forest	355.3	7
General Forest – Longer Rotation	4,397.3	93
Potential/Candidate Research Natural Areas	0.0	0
Riparian Areas	0.0	0

Source: USFS 2011j.

Ecological Land Types

The Alternative B: Smaller Federal Parcel lands contain the same five categories of ELTs as the federal lands. Section 4.3.4.1.1 provides a discussion of these ELT types.

Management Indicator Habitats

The Alternative B: Smaller Federal Parcel consists mostly of lowland black spruce-tamarack forest (MIH 9; 2,078.7 acres), with lesser amounts of upland conifer forest (MIH 5; 1,138.8 acres) and upland forest (MIH 1; 954.2 acres) (see Table 4.3.4-8 and Figure 4.2.4-3) (USFS 2010b). Aquatic habitats (MIH 14) are not tracked on the Alternative B: Smaller Federal Parcel lands, though several open water features are present. Though not considered an MIH type, the smaller federal parcel contains 385.4 acres of lowland shrub habitat and 115.4 acres of lowland emergent habitat, as well. The remaining acres present on the federal lands have no corresponding MIH classification.

The Alternative B: Smaller Federal Parcel consists of mostly mature (2,574.7 acres) forest stands, with smaller amounts of immature (1,325.9 acres) stands and young (271.1 acres) stands (see Table 4.3.4-8). There are currently no patches of mature upland forest over 300 acres on the Alternative B: Smaller Federal lands (USFS 2012c). However, since smaller patches will grow over time into larger contiguous patches, the USFS predicts that in 2020, there would be one patch (707.8 acres) over 300 acres on the Alternative B: Smaller Federal lands (USFS 2012d).

Table 4.3.4-8 MIH Types and Age Classes (Acres) for the Land Exchange Alternative B Lands

MIH Type	Total of Land Exchange Alternative B Parcel Lands
MIH 1	954.2
MIH 5	1,138.8
MIH 9	2,078.7
MIH 14	0.0
Lowland Shrub	385.4
Lowland Emergent	115.4
Upland Grass	0.0
Age Class	
Young	271.1
Immature	1,325.9
Mature	2,574.7

Sources: USFS 2010b; USFS 2011i.

Landscape Ecosystems

The Alternative B: Smaller Federal Parcel lands are located within two landscape ecosystem types. The Jack Pine-Black Spruce landscape ecosystem occupies 2,395.1 acres of the smaller federal parcel lands (represents less than 0.01 percent of Jack Pine-Black Spruce landscape ecosystem), while the Lowland Conifer landscape ecosystem occupies 2,349.1 acres (represents less than 0.01 percent of Lowland Conifer landscape ecosystem) (see Table 4.3.4-9).

Table 4.3.4-9 Landscape Ecosystem Types (Acres) on the Land Exchange Alternative B Lands and Tract 1 Lands[1]

Landscape Ecosystem Type	Alternative B: Smaller Federal Parcel Lands[2]	Tract 1 – Hay Lake
Dry-Mesic Red and White Pine	0.0	589.2
Mesic Red and White Pine	0.0	528.0
Jack Pine-Black Spruce	2,395.1	983.5
Lowland Conifer	2,349.1	2,835.3
Mesic Birch-Aspen-Spruce-Fir	0.0	0.9
Lowland Hardwood	0.0	0.0
Sugar Maple	0.0	0.0

Source: USFS 2011g.

Notes:
[1] Total acres may be more or less than presented elsewhere due to rounding or GIS layers used.
[2] Data may not have complete coverage of parcel.

Invasive Non-native Plants

The Alternative B: Smaller Federal Parcel lands contain similar invasive non-native species as those that are part of the Land Exchange Proposed Action, since they occupy a smaller portion of the federal lands.

Threatened and Endangered Plant Species

Endangered, Threatened, and Special Concern Plant Species

The Alternative B: Smaller Federal Parcel contains the same threatened and endangered species as the federal lands since it occupies the same general area, and the ETSC species located on the federal lands are also located within the boundary of the smaller federal parcel. Section 4.3.4.1.1 provides the list of species that occur on the Alternative B: Smaller Federal Parcel lands.

Regional Foresters Sensitive Species

The RFSS plants located on the smaller federal parcel are the same as those located on the federal lands and Mine Site. Sections 4.2.4.2.3 and 4.3.4.1.1 provide a list and discussion of these species.

4.3.4.2 Non-federal Lands

4.3.4.2.1 Cover Types

The non-federal lands portion of the Land Exchange Proposed Action includes five different private tracts of land that total up to 7,075.0 acres. These lands, which include forest and wetland habitat, are located throughout the Superior National Forest in St. Louis, Lake, and Cook counties.

4.3.4.2.2 Habitat Types

The MDNR GAP land cover types of the combined non-federal lands consist of mostly lowland coniferous forests, shrublands, and upland deciduous forests (see Table 4.3.4-10).

Table 4.3.4-10 Non-federal Lands Cover Types

Cover Types	Total Acres	Percent of Area
Lowland coniferous forest[1]	2,920.5	41
Shrubland	1,845.0	26
Upland deciduous forest[4]	1,232.9	17
Upland coniferous forest[3]	699.4	10
Aquatic environments	266.6	4
Upland conifer-deciduous mixed forest[5]	50.4	1
Cropland/grassland	31.7	<1
Lowland deciduous forest[2]	28.6	<1
Disturbed	0.0	0
Total	**7,075.0[(6)]**	**99[(7)]**

Source: MDNR 2006b.

Notes:
[1] Includes lowland black spruce, lowland northern white cedar, and tamarack forest cover types.
[2] Includes black ash forest cover types.
[3] Includes pine and spruce/fir forest cover types.
[4] Includes aspen/aspen-white birch, maple/basswood, and oak forest cover types.
[5] Includes all mixed coniferous-deciduous forest cover types.
[6] Total acres may be more or less than presented due to rounding.
[7] Percent totals less than 100 percent due to rounding.

Management Areas

The non-federal lands currently do not have any management area designations, as they are not managed by the federal government. Section 4.3.1 describes the management areas in detail.

Management Indicator Habitats

MIH types and age classes were determined and mapped for the non-federal lands using several data sources, including field survey maps, aerial maps, surrounding federal MIH data, topographic maps, and USFS review. This analysis limited the MIH types to those mentioned above in Section 4.2.4.2.3, due to risk of misidentification of further subcategories of forests. Lowland shrub habitat, while not an MIH type, was also considered due to its importance to several wildlife species such as moose (Greenlee, USFS, Pers. Comm., October 26, 2011). Additionally, lowland emergent wetlands and upland grass types were included. The non-federal lands are dominated by lowland black spruce-tamarack forest (MIH 9; 3,308.5 acres) and upland forest (MIH 1; 2,694.5 acres), with lesser amounts of aquatic habitats (MIH 14; 226.7 acres) and upland conifer forest (MIH 5; 79.9 acres) (see Table 4.3.4-3). Though not considered MIH types, the non-federal lands also contain 385.7 acres of lowland emergent wetlands, 332.2 acres of lowland shrub habitat, and 43.3 acres of upland grassland.

Of forested plant communities on the non-federal lands, immature forest stands (3,539.7 acres) are most abundant, with lesser amounts of mature (1,824.6 acres) and young (778.2 acres) forest types.

Landscape Ecosystems

The non-federal lands are located within seven landscape ecosystem types, including Jack Pine-Black Spruce, Lowland Conifer, Mesic Red and White Pine, Dry-Mesic Red and White Pine, Lowland Hardwood, Mesic Birch-Aspen-Spruce-Fir, and Sugar Maple (see Table 4.3.4-4). All landscape ecosystem types on each tract represent less than 0.01 percent of that landscape ecosystem type within the Northern Superior Uplands Section.

4.3.4.2.3 Invasive Non-native Plants

The non-federal lands contain similar invasive non-native species as the federal lands, although there are also different species. The subsections on each tract below provide more detailed discussions of these species.

4.3.4.2.4 Threatened and Endangered Plant Species

Endangered, Threatened, and Special Concern Plant Species

The non-federal lands contain three state-listed ETSC plant species according to the MDNR NHIS, including *Woodsia scopulina*, *Saxifraga paniculata*, and *Carex ormostachya*. The former two of these species are located on Tract 5, and the latter species is located on Tract 1. Additional information about these three species is presented in the discussion of Tracts 1 and 5 below. Rulemaking was conducted with the intent to update the list of ETSC species (*Minnesota Rules*, parts 6134.0100 to 6134.0400), with new listings becoming effective on August 19, 2013 (MDNR 2013h). This FEIS considers any new listings, or changes in the previous listings, associated with the updated list.

Regional Foresters Sensitive Species

The non-federal lands are located outside the current boundaries of the Superior National Forest; however, following the Land Exchange Proposed Action, some or all of the non-federal lands could become National Forest System lands. The USFS currently manages 58 vascular and non-vascular plant species that are listed as RFSSs in the Superior National Forest (see Table 4.2.4-5). Detailed RFSS plant surveys have not been conducted on the private non-federal lands, but information from other field surveys and habitat preferences (MIH types) for each species is used to determine potential habitat or occurrences of RFSS plant species on the non-federal lands.

Saxifraga paniculata is located on the non-federal lands and it is also an RFSS plant. The non-federal lands consist of mostly lowland black spruce-tamarack forests (MIH 9), which means there is generally more habitat available for the 13 RFSS species listed under that category to occur on the non-federal lands, if suitable habitat exists for them (see Table 4.2.4-5). One of these species is *Pyrola minor*, which is a state-listed ETSC plant species that occurs on the federal lands. The non-federal lands also contain a large portion of upland forest (MIH 1), which means there are many acres for the 17 RFSS species listed under that category to occur on the non-federal lands as well. Three of these species are state-listed ETSC species on the federal lands and include *Botrychium pallidum*, *Botrychium rugulosum*, and *Botrychium simplex*. *Botrychium lanceolatum* is also known to occur near the southwest corner of the Tract 1 lands, and is associated with MIH 1. There is a smaller amount of aquatic habitat (MIH 14) available on the non-federal lands, so there is less available habitat for the eight RFSS species listed under that category. One of these species is *Caltha natans*, which is a state-listed ETSC plant species and occurs on the federal lands. There is very little upland conifer forest habitat (MIH 5) available, meaning there are likely fewer occurrences of some species in the MIH 5 category. There are also 385.7 acres of lowland emergent wetland habitat on the non-federal lands, so the five RFSS plant species listed under this category may occur on the non-federal lands as well. This includes *Eleocharis nitida* and *Juncus stygius*, which are both state-listed ETSC plant species that occur on the federal lands.

4.3.4.2.5 Tract 1 – Hay Lake Lands

The largest non-federal tract is Tract 1, which is 4,926.3 acres in size. It is located in the Laurentian Ranger District (USFS 2011n). The parcel has moderate topographic relief and slopes toward the east-northeast, in the direction of the Pike River (AECOM 2011b).

Cover Types

Tract 1 is located in the Nashwauk Uplands subsection of the Laurentian Mixed Forest Province ecoregion (MDNR 2006a). See Section 4.2.4.1 for a description of the Nashwauk Uplands subsection.

Habitat Types

The primary MDNR GAP land cover types for Tract 1 include shrublands and lowland conifer forests (see Table 4.3.4-11). There are fewer acres of cropland/grassland and lowland deciduous forests. The MDNR GAP land cover types below may not fully represent the extent of mixed forest types, since the cover type level below is fairly specific, so there may be more mixed forest types than indicated.

Table 4.3.4-11 Tract 1 – Hay Lake Lands Cover Types

Cover Types	Total Acres	Percent of Area
Shrubland	1,664.6	34
Lowland coniferous forest[1]	1,524.2	31
Upland deciduous forest[4]	999.9	20
Upland coniferous forest[3]	437.3	9
Aquatic environments	251.1	5
Cropland/grassland	31.7	1
Lowland deciduous forest[2]	17.4	<1
Disturbed	0.0	0
Upland conifer-deciduous mixed forest[5]	0.0	0
Total	**4,926.3[(6)]**	**100**

Source: MDNR 2006b.

Notes:
1 Includes lowland black spruce, lowland northern white cedar, and tamarack forest cover types.
2 Includes black ash forest cover types.
3 Includes pine and spruce/fir forest cover types.
4 Includes aspen/aspen-white birch, maple/basswood, and oak forest cover types.
5 Includes all mixed coniferous-deciduous forest cover types.
6 Total acres may be more or less than presented due to rounding.

Plant Community Surveys

Much of Tract 1 (59 percent) is wetlands (AECOM 2011b). All of the 33 wetlands evaluated are rated high for wetland functions and values, according to MnRAM 3.2 (AECOM 2009b; AECOM 2011b). Most of the wetland habitats consist of scrub-shrub habitat dominated by speckled alder (*Alnus incana* ssp. *rugosa*), beaked hazel (*Corylus cornuta*), willows (*Salix* spp.), and bog birch (*Betula pumila*); pole and immature size coniferous forests dominated by black spruce, northern white cedar, and tamarack; and emergent/bog wetlands dominated by sedges (*Carex* spp.), cattail (*Typha* spp.), bog-Labrador tea, and leatherleaf (AECOM 2011b). There are several open water features on the parcel as well, including Hay Lake, Little Rice Lake, and the Pike River. See Section 4.3.3 for a more detailed description of wetland habitat types present.

Uplands consist of pole and immature deciduous forests, dominated by trembling aspen and paper birch, with midstories of sapling mountain maple (*Acer spicatum*), trembling aspen, paper birch, balsam fir, and black spruce. Shrub species include beaked hazel, with scattered speckled alder, twining honeysuckle (*Lonicera dioica*), and prickly rose (*Rosa acicularis*) (AECOM 2011b). The ground cover includes sedges, wild strawberry (*Fragaria virginiana*), bunchberry (*Cornus canadensis*), wild raspberry (*Rubus* spp.), horsetail (*Equisetum* spp.), clintonia (*Clintonia borealis*), twinflower (*Linnaea borealis*), large-leaved aster (*Aster macrophyllus*), rose twisted stalk (*Streptopus roseus*), skunk currant (*Ribes glandulosum*), spotted coralroot (*Corallorhiza maculata*), wood anemone (*Anemone quinquefolia*), tall buttercup (*Ranunculus acris*), bracken fern (*Pteridium aquilinum*), and interrupted fern (*Osmunda claytoniana*) (AECOM 2011b).

Disturbed areas and grasslands are primarily associated with abandoned logging roads, landings, and powerline ROWs and are dominated by forbs and grasses, including cow parsnip (*Heracleum lanatum*), white clover (*Trifolium repens*), ox-eye daisy (*Leucanthemum vulgare*), tall buttercup, common sow thistle (*Sonchus arvensis* ssp. *uliginosus*), orange hawkweed

(*Hieracium aurantiacum*), American vetch (*Vicia americana*), wild strawberry, wild raspberry, and common tansy (AECOM 2011b).

Almost all forest stands on Tract 1 consist of trees that are 8 to 11 inches dbh, having been harvested in relatively recent years (AECOM 2011b). Upland deciduous trees range up to 16 inches dbh, while upland coniferous trees range up to 10 inches dbh. Upland forest stands in the northern, central, and southwestern portions of the parcel are pole to immature, while upland stands in the western portion of the parcel are sapling to young pole. The majority of the trees on the parcel are estimated to be 60 years or younger (AECOM 2011b).

Minnesota Biological Survey

There are no lands designated as MBS Sites of Biodiversity Significance on Tract 1 (see Figure 4.3.4-1); however, the entire parcel is located within the preliminary Pike Range and Peatlands MBS Site of Outstanding Biodiversity Significance and could potentially be the only site ranked as Outstanding in the Nashwauk Uplands subsection upon final designation by the MDNR (Wilson, MDNR, Pers. Comm., February 14, 2012; MDNR *In progress*). The preliminary site is approximately 26,000 acres in size, approximately half of which is owned or managed by the Superior National Forest. On a larger landscape level, this site is one of the largest and most contiguous high-quality areas within the subsection or LTA scale. The Pike Mountain cRNA and Loka Lake cRNA abut Tract 1 and are included within this preliminary MBS site.

Native plant community designations are not available for Tract 1. However, native plant communities of the preliminary Pike Range and Peatlands MBS site are generally of high quality and include representative examples of almost all communities known to exist in the subsection (Holmstrom, MDNR, Pers. Comm., April 9, 2012; MDNR n.d.).

Scientific and Natural Areas

There are no lands designated as SNAs on Tract 1; however, state, federal, and private land near the southwest corner of the parcel has been identified as a “potential” SNA site (Wilson, MDNR, Pers. Comm., February 14, 2012). The federal lands bordering the southwest corner of the parcel are designated as the Pike Mountain cRNA, and this designation could be extended onto Tract 1 due to high-quality mature hardwood forest stands, rare cliff and rock outcrop features, and low human disturbance.

Culturally Important Plants

Wild rice has been observed on Tract 1, including on Hay Lake, Little Rice Lake, and the Pike River (Barr 2011a; 2012a; 2013m). Small populations of wild rice have been found on Hay Lake with less than 10 percent coverage, while Little Rice Lake has several locations with greater than 75 percent coverage of wild rice and continuous growth throughout the lake. Wild rice was also found along the Pike River flowing north into Little Rice Lake. The survey performed in 2012 found lower densities of wild rice beds. Hay Lake, Rice Lake, and the Pike River all had density factor ratings of 1. The decreases in density in Rice Lake and the Pike River were consistent with a decrease in wild rice bed density across all areas surveyed in 2012. Section 4.2.2 provides further discussion of wild rice on the Tract 1 lands.

As with the federal lands, natural resources culturally important to the Bands are discussed in Section 4.2.9.3.3.

Management Areas

The non-federal lands currently do not have any management area designations, as they are not managed by the federal government. Section 4.3.1 describes the management areas in detail.

Ecological Land Types

Tract 1 contains six categories of ELTs, including Lowland Loamy Moist (ELT 1), Lowland Loamy Wet (ELT 2), Lowland Organic Acid to Neutral (ELT 6), Upland Deep Loamy Over Sandy Dry (ELT 11), Upland Shallow Loamy Dry (ELT 16), and Upland Extremely Shallow Loamy Droughty (ELT 18). The majority of Tract 1 is included within the Pike-Sandy River Sand Plain LTA and the remainder is within the Mesabi Range LTA.

Management Indicator Habitats

Table 4.3.4-3 provides a summary of the MIH types and age classes present on the Tract 1 lands (see Figure 4.3.4-1) (USFS 2010b). Though not considered MIHs, Tract 1 also contains 365.0 acres of lowland emergent wetlands and 113.3 acres of lowland shrub habitat.

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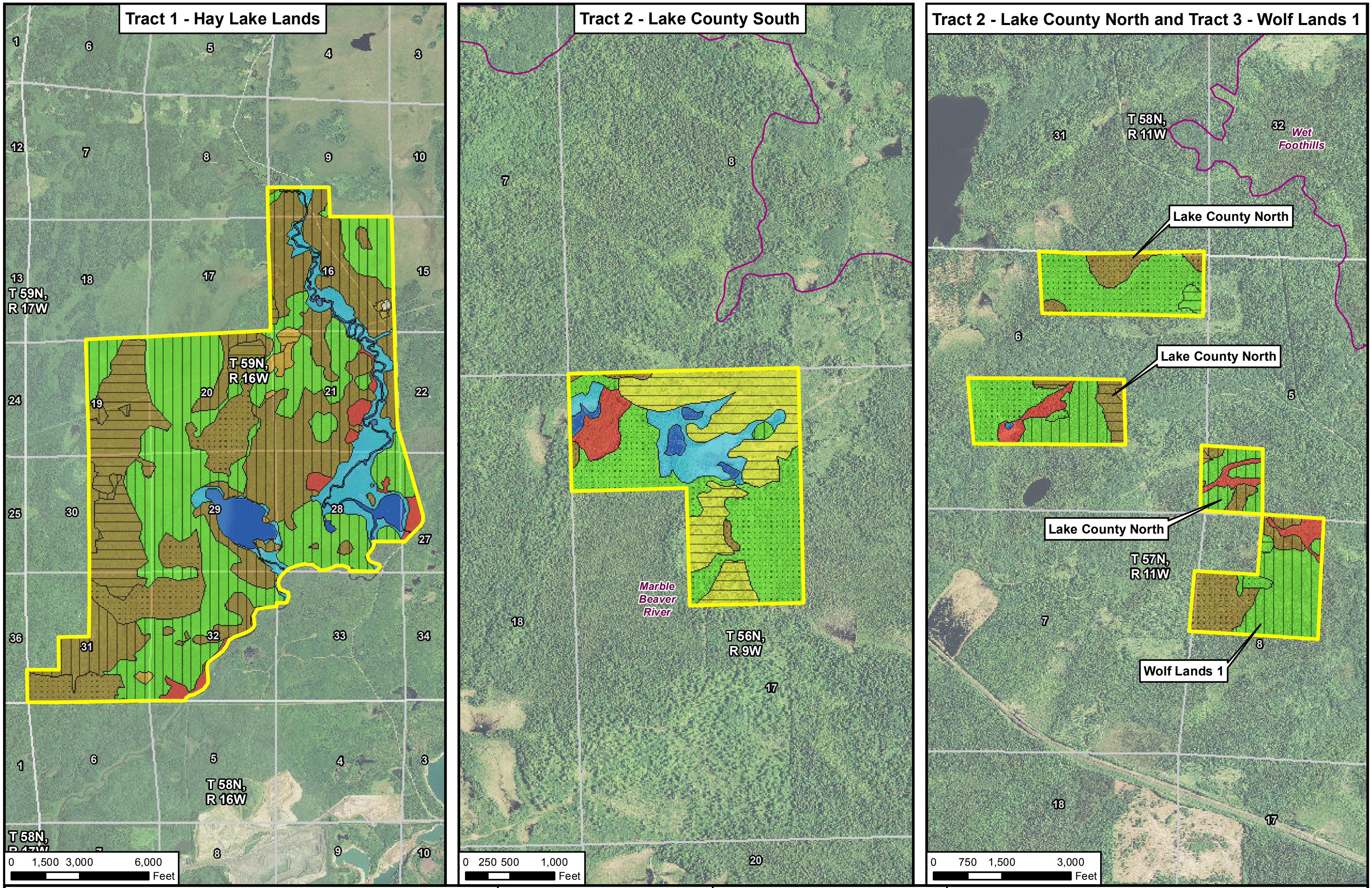

Non-federal Lands
Section Boundary
Section Label
Management Indicator Habitat
1 - Upland forest
5 - Upland conifer forest
9 - Lowland black spruce-tamarack forest
14 - Aquatic habitats
Other - Lowland Emergent
Other - Lowland Shrub
Other - Upland Grass
MBS Site of Biodiversity Significance
Age Classes
N/A
Young
Immature
Mature

US Army Corps of Engineers
St. Paul District

This document is a working document. This document may change over time as a result of new information, further deliberation, or other factors not yet known to the Co-lead Agencies.

N W E S

Figure 4.3.4-1
Management Indicator Habitat Types and Age Classes - Tracts 1, 2 and 3
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

493

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Landscape Ecosystems

Table 4.3.4-4 provides a summary of the landscape ecosystem types present on Tract 1.

The Lowland Conifer landscape ecosystem occupies 2,835.3 acres of Tract 1. The Jack Pine-Black Spruce landscape ecosystem occupies 983.5 acres of Tract 1. The Mesic Red and White Pine landscape ecosystem occupies 528.0 acres of Tract 1. See the previous federal lands section above (see Section 4.3.4.1.1) for a description of these landscape ecosystem types.

The Dry-Mesic Red and White Pine landscape ecosystem occupies 589.2 acres of Tract 1. It comprises the following species: aspen, paper birch, red pine, white pine, jack pine, balsam fir, black spruce, white spruce, bigtooth aspen, and red maple (USFS 2004a). On drier sites, jack pine, red pine, and black spruce dominate, while the other species dominate on mesic sites. Succession after fire disturbances is similar to the Mesic Red and White Pine landscape ecosystem described above.

The Mesic Birch-Aspen-Spruce-Fir landscape ecosystem occupies less than 1 acre of Tract 1. It is dominated by mixed stands of aspen, paper birch, balsam fir, and white spruce, though northern white cedar, bigtooth aspen, and red maple are sometimes also present (USFS 2004a). Fire disturbances usually result in aspen/birch-dominated stand regeneration, while wind disturbances usually result in balsam fir and white spruce forests. The climax tree stage consists of a multi-aged white spruce and balsam fir forest with components of paper birch and northern white cedar.

Invasive Non-native Plants

According to the Superior National Forest invasive plant geodatabase, Tract 1 contains two known occurrences of common tansy (USFS 2010a). Common tansy can spread vegetatively or reproductively via tufted seeds that are dispersed by wind or water (MDNR 2011b). It is widespread and common along roadsides or abandoned farmyards in northern Minnesota. Common tansy was observed during field investigations along trails near recently installed gates and disturbed earthen berms. Additionally, AECOM (2011b) identified common tansy, orange hawkweed, common sow thistle, and ox-eye daisy within disturbed logging roads, landings, and power line rights-of-way. Orange hawkweed primarily spreads vegetatively through runners, rhizomes, and root buds, but can also spread reproductively (MDNR 2011b). It colonizes newly disturbed sites and early successional habitats quickly. Ox-eye daisy spreads vegetatively and reproductively, but often cannot invade intact grasslands (MDNR 2011b). It can, however, invade newly disturbed areas quickly. Common sow thistle spreads vegetatively and through wind-borne seeds or root cuttings. It colonizes fields, woodlands, and roadsides, but generally is not a threat to intact native plant communities (MDNR 2011b).

Threatened and Endangered Plant Species

Endangered, Threatened, and Special Concern Plant Species

No federally listed ETSC plant species are known to occur on the Tract 1 lands according to field investigations (AECOM 2011b). Based on a review of the MDNR NHIS (MDNR 2014d), one state-listed species of special concern has been identified on Tract 1 (see Table 4.3.4-12 and Figure 4.3.4-3). Necklace sedge (*Carex ormostachya*) is not tracked by the USFS as an RFSS. No other state-listed species are known to occur on Tract 1.

Rulemaking was conducted with the intent to update the list of ETSC species (*Minnesota Rules*, parts 6134.0100 to 6134.0400), with new listings becoming effective on August 19, 2013 (MDNR 2013h). This FEIS considers any new listings, or changes in the previous listings, associated with the updated list.

Table 4.3.4-12 Endangered, Threatened, and Special Concern Plant Species Identified on the Tract 1 Lands [3]

Common Name	Scientific Name	State Status[1]	No. of Populations	No. of Individuals[2]	Habitat and Location
Necklace sedge	*Carex ormostachya*	SC	1	>20	Dry/mesic shallow soils on rock outcrop in red oak-dominated forest

Sources: MDNR 2014d.

Notes:
[1] E - Endangered, T - Threatened, SC - Species of Special Concern.
[2] Where the number of individuals cannot be determined without damaging the population, then patch size is used as a representative abundance measure.
[3] Data included here were provided by the Division of Ecological Resources, MDNR, and were current as of August 5, 2014. These data are not based on an exhaustive inventory of the state. The lack of data for any geographic area shall not be construed to mean that no significant features are present.

<u>Species Life Histories</u>

The following summary provides a description of the life history, state-wide distribution, and sensitivity to disturbance for the species of special concern found on Tract 1.

Necklace sedge (*Carex ormostachya*) is listed as a species of special concern in Minnesota and is globally ranked as apparently secure; it is not listed as an RFSS in the Superior National Forest. The species was first documented in Cook County, Minnesota in 1938, and has since been reported across northern Minnesota (Bell Museum of Natural History 2014). *C. ormostachya* reaches the southwest corner of its range in Minnesota (NatureServe 2014b). It typically occurs in moist to dry deciduous, evergreen, or mixed forests, often in sandy gravel or disturbed soils (eFlora 2014). *C. ormostachya* is a perennial herbaceous species that flowers and fruits in spring to summer.

Regional Foresters Sensitive Species

There is more upland forest (MIH 1) and lowland black spruce-tamarack forest (MIH 9) habitat available than any other type, so the RFSS plants associated with these types would be most likely to occur on Tract 1. *Botrychium lanceolatum* is known to occur near the southwest corner of the Tract 1 lands, and is associated with MIH 1. There is a moderate amount of aquatic habitat (MIH 14) and a smaller amount of upland conifer forest (MIH 5), so RFSS plants associated with these would be less likely to occur.

4.3.4.2.6 Tract 2 – Lake County Lands

Tract 2 is 381.9 acres in size and includes several subparcels ranging in size from 44 to 117 acres on the Laurentian Ranger District southeast of Seven Beaver Lake that are mostly surrounded by the Superior National Forest (USFS 2011n). Tract 2 is divided into north (Lake County North) and south (Lake County South) parcels, with the north parcel being the larger of the two. Lake

County North consists of three subparcels, which are made up of mostly wetland habitats; the majority of Lake County South lands consists of wetland habitats as well (AECOM 2011c).

Lake County North

Cover Types

The Tract 2 is located in the Laurentian Mixed Forest Province ecoregion. Lake County North is located in the Laurentian Uplands subsection of the Laurentian Mixed Forest Province ecoregion (MDNR 2006a). Section 4.2.4.1 provides a description of the Laurentian Uplands subsection.

Habitat Types

The primary MDNR GAP land cover type on the Tract 2 – Lake County North lands is lowland coniferous forest (see Table 4.3.4-13). It contains very few acres of aquatic environments or lowland deciduous forests. The MDNR GAP land cover types below may not fully represent the extent of mixed forest types, since the cover type level below is fairly specific, so there may be more mixed forest types than indicated.

Table 4.3.4-13 Tract 2 – Lake County North Cover Types

Cover Types	Total Acres	Percent of Area
Lowland coniferous forest[1]	133.0	50
Upland conifer-deciduous mixed forest[5]	34.0	13
Upland deciduous forest[4]	34.0	13
Upland coniferous forest[3]	32.8	12
Shrubland	28.1	11
Aquatic environments	1.8	1
Lowland deciduous forest[2]	1.4	1
Cropland/grassland	0.0	0
Disturbed	0.0	0
Total	**265.1[(6)]**	**101[(7)]**

Source: MDNR 2006b.

Notes:
[1] Includes lowland black spruce, lowland northern white cedar, and tamarack forest cover types.
[2] Includes black ash forest cover types.
[3] Includes pine and spruce/fir forest cover types.
[4] Includes aspen/aspen-white birch, maple/basswood, and oak forest cover types.
[5] Includes all mixed coniferous-deciduous forest cover types.
[6] Total acres may be more or less than presented due to rounding.
[7] Percent totals are greater than 100 percent due to rounding.

Plant Community Surveys

The primary cover types are pole coniferous forest on the wetlands and mature and pole deciduous forests on the uplands (AECOM 2011c). Wetlands are dominated by northern white cedar, black spruce, and tamarack; balsam fir is a common understory species. Lake County North also contains scrub-shrub habitats that are dominated by speckled alder and contain emergent wetlands that consist of sedges and Canada bluejoint (*Calamagrostis canadensis*). Lake County North has several open bog areas, a beaver pond, and drainages as well. See Section 4.3.3 for a more detailed description of wetland habitat types present.

Upland habitats are dominated by immature paper birch and black spruce, but recently logged areas support sapling paper birch stands or shrub habitats. The midstory is comprised of balsam fir, black spruce, and beaked hazel. Areas that have been recently logged are dominated by sapling paper birch with scattered sapling trembling aspen and pole paper birch. Beaked hazel forms a patchy shrub layer, with several grasses and forbs in the ground layer (AECOM 2011c). Older forests near logged areas contain large amounts of downed woody debris, and have a midstory dominated by dense stands of balsam fir, black spruce, and northern white cedar.

Lake County North wetland canopy trees range from 6 to 10 inches dbh, but northern white cedar up to 20 inches dbh and black spruce up to 14 inches dbh are found on the subparcels (AECOM 2011c). The north parcel also contains an immature forested wetland containing black ash (*Fraxinus nigra*) trees up to 16 inches dbh.

Minnesota Biological Survey

There are no MBS Sites of Biodiversity Significance located on the Lake County North subparcels (see Figure 4.3.4-1) (MDNR 2008a). However, Lake County North is located on the potential Seven Beavers MBS Site, which has not yet been finalized by the MDNR but is ranked as having Moderate to High Biodiversity Significance (MDNR 2007a).

Native plant community rankings for Lake County North are not available.

Scientific and Natural Areas

There are no lands designated as SNAs on Tract 2 – Lake County North.

Culturally Important Plants

A discussion of natural resources culturally important to the Bands is presented in Section 4.2.9.3.3.

Management Areas

The non-federal lands currently do not have any management area designations, as they are not managed by the federal government. Section 4.3.1 describes the management areas in detail.

Ecological Land Types

The Lake County North parcel contains five categories of ELTs, including Lowland Loamy Moist (ELT 1), Lowland Loamy Wet (ELT 2), Lowland Organic Acid to Neutral (ELT 6), Upland Deep Loamy Dry Course (ELT 13), and Upland Deep Medium Loamy Dry (ELT 14). All three subparcels of the Lake County North parcel are included in the Greenwood Lake Till Plain LTA.

Management Indicator Habitats

Table 4.3.4-3 provides a summary of the MIH types and age classes present on Tract 2 (see Figure 4.3.4-1) (USFS 2010b). Though not considered an MIH, the Lake County North parcel also contains 20.6 acres of lowland shrub habitat.

Landscape Ecosystems

Table 4.3.4-4 provides a summary of the landscape ecosystem types present on Tract 2.

The Lowland Conifer landscape ecosystem occupies 227.6 acres of Lake County North. The Mesic Birch-Aspen-Spruce-Fir landscape ecosystem occupies 37.4 acres of the Lake County North lands. See the federal or non-federal lands sections above for a description of these landscape ecosystem types.

Lake County South

Cover Types

The Lake County South parcel is located in the North Shore Highlands subsection of the Laurentian Mixed Forest Province ecoregion (MDNR 2006a). Most of the vegetative cover types in the North Shore Highlands subsection grow in thin, rocky red and brown glacial till (MDNR 2011g). Upper Precambrian bedrock is often exposed at the surface. The most common soils are loams and sandy loams, which support forest communities of white pine, red pine, jack pine, balsam fir, white spruce, and aspen-birch.

Habitat Types

The primary MDNR GAP land cover types on Tract 2 – Lake County South are lowland coniferous forest and upland coniferous forest (see Table 4.3.4-14). There are fewer acres of aquatic environments. The MDNR GAP land cover types below may not fully represent the extent of mixed forest types, since the cover type level below is fairly specific, so there may be more mixed forest types than indicated.

Table 4.3.4-14 Tract 2 – Lake County South Cover Types

Cover Types	Total Acres	Percent of Area
Lowland coniferous forest[1]	53.1	45
Upland coniferous forest[3]	38.8	33
Shrubland	10.8	9
Upland deciduous forest[4]	10.1	9
Aquatic environments	4.0	3
Cropland/grassland	0.0	0
Disturbed	0.0	0
Lowland deciduous forest[2]	0.0	0
Upland conifer-deciduous mixed forest[5]	0.0	0
Total	**116.8**[(6)]	**99**[(7)]

Source: MDNR 2006b.

Notes:
1 Includes lowland black spruce, lowland northern white cedar, and tamarack forest cover types.
2 Includes black ash forest cover types.
3 Includes pine and spruce/fir forest cover types.
4 Includes aspen/aspen-white birch, maple/basswood, and oak forest cover types.
5 Includes all mixed coniferous-deciduous forest cover types.
6 Total acres may be more or less than presented due to rounding.
7 Percent totals are less than 100 percent due to rounding.

Plant Community Surveys

The primary cover types on Tract 2 – Lake County South are similar to Tract 2 – Lake County North, with wetlands dominated by pole coniferous forest and upland areas dominated by immature paper birch, black spruce, jack pine, eastern white pine, and northern white cedar. There are five beaver ponds, surrounded by emergent wetland species, including sedges, narrow-leaved cattail (*Typha angustifolia*), woolgrass (*Scirpus cyperinus*), and Canada bluejoint (AECOM 2011c). Please see Section 4.3.3 for a more detailed description of wetland habitat types present.

Most upland areas on Tract 2 – Lake County South have been recently clear-cut, except the southwest portion of the parcel. This area has been partially thinned, leaving areas where immature paper birch, black spruce, jack pine, eastern white pine, and northern white cedar trees remain ranging from 12 to 24 inches dbh (AECOM 2011c). The midstory includes balsam fir and beaked hazel. Grasses and forbs dominate the ground layer.

Minnesota Biological Survey

The entire 116.9 acres of the Tract 2 – Lake County South parcel are located within the Marble Beaver River MBS Site of High Biodiversity Significance (see Figure 4.3.4-1) (MDNR 2008a). This site is located within the North Shore Highlands subsection.

Native plant communities have been identified for the Lake County South parcel. It contains one vegetation community, sugar maple (*Acer saccharum*) forest (MHn45c; 8 percent of parcel), which has been characterized as "vulnerable" in the state (MDNR 2008b). Black ash-conifer swamps (WFn64a; less than 1 percent of parcel) and lowland white cedar forests (WFn53a; 29 percent of parcel) are also present on the parcel and are ranked as "apparently secure" in Minnesota based on abundance, distribution, trends, and threats (MDNR 2008b).

Scientific and Natural Areas

There are no lands designated as SNAs on Tract 2 – Lake County South.

Culturally Important Plants

A discussion of natural resources culturally important to the Bands is presented in Section 4.2.9.3.3.

Management Areas

The non-federal lands currently do not have any management area designations, as they are not managed by the federal government. Section 4.3.1 describes the management areas in detail.

Ecological Land Types

Tract 2 – Lake County South contains two categories of ELTs, including Lowland Loamy Wet (ELT 2), and Upland Deep Medium Loamy Dry (ELT 14). The entire Lake County South parcel is included in the Tettegouche Till Plain LTA.

Management Indicator Habitats

Table 4.3.4-3 provides a summary of the MIH types and age classes present on Tract 2 lands (see Figure 4.3.4-1) (USFS 2010b). Though not considered MIHs, the Tract 2 – Lake County South parcel also contains 43.3 acres of upland grassland, 15.6 acres of lowland emergent wetland, and 6.4 acres of lowland shrub habitat.

Landscape Ecosystems

Table 4.3.4-4 provides a summary of the landscape ecosystem types present on Tract 2 lands.

The Lowland Conifer landscape ecosystem occupies 80.2 acres of Tract 2 – Lake County South. See the federal or non-federal lands sections above for a description of this landscape ecosystem type.

The Sugar Maple landscape ecosystem occupies 36.7 acres of Tract 2 – Lake County South. It generally is located in a band within 15 miles of Lake Superior and is dominated by sugar maple with yellow birch, although northern white cedar, basswood, red maple, and northern red oak may also be present (USFS 2004a). Fire and wind disturbances are very infrequent, leaving individual tree mortality as the principal disturbance.

Invasive Non-native Plants

According to the Superior National Forest invasive plant geodatabase, there are no known occurrences of invasive species on the Tract 2 lands (USFS 2010a). Field studies indicate that one area of Tract 2 – Lake County North and several areas in the Tract 2 – Lake County South parcel contain occurrences of thistles and ox-eye daisy in a recently clear-cut habitat (AECOM 2011c).

Threatened and Endangered Plant Species

Endangered, Threatened, and Special Concern Plant Species

Based on a review of the MDNR NHIS and field investigations, no federally or state-listed ETSC plant species are known to occur on the Tract 2 lands.

Regional Foresters Sensitive Species

There is more lowland black spruce-tamarack forest (MIH 9) and upland forest (MIH 1) habitat available than any other type, so the RFSS plants associated with these types would be most likely to occur on the Tract 2 lands. There is a very small amount of upland conifer forest (MIH 5) or aquatic habitat (MIH 14) so RFSS plants associated with these would be less likely to occur.

4.3.4.2.7 Tract 3 – Wolf Lands

Tract 3 is 1,575.8 acres in size and is located on the Laurentian and Tofte Ranger Districts. Tract 3 includes four separate parcels ranging in size from 126 to 768 acres, referred to here as Tract 3 – Wolf Lands 1 through 4, which would complement Superior National Forest ownership by reducing federal exterior boundaries and eliminating several private ownership patterns (USFS 2011n). Tract 3 lands are located east to southeast of the federal lands and Tract 3 – Wolf Lands 1 is adjacent to Tract 2 – Lake County North.

Cover Types

Tract 3 lands are located in the Laurentian Uplands subsection of the Laurentian Mixed Forest Province ecoregion (MDNR 2006a). Section 4.2.4.1 provides a description of the Laurentian Uplands subsection.

Tract 3 – Wolf Lands 1

Habitat Types

The primary MDNR GAP land cover type on the Tract 3 – Wolf Lands 1 parcel is lowland coniferous forest (see Table 4.3.4-15). It has fewer acres of shrubland and mixed upland forests. The MDNR GAP land cover types below may not fully represent the extent of mixed forest types, since the cover type level below is fairly specific, so there may be more mixed forest types than indicated.

Table 4.3.4-15 Tract 3 – Wolf Lands 1 Cover Types

Cover Types	Total Acres	Percent of Area
Lowland coniferous forest[1]	74.8	59
Upland deciduous forest[4]	27.2	22
Upland coniferous forest[3]	13.3	11
Shrubland	6.9	5
Upland conifer-deciduous mixed forest[5]	3.7	3
Aquatic environments	0.0	0
Cropland/grassland	0.0	0
Disturbed	0.0	0
Lowland deciduous forest[2]	0.0	0
Total	**125.9[(6)]**	**100**

Source: MDNR 2006b.

Notes:
[1] Includes lowland black spruce, lowland northern white cedar, and tamarack forest cover types.
[2] Includes black ash forest cover types.
[3] Includes pine and spruce/fir forest cover types.
[4] Includes aspen/aspen-white birch, maple/basswood, and oak forest cover types.
[5] Includes all mixed coniferous-deciduous forest cover types.
[6] Total acres may be more or less than presented due to rounding.

Plant Community Surveys

The primary cover types on Tract 3 – Wolf Lands 1 are pole coniferous forest on the wetlands, and immature mixed forest on the uplands (AECOM 2011c). The wetlands contain equal amounts of open, bog-like communities of sapling black spruce, northern white cedar, and tamarack, and denser pole forests of these same species, in addition to balsam fir. Please see Section 4.3.3 for a more detailed description of wetland habitat types present. Uplands are dominated by deciduous and coniferous immature forest with paper birch, trembling aspen, and balsam fir. Shrub species include beaked hazel and red-osier dogwood (*Cornus stolonifera*) (AECOM 2011c).

The majority of the Tract 3 – Wolf Lands 1 consists of wetland pole coniferous trees from 6 to 10 inches dbh, while the mature mixed forest trees on uplands are 12 inches dbh or greater (AECOM 2011c).

Minnesota Biological Survey

There are no designated MBS Sites of Biodiversity Significance located on the Tract 3 –Wolf Lands 1 parcel (see Figure 4.3.4-1) (MDNR 2008a). However, Tract 3 – Wolf Lands 1 is located on a potential MBS Site of Moderate to High Biodiversity Significance that has not yet been finalized by the MDNR (MDNR 2007a).

Native plant community rankings for Tract 3 are not available.

Scientific and Natural Areas

There are no SNAs located on the Tract 3 parcels.

Culturally Important Plants

A discussion of natural resources culturally important to the Bands is presented in Section 4.2.9.3.3.

Management Areas

The non-federal lands currently do not have any management area designations, as they are not managed by the federal government. Section 4.3.1 describes the management areas in detail.

Ecological Land Types

Tract 3 – Wolf Lands 1 contains three categories of ELTs, including Lowland Loamy Wet (ELT 2), Lowland Organic Acid to Neutral (ELT 6), and Upland Deep Medium Loamy Dry (ELT 14). The entire Tract 3 – Wolf Lands 1 parcel is included in the Greenwood Lake Till Plain LTA.

Management Indicator Habitats

Table 4.3.4-3 provides a summary of the MIH types and age classes present on Tract 3 lands (see Figure 4.3.4-1) (USFS 2010b). Though not considered an MIH, the Tract 3 – Wolf Lands 1 parcel also contains 9.7 acres of lowland shrub habitat.

Landscape Ecosystems

Table 4.3.4-4 provides a summary of the landscape ecosystem types present on Tract 3 lands.

The Lowland Conifer landscape ecosystem occupies 84.3 acres of the Tract 3 – Wolf Lands 1 parcel. The Mesic Birch-Aspen-Spruce-Fir landscape ecosystem occupies 41.5 acres of the Tract 3 – Wolf Lands 1 parcel. See the federal or non-federal lands sections above for a description of these landscape ecosystem types.

Tract 3 – Wolf Lands 2

Habitat Types

The primary MDNR GAP land cover type on the Tract 3 – Wolf Lands 2 parcel is lowland coniferous forest (see Table 4.3.4-16). The least abundant cover types include lowland deciduous forest and mixed upland forests. The MDNR GAP land cover types below may not fully represent the extent of mixed forest types, since the cover type level below is fairly specific, so there may be more mixed forest types than indicated.

Table 4.3.4-16 Tract 3 – Wolf Lands 2 Cover Types

Cover Types	Total Acres	Percent of Area
Lowland coniferous forest[1]	586.2	76
Upland coniferous forest[3]	86.5	11
Shrubland	54.0	7
Upland deciduous forest[4]	29.9	4
Lowland deciduous forest[2]	5.8	1
Upland conifer-deciduous mixed forest[5]	5.5	1
Aquatic environments	0.0	0
Cropland/grassland	0.0	0
Disturbed	0.0	0
Total	**767.9**	**100**

Source: MDNR 2006b.

Notes:
[1] Includes lowland black spruce, lowland northern white cedar, and tamarack forest cover types.
[2] Includes black ash forest cover types.
[3] Includes pine and spruce/fir forest cover types.
[4] Includes aspen/aspen-white birch, maple/basswood, and oak forest cover types.
[5] Includes all mixed coniferous-deciduous forest cover types.

Plant Community Surveys

Tract 3 – Wolf Lands 2 consists of mostly wetland habitats dominated by either pole black spruce, northern white cedar, or a mix of the two (AECOM 2011c). Midstory cover types in these forests consist of sapling black spruce, northern white cedar, or balsam fir. Scrub-shrub habitats of speckled alder dominate drainage areas. Some bogs, emergent wetlands, and beaver ponds exist on the parcel. Section 4.3.3 presents a more detailed description of wetland habitat types present.

Upland habitats consist of pole or immature mixed coniferous-deciduous forest types, including paper birch, trembling aspen, and black spruce, with a midstory of balsam fir and shrub layer of beaked hazel (AECOM 2011c).

The majority of Tract 3 – Wolf Lands 2 consists of wetland coniferous forests with canopy trees ranging from 4 to 8 inches dbh. An upland area in the northern portion of the parcel was logged in the past, and so the canopy cover in this area consists of immature coniferous and deciduous trees ranging from 5 to 12 inches dbh (AECOM 2011c).

Minnesota Biological Survey

The entire 767.9 acres of the Tract 3 – Wolf Lands 2 parcel is located within the East Greenwood MBS Site of Moderate Biodiversity Significance (see Figure 4.3.4-2) (MDNR 2007a; MDNR 2008a). This site is located in the Laurentian Uplands subsection. Sites of Moderate Biodiversity Significance are sites that contain occurrences of rare species and/or moderately disturbed native plant communities or landscapes that have a strong potential for recovery.

Native plant community rankings for Tract 3 are not available.

Scientific and Natural Areas

There are no SNAs located on the Tract 3 parcels.

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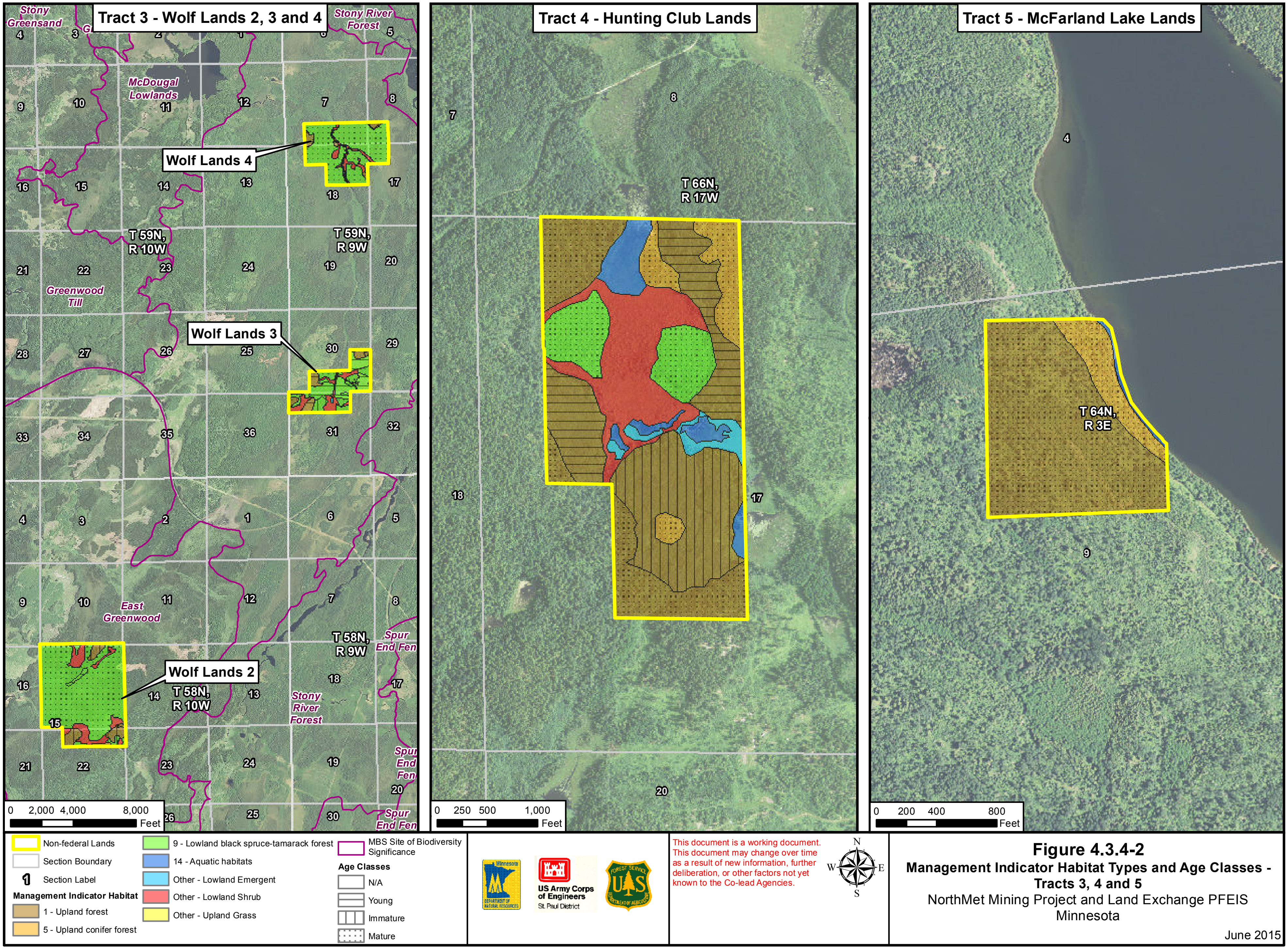

Figure 4.3.4-2

Management Indicator Habitat Types and Age Classes - Tracts 3, 4 and 5

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Minnesota

June 2015

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Culturally Important Plants

A discussion of natural resources culturally important to the Bands is presented in Section 4.2.9.3.3.

Management Areas

The non-federal lands currently do not have any management area designations, as they are not managed by the federal government. Section 4.3.1 describes the management areas in detail.

Ecological Land Types

Tract 3 – Wolf Lands 2 contains four categories of ELTs, including Lowland Loamy Moist (ELT 1), Lowland Loamy Wet (ELT 2), Upland Deep Loamy Dry Course (ELT 13), and Upland Deep Medium Loamy Dry (ELT 14). The entire Wolf Lands 2 parcel is included in the Greenwood Lake Till Plain LTA.

Management Indicator Habitats

Table 4.3.4-3 provides a summary of the MIH types and age classes present on Tract 3 lands (see Figure 4.3.4-2) (USFS 2010b). Though not considered an MIH, the Tract 3 – Wolf Lands 2 parcel also contains 76 acres of lowland shrub habitat. The Tract 3 – Wolf Lands 2 parcel contains one patch of mature forest over 300 acres (598.2 acres), which is an important habitat type. However, this is different from the USFS Patch layer discussed in Section 4.3.4.1.1.

Landscape Ecosystems

Table 4.3.4-4 provides a summary of the landscape ecosystem types present on Tract 3 lands.

The Lowland Conifer landscape ecosystem occupies 653.2 acres of the Tract 3 – Wolf Lands 2 parcel. The Mesic Birch-Aspen-Spruce-Fir landscape ecosystem occupies 114.7 acres of the Tract 3 – Wolf Lands 2 parcel. Previous federal or non-federal land sections present descriptions of these landscape ecosystem types.

Tract 3 – Wolf Lands 3

Habitat Types

The primary MDNR GAP land cover type on the Tract 3 – Wolf Lands 3 parcel is lowland coniferous forest (see Table 4.3.4-17). The upland deciduous forest and mixed upland forest types are least represented. The MDNR GAP land cover types below may not fully represent the extent of mixed forest types, since the cover type level below is fairly specific, so there may be more mixed forest types than indicated.

Table 4.3.4-17 Tract 3 – Wolf Lands 3 Cover Types

Cover Types	Total Acres	Percent of Area
Lowland coniferous forest[1]	183.8	66
Upland coniferous forest[3]	46.4	17
Shrubland	31.7	11
Upland deciduous forest[4]	12.4	4
Upland conifer-deciduous mixed forest[5]	3.1	1
Aquatic environments	0.0	0
Cropland/grassland	0.0	0
Disturbed	0.0	0
Lowland deciduous forest[2]	0.0	0
Total	**277.4**	**99[(6)]**

Source: MDNR 2006b.

Notes:
[1] Includes lowland black spruce, lowland northern white cedar, and tamarack forest cover types.
[2] Includes black ash forest cover types.
[3] Includes pine and spruce/fir forest cover types.
[4] Includes aspen/aspen-white birch, maple/basswood, and oak forest cover types.
[5] Includes all mixed coniferous-deciduous forest cover types.
[6] Percent totals less than 100 percent due to rounding.

Plant Community Surveys

The Tract 3 – Wolf Lands 3 parcel also consists of mostly wetland habitats (AECOM 2011c). Coyote Creek runs through the parcel and is bordered by sedge meadow wetlands, consisting of sedges, narrow-leaved cattail, and Canada bluejoint. Roughly half of the parcel has been recently logged. Logged wetlands are dominated by grasses, forbs, and shrubs, including red-osier dogwood and speckled alder. Unlogged wetlands consist of pole black spruce, with tamarack and balsam fir also present. Please see Section 4.3.3 for a more detailed description of wetland habitat types.

Upland areas within the parcel have been recently logged and most of these areas have few remaining trees. Logged uplands are dominated by grasses, forbs, and beaked hazel, but some areas still support paper birch and scattered balsam fir. The upland habitat bordering the parcel consists of young and mature paper birch with scattered black spruce and northern white cedar over an understory of balsam fir (AECOM 2011c).

Tract 3 – Wolf Lands 3 consists of pole coniferous trees in wetlands and sapling or mature mixed forest trees on uplands, which range from 0 to 4 inches dbh or 12 inches dbh or greater, respectively (AECOM 2011c). Unlogged wetland forests on the Tract 3 – Wolf Lands 3 parcel range from 4 to 10 inches dbh. Logged upland areas still support paper birches that are up to 16 inches dbh.

Minnesota Biological Survey

There are no designated MBS Sites of Biodiversity Significance located on the Tract 3 – Wolf Lands 3 parcel (see Figure 4.3.4-2) (MDNR 2008a). However, Tract 3 – Wolf Lands 3 is located on a potential MBS Site of Moderate to High Biodiversity Significance that has not yet been finalized by the MDNR (MDNR 2007a).

Native plant community rankings for Tract 3 are not available.

Scientific and Natural Areas

There are no SNAs located on the Tract 3 parcels.

Culturally Important Plants

A discussion of natural resources culturally important to the Bands is presented in Section 4.2.9.3.3.

Management Areas

The non-federal lands currently do not have any management area designations, as they are not managed by the federal government. Section 4.3.1 describes the management areas in detail.

Ecological Land Types

Tract 3 – Wolf Lands 3 contains three categories of ELTs, including Lowland Loamy Moist (ELT 1), Lowland Loamy Wet (ELT 2), and Lowland Organic Acid to Neutral (ELT 6). The entire Tract 3 – Wolf Lands 3 parcel is included in the Greenwood Lake Till Plain LTA.

Management Indicator Habitats

Table 4.3.4-3 provides a summary of the MIH types and age classes present on Tract 3 lands (see Figure 4.3.4-2) (USFS 2010b). Though not considered MIHs, the Tract 3 – Wolf Lands 3 parcel also contains 48.6 acres of lowland shrub habitat and less than an acre of lowland emergent habitat.

Landscape Ecosystems

Table 4.3.4-4 provides a summary of the landscape ecosystem types present on Tract 3 lands.

The Lowland Conifer landscape ecosystem occupies 217.7 acres of the Tract 3 – Wolf Lands 3 parcel. The Mesic Birch-Aspen-Spruce-Fir landscape ecosystem occupies 59.7 acres of the Tract 3 – Wolf Lands 3 parcel. Please see previous federal or non-federal lands sections above for a description of these landscape ecosystem types.

Tract 3 – Wolf Lands 4

Habitat Types

The primary MDNR GAP land cover type on the Tract 3 – Wolf Lands 4 parcel is lowland coniferous forest (see Table 4.3.4-18). The shrubland and mixed upland forest cover types are least represented. The MDNR GAP land cover types below may not fully represent the extent of mixed forest types, since the cover type level below is fairly specific, so there may be more mixed forest types than indicated.

Table 4.3.4-18 Tract 3 – Wolf Lands 4 Cover Types

Cover Types	Total Acres	Percent of Area
Lowland coniferous forest[1]	356.5	88
Upland coniferous forest[3]	32.0	8
Upland deciduous forest[4]	8.2	2
Upland conifer-deciduous mixed forest[5]	4.1	1
Shrubland	3.9	1
Aquatic environments	0.0	0
Cropland/grassland	0.0	0
Disturbed	0.0	0
Lowland deciduous forest[2]	0.0	0
Total	**404.7**	**100**

Source: MDNR 2006b.

Notes:
[1] Includes lowland black spruce, lowland northern white cedar, and tamarack forest cover types.
[2] Includes black ash forest cover types.
[3] Includes pine and spruce/fir forest cover types.
[4] Includes aspen/aspen-white birch, maple/basswood, and oak forest cover types.
[5] Includes all mixed coniferous-deciduous forest cover types.

Plant Community Surveys

The Tract 3 – Wolf Lands 4 parcel consists of approximately 90 percent wetland habitats (AECOM 2011c). Coyote Creek bisects the parcel and is bordered on either side by emergent wetland habitats similar to Tract 3 – Wolf Lands 3. Wetlands are dominated by pole black spruce in the northern half of the parcel and pole northern white cedar in the southern half. Scrub-shrub wetlands consist of speckled alder, leatherleaf, and bog-Labrador tea. See Section 4.3.3 for a more detailed description of wetland habitat types present.

Upland habitats consist of immature paper birch and black spruce, with balsam fir, beaked hazel, and raspberry also present. In areas that have been logged recently, sapling trembling aspen and paper birch are common over a shrub layer of beaked hazel, raspberry, and bog Labrador-tea (AECOM 2011c).

The majority of the black spruce/northern white cedar wetlands are dominated by trees ranging from 4 to 8 inches dbh (AECOM 2011c). Upland mature coniferous and deciduous trees range up to 18 inches dbh, although a 30-inch-dbh jack pine and several red pines up to 24 inches dbh have been found.

Minnesota Biological Survey

There are no designated MBS Sites of Biodiversity Significance located on the Tract 3 – Wolf Lands 4 parcel (see Figure 4.3.4-2) (MDNR 2008a). However, Tract 3 – Wolf Lands 4 is located on a potential MBS Site of Moderate to High Biodiversity Significance that has not yet been finalized by the MDNR (MDNR 2007a).

Native plant community rankings for Tract 3 are not available.

Scientific and Natural Areas

There are no SNAs located on the Tract 3 parcels.

Culturally Important Plants

A discussion of natural resources culturally important to the Bands is presented in Section 4.2.9.3.3.

Management Areas

The non-federal lands currently do not have any management area designations, as they are not managed by the federal government. Section 4.3.1 describes the management areas in detail.

Ecological Land Types

Tract 3 – Wolf Lands 4 contains four categories of ELTs, including Lowland Loamy Moist (ELT 1), Lowland Loamy Wet (ELT 2), Lowland Organic Acid to Neutral (ELT 6), and Upland Deep Medium Loamy Dry (ELT 14). The entire Tract 3 – Wolf Lands 4 parcel is included in the Greenwood Lake Till Plain LTA.

Management Indicator Habitats

Table 4.3.4-3 provides a summary of the MIH types and age classes present on Tract 3 lands (see Figure 4.3.4-2) (USFS 2010b). Though not considered an MIH, the Tract 3 – Wolf Lands 4 parcel also contains 31.0 acres of lowland shrub habitat.

Landscape Ecosystems

Table 4.3.4-4 provides a summary of the landscape ecosystem types present on Tract 3 lands.

The Lowland Conifer landscape ecosystem occupies 356.7 acres of the Tract 3 – Wolf Lands 4 parcel. The Mesic Birch-Aspen-Spruce-Fir landscape ecosystem occupies 47.9 acres of the Tract 3 – Wolf Lands 4 parcel. Please see previous federal or non-federal lands sections above for a description of these landscape ecosystem types.

Invasive Non-native Plants

According to the Superior National Forest invasive plant geodatabase, there are no known occurrences of invasive species on any of the Tract 3 parcels (USFS 2010a). Field studies indicate that one area of Tract 3 – Wolf Lands 3 contains an occurrence of thistles and ox-eye daisy in a recently clear-cut habitat (AECOM 2011c).

Threatened and Endangered Plant Species

Endangered, Threatened, and Special Concern Plant Species

Based on a review of the MDNR NHIS and field investigations, no federally or state-listed ETSC plant species are known to occur on the Tract 3 – Wolf Lands.

Regional Foresters Sensitive Species

There is more lowland black spruce-tamarack forest (MIH 9) and upland forest (MIH 1) habitat available than any other type, so the RFSS plants associated with these types would be most likely to occur on the Tract 3 lands. There is a very small amount of upland conifer forest (MIH 5) or aquatic habitats (MIH 14) so RFSS plants associated with these would be less likely to occur.

4.3.4.2.8 Tract 4 – Hunting Club Lands

Tract 4 is 160.2 acres in size, located on the LaCroix Ranger District, 5 miles southwest of Crane Lake. Tract 4 is surrounded by the Superior National Forest, St. Louis County lands, and privately owned lands (USFS 2011n).

Cover Types

Tract 4 is located in the Laurentian Mixed Forest Province Ecoregion and in the Border Lakes subsection of the Laurentian Mixed Forest Province ecoregion (MDNR 2006a). Most of the vegetative cover types in this subsection grow in thin, acid, cobbly to gravelly glacial materials over Precambrian bedrock (MDNR 2011g). Lakes and rocky ridges dominate this type of landscape. Soils vary from coarse-loamy to coarse texture, and support forest communities of aspen-birch, aspen-birch-conifer, and, on dry sites, jack pine barrens. Many such communities within this subsection are fire-dependent.

Habitat Types

The primary MDNR GAP land cover type on Tract 4 is upland deciduous forest (see Table 4.3.4-19). The upland conifer forest and lowland deciduous forest types are least represented. The MDNR GAP land cover types below may not fully represent the extent of mixed forest types, since the cover type level below is fairly specific, so there may be more mixed forest types than indicated.

Table 4.3.4-19 Tract 4 – Hunting Club Lands Cover Types

Cover Types	Total Acres	Percent of Area
Upland deciduous forest[4]	84.6	53
Shrubland	45.0	28
Aquatic environments	9.6	6
Lowland coniferous forest[1]	8.9	6
Upland coniferous forest[3]	8.2	5
Lowland deciduous forest[2]	4.0	2
Cropland/grassland	0.0	0
Disturbed	0.0	0
Upland conifer-deciduous mixed forest[5]	0.0	0
Total	**160.3[6]**	**100**

Source: MDNR 2006b.

Notes:
[1] Includes lowland black spruce, lowland northern white cedar, and tamarack forest cover types.
[2] Includes black ash forest cover types.
[3] Includes pine and spruce/fir forest cover types.
[4] Includes aspen/aspen-white birch, maple/basswood, and oak forest cover types.
[5] Includes all mixed coniferous-deciduous forest cover types.
[6] Total acres may be more or less than presented due to rounding.

Plant Community Surveys

The primary cover types on Tract 4 are pole and mature deciduous forests on the uplands and scrub-shrub and emergent wetlands (AECOM 2011c). An unnamed creek bisects the parcel, and beaver ponds and dams are common wetland features. Emergent vegetation surrounding open water consists of Canada bluejoint, narrow-leaved cattail, and sedges, while speckled alder dominates scrub-shrub wetlands. Pole black spruce and scattered tamarack dominate the wetlands on the interior of the parcel. Please see Section 4.3.3 for a more detailed description of wetland habitat types present.

Upland habitats in the northwestern, northeastern, and southern portions of the parcel are dominated by mature white pine, red pine, paper birch, and trembling aspen, with balsam fir and beaked hazel also present, though some areas consist of sapling and immature trees. The upland habitats in the eastern and southern portions of the parcel consist of patches of sapling and pole trembling aspen, with beaked hazel, black spruce, and balsam fir. An “island” of immature white pine, trembling aspen, and black spruce exists within this patch of sapling trembling aspen (AECOM 2011c).

The Tract 4 uplands are dominated by mostly deciduous sapling trees from 0 to 4 inches dbh, but mature white pines up to 24 inches dbh, and paper birch and trembling aspen up to 12 inches dbh occupy a large area as well (AECOM 2011c). Other upland areas on the parcel contain trembling aspen and white pine up to 16 inches dbh, and black spruce up to 12 inches dbh. Wetlands are dominated by immature coniferous forest trees ranging from 5 to 12 inches dbh.

Minnesota Biological Survey

There are no lands designated as MBS Sites of Biodiversity Significance on Tract 4 (see Figure 4.3.4-2) (MDNR 2008a).

Native plant community rankings are not available for Tract 4.

Scientific and Natural Areas

There are no lands designated as SNAs on Tract 4.

Culturally Important Plants

A discussion of natural resources culturally important to the Bands is presented in Section 4.2.9.3.3.

Management Areas

The non-federal lands currently do not have any management area designations, as they are not managed by the federal government. Section 4.3.1 describes the management areas in detail.

Ecological Land Types

Tract 4 contains seven different categories of ELTs, including Lowland Clayey Moist (ELT 3), Lowland Clayey Wet (ELT 4), Lowland Organic Acid to Neutral (ELT 6), Upland Deep Clayey Dry (ELT 10), Upland Shallow Loamy Dry (ELT 16), Upland Very Shallow Loamy Droughty (ELT 17), and Upland Extremely Shallow Loamy Droughty (ELT 18). The entire Tract 4 is included in the Johnson Lake Bedrock Complex LTA.

Management Indicator Habitats

Table 4.3.4-3 provides a summary of the MIH types and age classes present on Tract 4 (see Figure 4.3.4-2) (USFS 2010b). Though not considered MIHs, Tract 4 also contains 26.6 acres of lowland shrub habitat and 4.2 acres of lowland emergent habitat.

Landscape Ecosystems

Table 4.3.4-4 provides a summary of the landscape ecosystem types present on Tract 4.

The Dry-Mesic Red and White Pine landscape ecosystem occupies 93.7 acres of Tract 4. Please see previous federal or non-federal lands sections above for a description of this landscape ecosystem type.

The Lowland Hardwood landscape ecosystem occupies 66.5 acres of Tract 4. It is dominated by black ash and/or balsam poplar, although elm, green ash, paper birch, aspen, yellow birch, balsam fir, northern white cedar, and white spruce may also be present (USFS 2004a). This landscape ecosystem typically occurs on sites that are seasonally wet or wet year-round. Stand replacement disturbances are infrequent, resulting in a multi-aged stand of black ash and balsam poplar.

Invasive Non-native Plants

According to the Superior National Forest invasive plant geodatabase, there are no known occurrences of invasive species on Tract 4 (USFS 2010a).

Threatened and Endangered Plant Species

Endangered, Threatened, and Special Concern Plant Species

Based on a review of the MDNR NHIS and field investigations, no federally or state-listed ETSC plant species are known to occur on Tract 4.

Regional Foresters Sensitive Species

There is more upland forest (MIH 1) habitat available than any other type, so the RFSS plants associated with this type would be most likely to occur on Tract 4. There is a similar smaller amount of upland conifer forest (MIH 5), lowland black spruce-tamarack forest (MIH 9), and aquatic habitats (MIH 14), so RFSS plants associated with these would be less likely to occur.

4.3.4.2.9 Tract 5 – McFarland Lake Lands

Tract 5 is 30.8 acres in size on the Gunflint Ranger District in northeastern Cook County. The tract adds to Superior National Forest ownership and includes lakefront property on McFarland Lake, which is an entry point to the BWCAW. The parcel reaches an approximate maximum elevation of 1,762 ft amsl and the topography slopes steeply to the east toward its eastern border of McFarland Lake (NTS 2010b).

Cover Types

Tract 5 is located in the Border Lakes subsection of the Laurentian Mixed Forest Province ecoregion (MDNR 2006a). See Tract 4 above for a description of the Border Lakes subsection.

Habitat Types

The primary MDNR GAP land cover type on Tract 5 is upland deciduous forest (see Table 4.3.4-20). The remaining cover types on the parcel are upland conifer forest and aquatic environments. The MDNR GAP land cover types below may not fully represent the extent of mixed forest types, since the cover type level below is fairly specific, so there may be more mixed forest types than indicated.

Table 4.3.4-20 Tract 5 – McFarland Lake Lands Cover Types

Cover Types	Total Acres	Percent of Area
Upland deciduous forest[4]	26.6	86
Upland coniferous forest[3]	4.0	13
Aquatic environments	0.2	1
Cropland/grassland	0.0	0
Disturbed	0.0	0
Lowland coniferous forest[1]	0.0	0
Lowland deciduous forest[2]	0.0	0
Shrubland	0.0	0
Upland conifer-deciduous mixed forest[5]	0.0	0
Total	**30.8**	**100**

Source: MDNR 2006b.

Notes:
[1] Includes lowland black spruce, lowland northern white cedar, and tamarack forest cover types.
[2] Includes black ash forest cover types.
[3] Includes pine and spruce/fir forest cover types.
[4] Includes aspen/aspen-white birch, maple/basswood, and oak forest cover types.
[5] Includes all mixed coniferous-deciduous forest cover types.

Plant Community Surveys

Tract 5 consists of upland habitats, dominated by pole and mature deciduous and coniferous forests (AECOM 2009b; AECOM 2011b). The parcel is located on McFarland Lake, and a narrow band of horsetail and white cedar was observed along the shoreline (AECOM 2011b). Section 4.3.3 presents a more detailed description of wetland habitat types present.

Upland forest types on the hill slope of the parcel consist of trembling aspen, paper birch, mountain maple, northern white cedar, black spruce, and balsam fir. Mountain maple and northern white cedar are common on the lower hill slopes, while red pine and trembling aspen are more prevalent at the top of the hill slope. The shrub layer includes smooth sumac (*Rhus glabra*) and beaked hazel, while the ground layer includes forbs such as bunchberry, twining honeysuckle, clintonia, large-leaved aster, twinflower, false lily-of-the-valley (*Maianthemum canadense*), ox-eye daisy, thimbleberry (*Rubus parviflorus*), wild raspberry, wild strawberry, bog rosemary (*Andromeda glaucophylla*), bog cranberry (*Vaccinium oxycoccus*), wild sarsaparilla (*Aralia nudicaulis*), bracken fern and other ferns, and club moss (*Lycopodium* spp.) (AECOM 2011b). Some recent logging has occurred along the hill slope of the western boundary of the parcel. Steep rocky cliffs about 150 ft in height exist toward this western boundary (AECOM 2011b). Enchanter's nightshade (*Circaea quadrisulcata*) and wild columbine (*Aquilegia canadensis*) have been observed on the rocky cliffs.

Upland forests on the parcel contain trembling aspen, red pine, and eastern white pine up to 18 inches dbh, balsam fir up to 16 inches dbh, and paper birch up to 12 inches dbh (AECOM 2011b). Wetland forests along McFarland Lake contain northern white cedar up to 24 inches dbh.

Minnesota Biological Survey

There are no lands designated as MBS Sites of Biodiversity Significance on the Tract 5 lands (see Figure 4.3.4-2) (MDNR 2008a).

Native plant community rankings are not available for the Tract 5 lands.

Scientific and Natural Areas

There are no lands designated as SNAs on the Tract 5 lands.

Culturally Important Plants

A discussion of natural resources culturally important to the Bands is presented in Section 4.2.9.3.3.

Management Areas

The non-federal lands currently do not have any management area designations, as they are not managed by the federal government. Section 4.3.1 describes the management areas in detail.

Ecological Land Types

Tract 5 contains four different categories of ELTs, including Lowland Loamy Wet (ELT 2), Upland Deep Medium Loamy Dry (ELT 14), Upland Shallow Loamy Dry (ELT 16), and Upland Extremely Shallow Loamy Droughty (ELT 18), though categories are not available for the entire parcel. All of Tract 5 is included in the Rove Slate Bedrock Complex LTA.

Management Indicator Habitats

Table 4.3.4-3 provides a summary of the MIH types and age classes present on Tract 5 (see Figure 4.3.4-2) (USFS 2010b).

Landscape Ecosystems

Table 4.3.4-4 provides a summary of the landscape ecosystem types present on Tract 5.

The Mesic Red and White Pine landscape ecosystem occupies 30.8 acres of the Tract 5. See the federal or non-federal lands sections above for a description of these landscape ecosystem types.

<u>Invasive Non-native Plants</u>

According to the Superior National Forest invasive plant geodatabase, there are no known occurrences of invasive species on the Tract 5 lands (USFS 2010a).

Threatened and Endangered Plant Species

Endangered, Threatened, and Special Concern Plant Species

No federally listed ETSC plant species are known to occur on Tract 5. Based on a review of the MDNR NHIS, one state-listed threatened species and one species of special concern have been identified on Tract 5 (see Table 4.3.4-21 and Figure 4.3.4-3). Encrusted saxifrage is also tracked by the USFS as an RFSS. No other state-listed species are known to occur on Tract 5.

Rulemaking was conducted with the intent to update the list of ETSC species (*Minnesota Rules*, parts 6134.0100 to 6134.0400), with new listings becoming effective on August 19, 2013 (MDNR 2013h). This FEIS considers any new listings, or changes in the previous listings, associated with the updated list.

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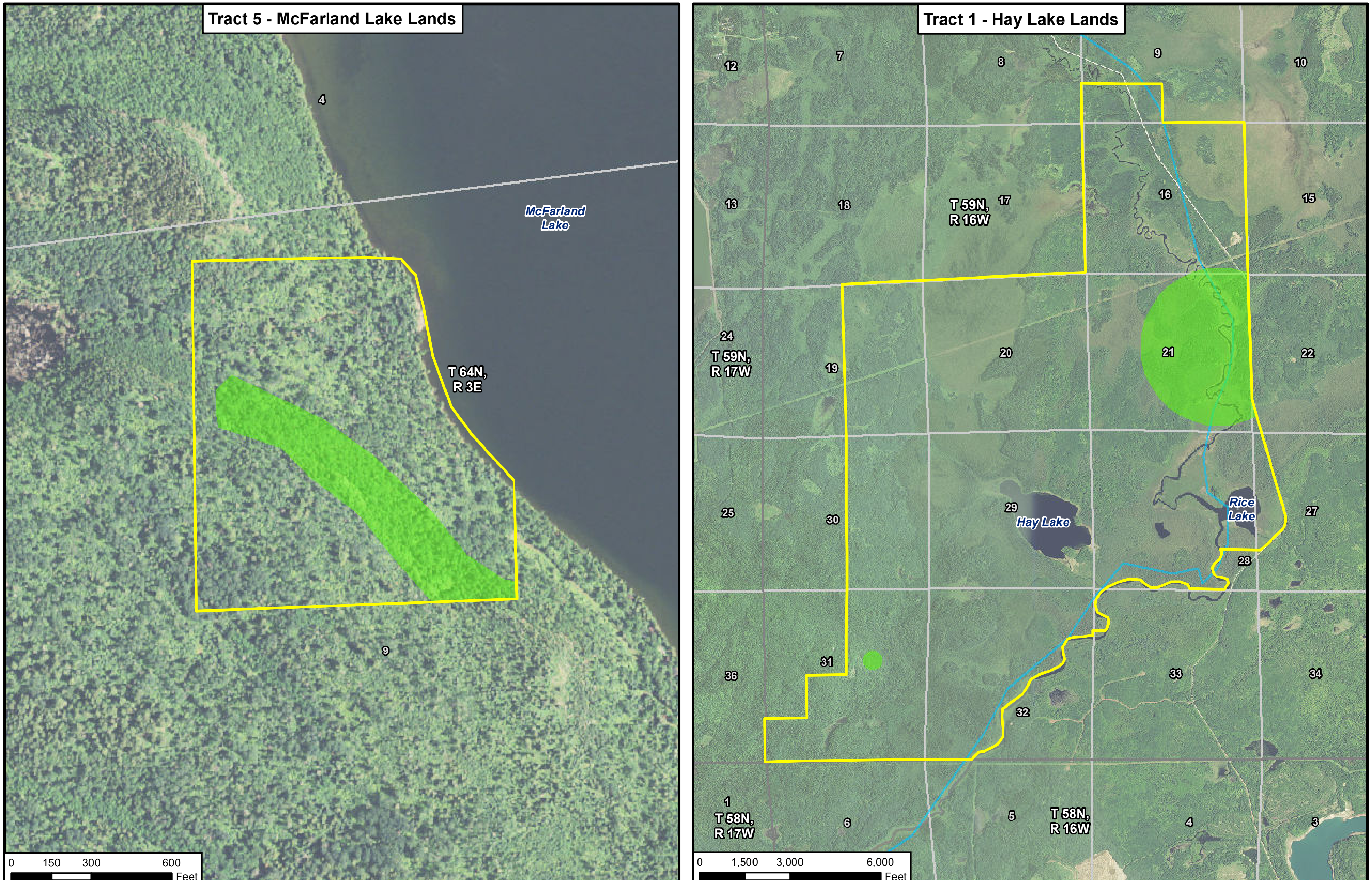


Non-federal Lands

Endangered, Threatened and Special Concern Vegetation Species

1 - Section Number

Minnesota Department of Natural Resources

US Army Corps of Engineers St. Paul District

Forest Service U.S. Department of Agriculture

This document is a working document. This document may change over time as a result of new information, further deliberation, or other factors not yet known to the Co-lead Agencies.

N W E S

Figure 4.3.4-3

ETSC Vegetation - Tracts 1 and 5

NorthMet Mining Project and Land Exchange PFEIS

Minnesota

June 2015

1178 -Page Intentionally Left Blank-

Table 4.3.4-21 Endangered, Threatened, and Special Concern Plant Species Identified on the Tract 5 Lands [4]

Common Name	Scientific Name	State Status[1]	No. of Populations	No. of Individuals[2]	Habitat and Location
Encrusted saxifrage[3]	*Saxifraga paniculata* (=*aizoon*)	SC	1	1000+	Shaded rock crevices and mossy ledges of north-facing sedimentary rock cliffs.
Rocky Mountain woodsia	*Woodsia scopulina*	T	1	2+	Cool, moist moss-covered chutes of north-facing sedimentary rock cliffs.

Sources: MDNR 2014d; MDNR 2011k.

Notes:
1 E - Endangered, T - Threatened, SC - Species of Special Concern.
2 Where the number of individuals cannot be determined without damaging the population, then patch size is used as a representative abundance measure.
3 These species are also RFSS as tracked by the USFS.
4 Data included here were provided by the Division of Ecological Resources, MDNR, and were current as of August 5, 2014. These data are not based on an exhaustive inventory of the state. The lack of data for any geographic area shall not be construed to mean that no significant features are present.

<u>*Species Life Histories*</u>

The following summary provides descriptions of the life histories, state-wide distributions, and sensitivity to disturbance for each of the two threatened species found on Tract 5.

Encrusted saxifrage (*Saxifraga paniculata*) (synonyms: *Saxifraga aizoon* var. *neogaea*, white mountain saxifrage) is listed as a species of special concern in Minnesota and as an RFSS in the Superior National Forest. The species was first documented in Cook County, Minnesota in 1932, and has since only been reported in Cook and Lake counties (Bell Museum of Natural History 2011).

S. paniculata is an arctic-alpine species that reaches the southern end of its range in Minnesota (MDNR 2011k). It typically occurs in rock crevices and on ledges of shaded north-facing cliffs with bedrock of diabase, gabbro/diorite, basalt, or Rove Formation rocks. *S. paniculata* is a perennial herb species that flowers from early June to July and bears fruit from late July through August, though it can also spread vegetatively via stolons. There is very little suitable cliff habitat for *S. paniculata* in Minnesota, and threats to the species could include climate change, changes in the biotic community, and recreational exploration of vulnerable cliff faces.

Rocky Mountain woodsia (*Woodsia scopulina*) (Synonyms: *Woodsia scopulina* ssp. *laurentiana*) is listed as a threatened species in Minnesota; it is not listed as an RFSS in the Superior National Forest. The species was first documented in Cook County, Minnesota in 1929 amidst slate rocks, and has since only been reported in Cook County (Bell Museum of Natural History 2011). Though it is common in the Rocky Mountains, it is limited primarily to cool, moist north-facing cliffs of the Rove Slate Formation in northeast Minnesota (MDNR 2011k). *W. scopulina* is a perennial fern that grows in small clumps, and produces spores from summer to fall (eFlora 2011). There is very little suitable cliff habitat for *W. scopulina* in Minnesota, as it requires diabase and slate bedrock and east-west oriented valleys. Threats to the species could include climate change, introduction of non-native species, erosion events, forest management activities that alter the biotic community, or recreational exploration of vulnerable cliff faces.

Regional Foresters Sensitive Species

Based on a review of the MDNR NHIS, *Saxifraga paniculata* is located on Tract 5, and it is also an RFSS plant. There is more upland forest (MIH 1) habitat available than any other type, so the RFSS plants associated with this type would be most likely to occur on the Tract 5 lands. There is a smaller amount of upland conifer forest (MIH 5) and aquatic habitats (MIH 14) so RFSS plants associated with these would be less likely to occur. There is no lowland black spruce-tamarack forest (MIH 9) available, and so RFSS plants associated with this habitat would likely not exist. The cliff habitat present on Tract 5 is important to the 12 RFSS plants that utilize exposed rock habitats in the Superior National Forest (see Table 4.2.4-5), including *Saxifraga paniculata*, as there is very little suitable cliff microhabitat for these species in Minnesota. *Woodsia scopulina* also utilizes this habitat type.

4.3.5 Wildlife

Rulemaking was conducted with the intent to update the list of ETSC species (*Minnesota Rules*, parts 6134.0100 to 6134.0400), with new listings becoming effective on August 19, 2013 (MDNR 2013h). This FEIS considers any new listings, or changes in the previous listings, associated with the updated list. A BA that provides further information on federally listed species, and a BE that contains further information about RFSS have been prepared. The BA and BE are included in Appendix D and are posted on the USFS website (http://www.fs.usda.gov/goto/superior/northmet).

4.3.5.1 Federal Lands

4.3.5.1.1 Land Exchange Proposed Action

The federal land portion of the Land Exchange Proposed Action is similar to the Mine Site previously discussed, but extends further north and west and excludes the privately owned land bordering Dunka Road to the south of the Mine Site. Section 4.2.5.1 provides further discussion of the existing conditions on the Mine Site and associated federal lands.

The acres of key habitat present on the federal lands, along with the associated SGCN (and RFSS), are included in Table 4.3.5-1 below (see Figure 4.2.4-3).

Table 4.3.5-1 Key Habitat, Cover Types, and Associated Species for the Federal Lands under the Land Exchange Proposed Action and Land Exchange Alternative B

Key Habitat Type, Cover Types, and Management Indicator Habitats	Associated Wildlife Species[1]	Land Exchange Proposed Action (Acres)	Land Exchange Alternative B (Acres)
1. Mature Upland Forest, Continuous Upland/Lowland Forest: aspen forest/aspen-birch forest, jack pine forest, mixed pine-hardwood forest (MIHs 1-13)	Rock vole, *northern goshawk*, veery, whip-poor-will, eastern wood-pewee, yellow-bellied sapsucker, ovenbird, Canada warbler, spruce grouse, Cape May warbler, winter wren, boreal chickadee, *boreal owl*, wood thrush, black-backed woodpecker, *bald eagle,* black-throated blue warbler, *bay-breasted warbler, great gray owl, three-toed woodpecker*	5,719.7	4,258.1
2. Open Ground, Bare Soils: disturbed/ developed (no MIH)	Laurentian tiger beetle	63.8	29.1
3. Grassland and Brushland, Early Successional Forest (no MIH)	Franklin's ground squirrel, American badger, Le Conte's sparrow, eastern meadowlark, brown thrasher, white-throated sparrow, sharp-tailed grouse, golden-winged warbler, American woodcock, northern harrier, sedge wren, common nighthawk, black-billed cuckoo, bobolink, tawny crescent	651.8	439.1

Key Habitat Type, Cover Types, and Management Indicator Habitats	Associated Wildlife Species[1]	Land Exchange Proposed Action (Acres)	Land Exchange Alternative B (Acres)
4. Aquatic Environments: rivers, lakes, ponds, wetlands, etc. (MIH 14)	American black duck, American bittern, swamp sparrow, common loon, northern rough-winged swallow, semipalmated sandpiper, American golden-plover, greater yellowlegs, buff-breasted sandpiper, eastern red-backed salamander, common snapping turtle, bog copper, *taiga alpine*	60.1	26.3
5. Multiple Habitats (MIHs 1-14)	Gray wolf[2] (1-4[3]), *Canada lynx*[2] (1-4), rose-breasted grosbeak (1, 3), Macoun's arctic (1, 3), least flycatcher (1, 3), *Connecticut warbler* (1, 3), *olive-sided flycatcher (1, 4)*, *grizzled skipper* (2, 3), *Nabokov's blue* (2, 4), wood turtle[2] (1, 3, 4)	NA	NA
Total		6,495.4	4,752.6

Source: MDNR 2006b.

Notes:
1 Plain text indicates SGCN species; italicized text indicates RFSS; plain text indicates SGCN species identified as likely to be present at the Mine Site or Plant Site but not targeted in surveys.
2 Canada lynx, gray wolf, bald eagle, and wood turtle are or have recently been listed as ETSC species as discussed in detail in the ETSC species section.
3 Numbers refer to the Key Habitat Types (1-4) where those species may occur or are known to occur.

4.3.5.1.2 Land Exchange Alternative B

As shown on Table 4.3.5-1, each of the key habitat types and MIH categories that are found on the federal lands of the Land Exchange Proposed Action are also found on the smaller federal parcel of the Land Exchange Alternative B. Acreages of each habitat category are correspondingly reduced for the Land Exchange Alternative B.

4.3.5.2 Non-federal Lands

4.3.5.2.1 Tract 1 – Hay Lake Lands

<u>Federally and State-listed Species and Species of Special Concern</u>

Tract 1 is not located in an LAU but is located in designated lynx critical habitat. No Canada lynx or their sign have been observed on the non-federal lands during surveys (AECOM 2011b; AECOM 2011c). The Tract 1 parcel is located in Wolf Zone 2 and the Minnesota Northeast Wolf Zone. Radio-collared wolves have been recorded in the vicinity and evidence of wolves was observed during 2009 wildlife surveys (AECOM 2009b). Moose sign, including droppings, tracks, and browsing evidence, were observed on the Tract 1 lands in speckled alder and shrub wetlands (AECOM 2011b). Trumpeter swans, state-listed as species of special concern, were identified on the Tract 1 lands during wildlife surveys (AECOM 2011b) and habitat for the Laurentian tiger beetle, state-listed as a species of special concern, is present at the former sand and gravel pit on the parcel. An active northern goshawk territory is present on Tract 1, and is currently being monitored by the MDNR. Though northern goshawks were not seen or heard during 2011 field surveys (AECOM 2011b), NHIS records indicate one chick was observed on a new nest in 2013. Bats were recorded at several echolocation survey sites on or near the Tract 1 lands, but the species of the bats recorded was not determined (AECOM 2011b). Both NHIS records and surveys of the parcel failed to identify individuals or signs of the remaining federally and state-listed species and species of special concern, including wood turtle, horned grebe, Wilson's phalarope, common tern, boreal owl, American white pelican, marbled godwit, yellow rail, smoky shrew, eastern heather vole, least weasel, and mountain lion (AECOM 2011b).

Species of Greatest Conservation Need

As discussed in Section 4.2.5.1.2, the potential presence of SGCN can be correlated to the presence of their corresponding habitat. Table 4.3.5-2 below lists the SGCN (and RFSS) by the key habitat types and cover types present in the Nashwauk Uplands ecological subsection.

Tract 1 is located in the Nashwauk Uplands ecological subsection. The species found in this subsection are listed in Table 4.3.5-2 below.

Table 4.3.5-2 Key Habitat and Cover Types of Species of Greatest Conservation Need and Regional Forester Sensitive Species for Tract 1 in the Nashwauk Ecological Subsection

Key Habitat Type, Cover Types, and Management Indicator Habitats	Associated Wildlife Species[1]	Tract 1 (Acres)
1. Mature Upland Forest, Continuous Upland/Lowland Forest: aspen forest/aspen-birch forest, jack pine forest, mixed pine-hardwood forest (MIHs 1-13)	*Northern goshawk*, veery, whip-poor-will, eastern wood-pewee, yellow-bellied sapsucker, ovenbird, Canada warbler, spruce grouse, Cape May warbler, winter wren, boreal chickadee, wood thrush, black-backed woodpecker, *bald eagle, great gray owl, three-toed woodpecker*	2,978.8
2. Open Ground, Bare Soils: disturbed/developed (no MIH)		0.0
3. Grassland and Brushland, Early Successional Forest (no MIH)	Franklin's ground squirrel, American badger, Le Conte's sparrow, eastern meadowlark, brown thrasher, white-throated sparrow, sharp-tailed grouse, golden-winged warbler, American woodcock, northern harrier, sedge wren, common nighthawk, black-billed cuckoo, red-headed woodpecker, bobolink, tawny crescent	1,696.3
4. Aquatic Environments: rivers, lakes, ponds, wetlands, etc. (MIH 14)	American black duck, American bittern, swamp sparrow, common loon, red-necked grebe, northern rough-winged swallow, dunlin, semipalmated sandpiper, short-billed dowitcher, American golden-plover, Virginia rail, greater yellowlegs, buff-breasted sandpiper, eastern red-backed salamander, common snapping turtle, bog copper, *taiga alpine, ebony boghaunter*	251.1
5. Multiple Habitats (MIHs 1-14)	Gray wolf[2] (1-4[3]), Canada lynx[2] (1-4), *eastern pipistrelle* (1,3), rose-breasted grosbeak(1,3), least flycatcher (1,3), *olive-sided flycatcher* (1,4), *Connecticut warbler* (1,3), peregrine falcon(1-3), Macoun's arctic (1,3), *Nabokov's blue* (2,4), *grizzled skipper* (2,3), *Quebec emerald* (3,4)	NA
Total[4]		4,926.2

Source: MDNR 2006b.

Notes:
[1] Plain text indicates SGCN species, italicized text indicates RFSS.
[2] Canada lynx, gray wolf, bald eagle, and wood turtle are or have recently been listed as ETSC species as discussed in detail in the ETSC species section.
[3] Numbers refer to the Key Habitat Types (1-4) where those species may occur or are known to occur.
[4] Total acres may be more or less than presented due to rounding.

Regional Forester Sensitive Species

RFSS that are also state-listed or species of special concern are discussed above. With the possible exception of RFSS bat species, no other RFSS were observed during surveys of Tract 1 (AECOM 2011b). Potential Superior National Forest RFSS and their habitat on Tract 1 are listed on Table 4.3.5-2.

Other Wildlife Species

Other wildlife species, including species of concern to the Bands, were observed during surveys of Tract 1. Species observed, or their sign, include black bear, white-tailed deer, red fox, river otter, beaver, marten, red squirrel, snowshoe hare, ruffed grouse, American woodcock, common loon, hooded merganser, ring-necked duck, red-tailed hawk, broad-winged hawk, barred owl, great horned owl, pileated woodpecker, several passerine bird species, snapping turtle, and painted turtle (AECOM 2011b).

Sections 4.2.5, 4.2.9, 5.2.5, and 5.2.9 discuss species of importance to the Bands.

4.3.5.2.2 Tract 2 – Lake County Lands

Federally and State-listed Species and Species of Special Concern

Tract 2 is split into two parcels, Lake County Lands North and Lake County Lands South. Lake County North is located in LAU 16 and Lake County South is located in LAU 22. Both are in designated lynx critical habitat. No Canada lynx or their sign have been observed on the non-federal lands during surveys (AECOM 2011b; AECOM 2011c). While no lynx or their sign have been observed on the Tract 2 parcels, denning habitat may be present. Areas of blowdown or logging slash where there is both vertical and horizontal cover may be used by lynx for denning sites (Moen 2009). Moose sign, including droppings, tracks, and browsing evidence, were observed on the Lake County South parcel in speckled alder and shrub wetlands (AECOM 2011c).

Both Tract 2 parcels are located in federal Wolf Zone 2 and the Minnesota Northeast Wolf Zone. Wolf sign was observed on Lake County North during 2010 wildlife surveys (AECOM 2011c). Both NHIS records and surveys of the parcel failed to identify individuals or signs of the remaining federally and state-listed species or species of special concern (MDNR 2014d; AECOM 2011c).

Species of Greatest Conservation Need

The Lake County North parcel is located in the Laurentian Uplands ecological subsection and the Lake County South parcel is located in the North Shore Highlands ecological subsection. Table 4.3.5-3 below lists the SGCN (and RFSS) by the key habitat types and cover types present at Tract 2.

Table 4.3.5-3 Key Habitat and Cover Types of Species of Greatest Conservation Need and Regional Forester Sensitive Species for Tract 2 in the Laurentian Uplands and North Shore Highlands Ecological Subsections

Key Habitat Type, Cover Types, and Management Indicator Habitats	**Associated Wildlife Species[1]**	**Tract 2 (Acres)**
1. Mature Upland Forest, Continuous Upland/Lowland Forest: aspen forest/aspen-birch forest, jack pine forest, mixed pine-hardwood forest (MIHs 1-13)	Rock vole, *northern goshawk*, veery, whip-poor-will, eastern wood-pewee, yellow-bellied sapsucker, ovenbird, Canada warbler, spruce grouse, Cape May warbler, winter wren, boreal chickadee, *boreal owl*, wood thrush, black-backed woodpecker, *bald eagle,* black-throated blue warbler, *bay-breasted warbler, great gray owl, three-toed woodpecker*	337.2
2. Open Ground, Bare Soils: disturbed/ developed (no MIH)	Laurentian tiger beetle	0.0
3. Grassland and Brushland, Early Successional Forest (no MIH)	Franklin's ground squirrel, American badger, Le Conte's sparrow, eastern meadowlark, brown thrasher, white-throated sparrow, sharp-tailed grouse, golden-winged warbler, American woodcock, northern harrier, sedge wren, common nighthawk, black-billed cuckoo, bobolink, red-headed woodpecker, tawny crescent	38.9
4. Aquatic Environments: rivers, lakes, ponds, wetlands, etc. (MIH 14)	American black duck, American bittern, swamp sparrow, common loon, northern rough-winged swallow, dunlin, semipalmated sandpiper, short-billed dowitcher, American golden-plover, Virginia rail, greater yellowlegs, buff-breasted sandpiper, ruddy turnstone, white-rumped sandpiper, marsh wren, Hudsonian godwit, whimbrel, common tern, eastern red-backed salamander, common snapping turtle, Blanding's turtle, bog copper, *taiga alpine,* extra-striped snaketail, *ebony boghaunter*	5.8
5. Multiple Habitats (MIHs 1-14)	Gray wolf[2] (1-4[(3)]), Canada lynx[2] (1-4), *eastern heather vole* (1,3), smoky shrew (1,3), *northern long-eared bat* (1,4), *eastern pipistrelle* (1,3,4), eastern spotted skunk (1,3), rose-breasted grosbeak (1,3), least flycatcher (1,3), *olive-sided flycatcher* (1,4), *Connecticut warbler* (1,3), peregrine falcon(1-3), *wood turtle*[2] (1,3,4), four-toed salamander (1,4), Macoun's arctic (1,3), *Nabokov's blue* (2,4), *grizzled skipper* (2,3), *Quebec emerald* (3,4)	NA
Total		381.9

Source: MDNR 2006b.

Notes:
[1] Plain text indicates SGCN species, italicized text indicates RFSS.
[2] Canada lynx, gray wolf, bald eagle, and wood turtle are or have recently been listed as ETSC species as discussed in detail in the ETSC species section.
[3] Numbers refer to the Key Habitat Types (1-4) where those species may occur or are known to occur.

Regional Forester Sensitive Species

RFSS that are also state-listed or species of special concern are discussed above. No other RFSS were observed during surveys of Tract 2. Potential Superior National Forest RFSS and their habitat on Tract 2 are listed on Table 4.3.5-3.

Other Wildlife Species

Other wildlife species, including species of concern to the Bands, were observed during surveys of Tract 2. Species observed, or their sign, include white-tailed deer, beaver, snowshoe hare, marten, mink, red squirrel, raven, ruffed grouse, pileated woodpecker, and several passerine bird species (AECOM 2011c).

Sections 4.2.5, 4.2.9, 5.2.5, and 5.2.9 discuss species of importance to the Bands.

4.3.5.2.3 Tract 3 – Wolf Lands

Federally and State-listed Species and Species of Special Concern

Tract 3 is split into four parcels, Wolf Lands 1, 2, 3, and 4. Wolf Lands 1 is located in LAU 16 and Wolf Lands 2 through 4 are located in LAU 22. All are within designated lynx critical habitat. No Canada lynx or their sign have been observed on the non-federal lands during surveys (AECOM 2011b; AECOM 2011c). While no lynx or their sign have been observed on the Tract 3 parcels, denning habitat may be present. Areas of blowdown or logging slash where there is both vertical and horizontal cover may be used by lynx for denning sites (Moen 2009). Moose sign, including droppings, tracks, and browsing evidence, were observed on the Wolf Lands 3 and 4 parcels in speckled alder and shrub wetlands (AECOM 2011c).

All Tract 3 parcels are located in federal Wolf Zone 2 and the Minnesota Northeast Wolf Zone. Wolf sign was observed on Wolf Lands 3 and 4 during 2010 wildlife surveys (AECOM 2011c). Both NHIS records and surveys of the parcel failed to identify individuals or signs of the remaining federally and state-listed species or species of special concern (MDNR 2014d; AECOM 2011c).

Species of Greatest Conservation Need

The Wolf Lands parcels are located in the Laurentian Uplands ecological subsection. The species of greatest conservation need and habitat that may be found in this subsection are listed on Table 4.3.5-4.

Table 4.3.5-4 Key Habitat and Cover Types of Species of Greatest Conservation Need and Regional Forester Sensitive Species for Tract 3 in the Laurentian Uplands Ecological Subsection

Key Habitat Type, Cover Types, and Management Indicator Habitats	Associated Wildlife Species[1]	Tract 3 (Acres)
1. Mature Upland Forest, Continuous Upland/Lowland Forest: aspen forest/aspen-birch forest, jack pine forest, mixed pine-hardwood forest (MIHs 1-13)	Rock vole, *northern goshawk*, veery, whip-poor-will, eastern wood-pewee, yellow-bellied sapsucker, ovenbird, Canada warbler, spruce grouse, Cape May warbler, winter wren, boreal chickadee, *boreal owl*, wood thrush, black-backed woodpecker, *bald eagle,* black-throated blue warbler, *bay-breasted warbler, great gray owl, three-toed woodpecker*	1,479.4
2. Open Ground, Bare Soils: disturbed/ developed (no MIH)	Laurentian tiger beetle	0.0
3. Grassland and Brushland, Early Successional Forest (no MIH)	Franklin's ground squirrel, American badger, Le Conte's sparrow, eastern meadowlark, brown thrasher, white-throated sparrow, sharp-tailed grouse, golden-winged warbler, American woodcock, northern harrier, sedge wren, common nighthawk, black-billed cuckoo, bobolink, tawny crescent	96.5
4. Aquatic Environments: rivers, lakes, ponds, wetlands, etc. (MIH 14)	American black duck, American bittern, swamp sparrow, common loon, northern rough-winged swallow, semipalmated sandpiper, American golden-plover, greater yellowlegs, buff-breasted sandpiper, eastern red-backed salamander, common snapping turtle, bog copper, *taiga alpine, ebony boghaunter*	0.0
5. Multiple Habitats (MIHs 1-14)	Gray wolf[2] (1-4[(3)]), Canada lynx[2] (1-4), *eastern heather vole* (1,3), smoky shrew (1,3), *eastern pipistrelle* (1,3,4), rose-breasted grosbeak (1,3), least flycatcher (1,3), *olive-sided flycatcher* (1,4), *Connecticut warbler* (1,3), Macoun's arctic (1,3), *Nabokov's blue* (2,4), *grizzled skipper* (2,3), *Quebec emerald* (3,4)	NA
Total[4]		1,575.9

Source: MDNR 2006b.

Notes:
[1] Plain text indicates SGCN species, italicized text indicates RFSS.
[2] Canada lynx, gray wolf, and bald eagle are or have recently been listed as ETSC species as discussed in detail in the ETSC species section.
[3] Numbers refer to the Key Habitat Types (1-4) where those species may occur or are known to occur.
[4] Total acres may be more or less than presented due to rounding.

Regional Forester Sensitive Species

RFSS that are also state-listed or species of special concern are discussed above. No other RFSS were observed during surveys of Tract 3. Potential Superior National Forest RFSS and their habitat on Tract 3 are listed on Table 4.3.5-4.

Other Wildlife Species

Other wildlife species, including species of concern to the Bands, were observed during surveys of Tract 3. Species observed, or their sign, include white-tailed deer, red fox, marten, snowshoe hare, beaver, red squirrel, ruffed grouse, pileated woodpecker, and several passerine bird species (AECOM 2011c).

Sections 4.2.5, 4.2.9, 5.2.5, and 5.2.9 discuss species of importance to the Bands.

4.3.5.2.4 Tract 4 – Hunting Club Lands

Federally and State-listed Species and Species of Special Concern

Tract 4 is located in LAU 4 and is located in designated lynx critical habitat. No Canada lynx or their sign have been observed on the non-federal lands during surveys (AECOM 2011b; AECOM 2011c). The Tract 4 parcel is located in federal Wolf Zone 2 and the Minnesota Northeast Wolf Zone. Both NHIS records and surveys of the parcel failed to identify individuals or signs of federally and state-listed species or species of special concern (MDNR 2014d; AECOM 2011c).

Species of Greatest Conservation Need

Tract 4 is located in the Border Lakes ecological subsection. Table 4.3.5-5 lists the species of greatest conservation need and habitat that may be found in this subsection.

Table 4.3.5-5 Key Habitat and Cover Types of Species of Greatest Conservation Need and Regional Forester Sensitive Species for Tracts 4 and 5 in the Border Lakes Ecological Subsection

Key Habitat Type, Cover Types, and Management Indicator Habitats	Associated Wildlife Species[1]	Tract 4 (Acres)	Tract 5 (Acres)
1. Mature Upland Forest, Continuous Upland/Lowland Forest: aspen forest/aspen-birch forest, jack pine forest, mixed pine-hardwood forest (MIHs 1-13)	Rock vole, *northern goshawk*, veery, whip-poor-will, eastern wood-pewee, yellow-bellied sapsucker, ovenbird, Canada warbler, spruce grouse, Cape May warbler, winter wren, boreal chickadee, *boreal owl*, wood thrush, black-backed woodpecker, *bald eagle,* black-throated blue warbler, *bay-breasted warbler, great gray owl, three-toed woodpecker*	105.7	30.6
2. Open Ground, Bare Soils: disturbed/ developed (no MIH)	Laurentian tiger beetle	0.0	0.0
3. Grassland and Brushland, Early Successional Forest (no MIH)	Le Conte's sparrow, eastern meadowlark, brown thrasher, white-throated sparrow, golden-winged warbler, American woodcock, northern harrier, sedge wren, common nighthawk, black-billed cuckoo, bobolink, tawny crescent	45.0	0.0
4. Aquatic Environments: rivers, lakes, ponds, wetlands, etc. (MIH 14)	American black duck, American bittern, swamp sparrow, common loon, northern rough-winged swallow, semipalmated sandpiper, American golden-plover, greater yellowlegs, buff-breasted sandpiper, ruddy turnstone, white-rumped sandpiper, black tern, red-necked grebe, eastern red-backed salamander, common snapping turtle, *taiga alpine, ebony boghaunter*	9.6	0.2
5. Multiple Habitats (MIHs 1-14)	Gray wolf[2] (1-4[3]), Canada lynx[2] (1-4), *eastern heather vole* (1,3), smoky shrew (1,3), *eastern pipistrelle* (1,3), rose-breasted grosbeak (1,3), least flycatcher (1,3), *olive-sided flycatcher* (1,4), *Connecticut warbler* (1,3), rusty blackbird (1,4), Macoun's arctic (1,3), *Nabokov's blue* (2,4), *grizzled skipper* (2,3), *Quebec emerald* (3,4)	NA	NA
Total[4]		160.3	30.8

Source: MDNR 2006b.

Notes:
[1] Plain text indicates SGCN species, italicized text indicates RFSS.
[2] Canada lynx, gray wolf, and bald eagle are or have recently been listed as ETSC species as discussed in detail in the ETSC species section.
[3] Numbers refer to the Key Habitat Types (1-4) where those species may occur or are known to occur.
[4] Total acres may be more or less than presented due to rounding.

Regional Forester Sensitive Species

RFSS that are also state-listed or species of special concern are discussed above. No other RFSS were observed during surveys of Tract 4 (AECOM 2011c). Potential Superior National Forest RFSS and their habitat on Tract 4 are listed on Tables 4.3.5-5.

Other Wildlife Species

Other wildlife species, including species of concern to the Bands, were observed during surveys of Tract 4. Species observed, or their sign, include white-tailed deer, red fox, marten, snowshoe hare, beaver, red squirrel, pileated woodpecker, and several passerine bird species (AECOM 2011c).

Sections 4.2.5, 4.2.9, 5.2.5, and 5.2.9 discuss species of importance to the Bands.

4.3.5.2.5 Tract 5 – McFarland Lake Lands

Federally and State-listed Species and Species of Special Concern

Tract 5 is located in LAU 42 and is located in designated lynx critical habitat. No Canada lynx or their sign have been observed on the non-federal lands during surveys (AECOM 2011b; AECOM 2011c). Though bats were observed on the parcel, the species of bats were not determined and may potentially include eastern pipistrelle and/or northern long-eared bat (AECOM 2011b). The Tract 5 parcel is located in federal Wolf Zone 2 and the Minnesota Northeast Wolf Zone. Wolf sign was observed on the parcel in October 2011. Both NHIS records and surveys of the parcel failed to identify individuals or signs of the remaining federally and state-listed species or species of special concern (MDNR 2014d; AECOM 2011c).

Species of Greatest Conservation Need

Like Tract 4, Tract 5 is located in the Border Lakes ecological subsection. Table 4.3.5-5 provides a list of species of greatest conservation need and habitat that may be found in this subsection.

Regional Forester Sensitive Species

RFSS that are also state-listed or species of special concern are discussed above. With the possible exception of RFSS bat species, no other RFSS were observed during surveys of Tract 5 (AECOM 2011b). Potential Superior National Forest RFSS and their habitat on Tract 5 are listed on Table 4.3.5-5.

Other Wildlife Species

Other wildlife species, including species of concern to the Bands, were observed during surveys of Tract 5. Species observed, or their sign, include black bear, white-tailed deer, red fox, beaver, red squirrel, raven, ruffed grouse, common loon, hooded merganser, broad-winged hawk, barred owl, pileated woodpecker, and several passerine bird species (AECOM 2011b).

Sections 4.2.5, 4.2.9, 5.2.5, and 5.2.9 discuss species of importance to the Bands.

216 -Page Intentionally Left Blank-

4.3.6 Aquatic Species

This section discusses aquatic resources located on the non-federal parcels considered for acquisition by the USFS through the Land Exchange Proposed Action. The federal lands are discussed in Section 4.2.6.1 along with the Mine Site. The Alternative B: Smaller Federal Parcel contains similar surface waters, but smaller acreages or linear distances than the federal lands.

Some of the non-federal lands contain streams, creeks, rivers, and lakes. Tract 1 contains three lakes and one river, comprising approximately 90,000 linear ft of shoreline and approximately 129 acres of surface area. Tract 3 – Wolf Lands 3 and Wolf Lands 4 contain Coyote Creek, with approximately 12 linear ft of river frontage per acre. Tract 5 includes 506 ft of McFarland Lake frontage. Tract 2 and Tract 4 do not contain surface water features.

There are no SGCN, state, federal, or RFSS species known to occur at or in the immediate vicinity of the non-federal lands. According to available data, however, there are several SGCN or RFSS that are associated with the Superior National Forest or various ecoregions on which the non-federal lands are located.

Rulemaking was conducted with the intent to update the list of ETSC species (*Minnesota Rules*, parts 6134.0100 to 6134.0400), with new listings becoming effective on August 19, 2013 (MDNR 2013h). The FEIS considers any new listings, or changes in the previous listings, associated with the updated list. The FEIS also considers any federal listing changes. A BE has been prepared that contains further information about RFSS species. The BE is included in Appendix D and is posted on the USFS website (http://www.fs.usda.gov/goto/superior/northmet).

4.3.6.1 Federal Lands

4.3.6.1.1 Land Exchange Proposed Action

The existing conditions found within the federal lands area are discussed in Section 4.2.6.1.

4.3.6.1.2 Land Exchange Alternative B

The existing conditions found within the Alternative B area are discussed in Section 4.2.6.1. However, site-specific information is presented below.

<u>Surface Water Features</u>

A portion of Mud Lake, covering 8.9 acres with approximately 1,200 ft of lake frontage, is located within the Alternative B lands. The length of lake frontage per acre of this alternative boundary is 0.3 ft.

As with the federal lands within the Land Exchange Proposed Action, Yelp Creek and the Partridge River, which originates at the Northshore Mine, flow out of the One Hundred Mile Swamp and through portions of the smaller federal parcel within the Land Exchange Alternative B. Collectively, the creek and river are 5.3 miles in length in the Alternative B, corresponding to 55,968 linear ft of creek/river frontage (counting both shores). The combined Yelp Creek and Partridge River frontage per acre of the smaller federal parcel within the Land Exchange Alternative B is 11.8 ft (see Table 4.3.6-1).

The MIH represented within the boundaries of the Alternative B: Smaller Federal Parcel includes 8.9 acres for Mud Lake and 55,968 linear ft for the combined Yelp Creek and Partridge River.

Table 4.3.6-1 Alternative B Surface Water Characteristics

Surface Water	Size on Parcel	Approximate Shoreline Frontage (ft)	MIH	Frontage Index (ft/acre)
Mud Lake	8.9 acres	1,200.0	8.9 acres	0.3
Yelp Creek	1.1 miles	*	*	*
Partridge River	4.2 miles	55,968.0	55,968.0 linear ft	11.8

Source: Adapted from AECOM 2011d.

* Combined with Partridge River.

4.3.6.2 Non-federal Lands

4.3.6.2.1 Tract 1 – Hay Lake Lands

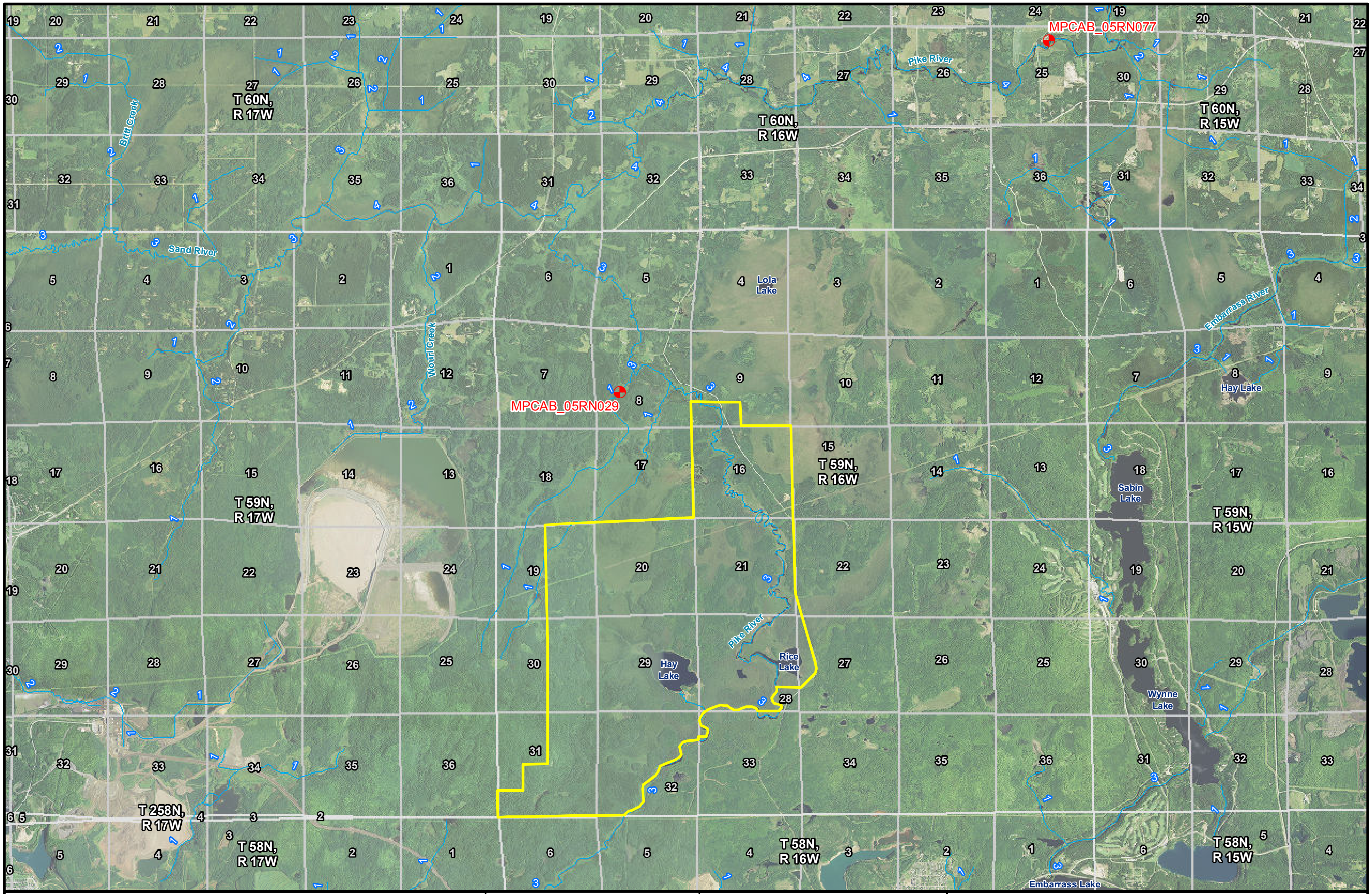
Surface Water Features

Surface water features on Tract 1 include three lakes and one river. Aerial photograph review of the three lakes associated with the parcel indicates a mix of deep water and shallow, submergent/emergent vegetation habitats in the open water portions of the lakes, which provide fish and macroinvertebrate habitats.

The Pike River, which flows north through the tract, is classified as a third-order stream (see Figure 4.3.6-1) within Tract 1 and includes approximately 376.2 acres of mapped floodplain. The heavily vegetated riparian habitats and associated floodplains adjacent to the river's edge likely provide important fish and macroinvertebrate habitats. Tract 1 also has unmapped floodplains associated with Hay Lake itself, which has been estimated to be approximately 175.0 acres.

The USFS MIH categories within Tract 1 include 129.6 acres of lakes, 16,424 linear ft of lake shoreline, and 72,864 linear ft of river shoreline (see Table 4.3.6-2).

Riparian habitats, which surround all surface water features on the parcel, include shrub-carr, coniferous swamp, sedge meadow, alder thicket, shallow open water, and deep marsh wetlands (AECOM 2011d). Aerial photograph review indicates a wide riparian buffer and minimal disturbance along each surface water feature. All wetlands adjacent to the surface water features scored high for fish habitat according to the MnRAM 3.2 rating (AECOM 2011d).



Non-federal Lands
Monitoring Station
Stream / River
Section Boundary
Section Label
Stream Order Number

US Army Corps of Engineers
St. Paul District

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Figure 4.3.6-1

Monitoring Sample Site Locations

Tract 1 - Hay Lake Lands

NorthMet Mining Project and Land Exchange PFEIS

Minnesota

June 2015

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Table 4.3.6-2 Tract 1 Surface Water Characteristics

Surface Water	Surface Area (acres)	Approximate Shoreline Frontage (linear ft)	MIH
Hay Lake	96.2	9,894.4	96.2 acres
Rice Lake	29.5	4,829.6	29.5 acres
Unnamed lake	3.9	1,700	3.9 acres
Pike River	na	72,864[1]	72,864 linear ft
Total	129.6	89,288	

Source: Adapted from AECOM 2011d.

Notes:
na = Not available
[1] Includes riparian distance on both sides of river except along property boundary to the southeast where only the west side of the river is included.

Aquatic Biota Studies

No aquatic biota studies were performed within the surface water features associated with Tract 1; however, studies were completed by the MPCA (MPCA 2011c) for two locations downstream from the parcel's northern boundary (see Figure 4.3.6-1). Aquatic biota sampling station MPCAB_05RN029 is located in a first-order section of an unnamed tributary to the Pike River approximately 1 river mile downstream from Tract 1's northern boundary. The sampling station MPCAB_05RN077 is located approximately 12 river miles downstream of the parcel's northern boundary in a fourth-order section of the Pike River. These aquatic biota sampling stations recorded predominant stream substrate and fish assemblages at both locations and benthic macroinvertebrate assemblages at station MPCAB_05RN029, as summarized in Table 4.3.6-3 and 4.3.6-4.

Table 4.3.6-3 Fish Species Collected at the MPCA Sampling Sites in the Vicinity of the Tract 1 Parcel

Scientific Name	Common Name	Tolerance Designation[1]	Site: MPCAB_ 05RN029 (individuals recorded)	Site: MPCAB_ 05RN077 (individuals recorded)
Catostomus commersonii	White sucker	Tolerant	9	1
Notemigonus crysoleucas	Golden shiner	Tolerant		3
Notropis hudsonius	Spottail shiner	Intermediate		6
Etheostoma nigrum	Johnny darter	Intermediate		19
Lota lota	Burbot	Intermediate		12
Ambloplites rupestris	Rock bass	Intermediate		1
Esox lucius	Northern pike	Intermediate		2
Culaea inconstans	Brook stickleback	Intermediate	8	
Umbra limi	Central mudminnow	Tolerant	7	43
Phoxinus neogaeus	Finescale dace	Intermediate	1	
Semotilus atromaculatus	Creek chub	Tolerant	3	2
Study year			2005	2009
Species observed			5	9
# intolerant species			0	0

			Site	
Scientific Name	**Common Name**	**Tolerance Designation[1]**	**MPCAB_ 05RN029 (individuals recorded)**	**MPCAB_ 05RN077 (individuals recorded)**
Total abundance			28	89
Index of Biological Integrity (IBI)[2]			25	60
Predominant Substrate			sand	sand

Source: MPCA 2011c.

Notes:

[1] Adapted from NCDENR 2006, Ohio EPA 1989, and Hubbs and Lagler 2007. Tolerance values indicate qualitative tolerances of physical and chemical disturbances.

[2] IBI is the sum of study specific metrics where 0 represents the worst fish assemblage conditions and 100 represents the best fish assemblage conditions (USEPA 2011a).

-- = no designation assigned.

Table 4.3.6-4 Benthic Macroinvertebrate Attributes for Aquatic Biota Sampling Site MPCAB_05RN029

Benthic Macroinvertebrate Attributes[1]	MPCAB_ 05RN029
EPT (mayfly, stonefly, caddisfly) Taxa	1
Ephemeroptera (mayfly) Taxa	1
Hilsenhoff's Biotic Index (HBI)	5.7
Intolerant Families	2
Percent Pollution Tolerant	3
Percent Chironomidae (midges)	69.5
Percent Diptera (true flies)	71.3
Percent Dominant Taxa	69.5
Percent Dominant Two Taxa	91.1
Percent Filterers	0.9
Percent Gatherers	92.3
Percent Hydropsychidae (net- spinning caddisflies)	0
Percent Scraper	0
Plecoptera (stonefly) Families	0
Total Families	11
Trichoptera (caddisfly) Families	0

Source: MPCA 2011c.

The majority of fish species found at the two sample sites were designated pollution-tolerant and intermediate species (Table 4.2.6-3). The IBI score of 25 at sample location MPCAB_05RN029 was at the low end of the scale, indicating below-average fish communities existed. This is likely a function of the sampling location, as less diverse fish habitat may exist at headwater stream locations (Barbour et al. 1999).

The MPCAB_05RN077 fourth-order stream sampling site results did not identify any intolerant fish species; however, with increasing stream order, fish diversity increases (Barbour et al. 1999) but is variable, as exhibited by the abundance values of 28 and 89 fish, respectively, in the first- and fourth-order study site locations. The IBI score of 60 at this fourth-order sampling location indicates above-average fish communities and habitat exist. The dominant sand substrates, as opposed to silt substrate, and apparent wide riparian shoreline characteristics at these two sampling sites would also indicate quality fish habitat exists at the sampling sites.

The third-order sections of the Pike River within Tract 1 likely display some similar fish habitats and communities compared to the two study locations.

Macroinvertebrate assemblages exhibited low Ephemeroptera, Plecoptera, and Trichoptera (EPT) taxa and were dominated by midges and true flies at the headwater sampling location referenced above for fish assemblages. The attributes collected for macroinvertebrates at this sampling site suggest diverse macroinvertebrate habitats were not present, which may be attributed to the headwater characteristics and substrate of the sampling site. The macroinvertebrate habitat available for the third-order segments of the Pike River within the Tract 1 parcel likely exhibit more diverse and high-quality habitats than the headwater macroinvertebrate sampling location.

Special Status Fish and Macroinvertebrates

No SGCN, state, federal, or RFSS species are known to occur within or in the immediate vicinity of Tract 1. Of the species listed as potentially occurring in the Nashwauk Uplands ecoregion or Superior National Forest (see Table 4.3.6-5), the northern brook lamprey and creek heelsplitter are the most likely species to occur at this parcel.

Suitable habitat for northern brook lamprey is likely to exist within Tract 1; however, the nearest known occurrence of this species is more than 19 miles from Tract 1.

Suitable habitat likely exists for the creek heelsplitter in the third-order segments of the Pike River within Tract 1, as the substrate likely contains adequate sand substrate and flow to provide habitat for this freshwater mussel species. Additionally, this species has been documented 0.5 mile upstream of the Sand and Pike rivers confluence, where the Pike River becomes a fourth-order stream (see Figure 4.3.6-2).

Table 4.3.6-5 SGCN and RFSS Species Identified Within Portions of the Nashwauk Uplands Ecoregion or Superior National Forest

Scientific Name	Common Name	Nashwauk Uplands Ecoregion SGCN	RFSS
Insects			
Chilostigma itascae	Headwaters chilostigman caddisfly		X
Somatochlora brevicincta	Quebec emerald		X
Williamsonia flechen	Ebony boghaunter		X
Fish			
Acipenser fulvescens	Lake sturgeon		X
Coregonus nipigon	Nipigon cisco		X
Coregonus zenithicus	Shortjaw cisco		X
Ichthyomyzon fossor	Brook lamprey	X	X
Mussels			
Lasmigona compressa	Creek heelsplitter	X	X
Ligumia recta	Black sandshell	X	X

Sources: MDNR 2006d; USFS 2015a.

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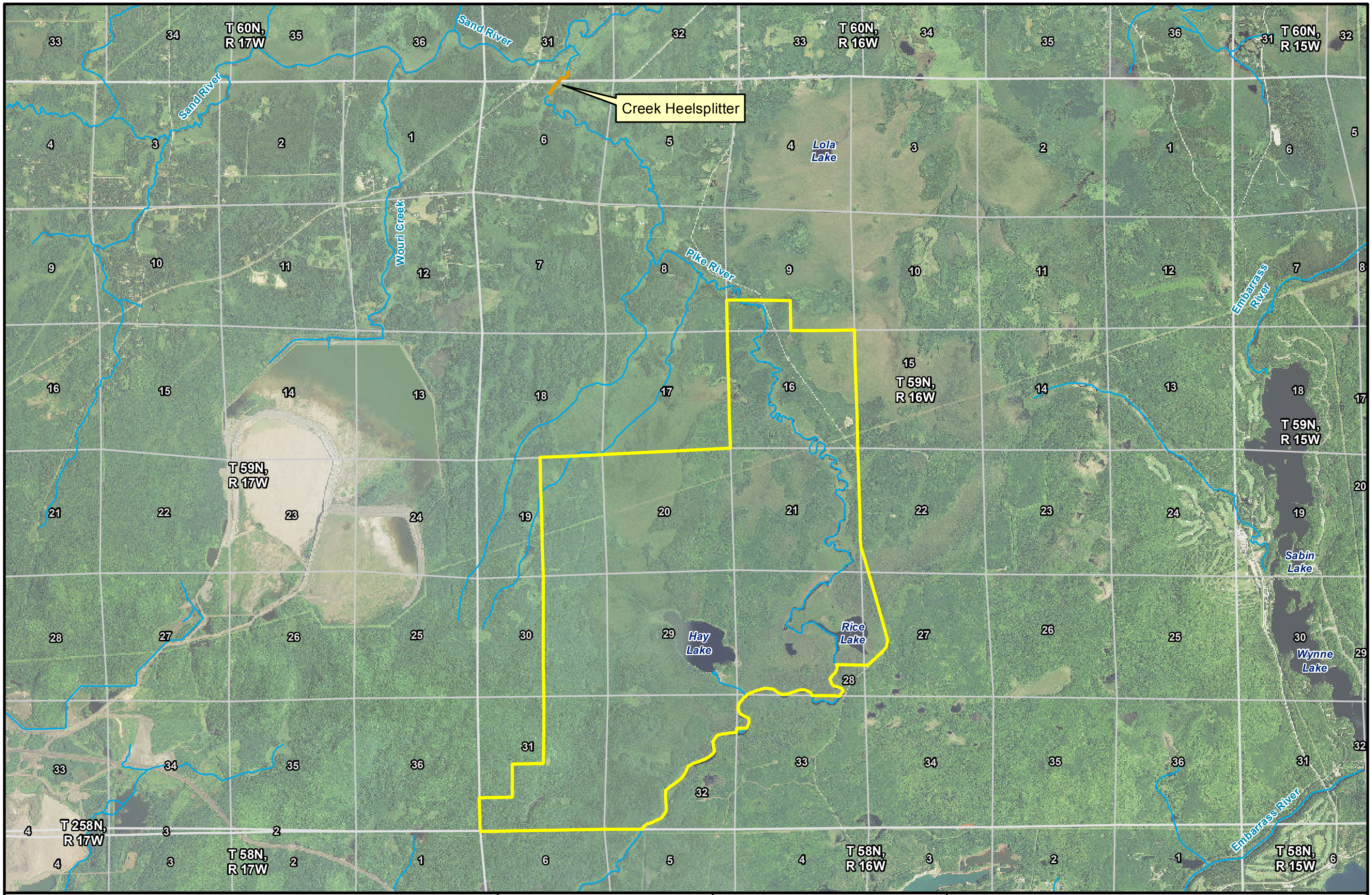

Non-federal Lands
Creek Heelsplitter
Stream / River
Section Boundary
Section Label

US Army Corps of Engineers
St. Paul District

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N S E W

0 0.25 0.5 1 1.5 Miles

Figure 4.3.6-2

Creek Heelsplitter Locations Near Tract 1 - Hay Lake Lands

NorthMet Mining Project and Land Exchange PFEIS

Minnesota

June 2015

132 -Page Intentionally Left Blank-

4.3.6.2.2 Tract 2 - Lake County Lands

No lakes or waterbodies are known to exist within Tract 2 (AECOM 2011d); therefore, no fish or macroinvertebrate habitats are present.

4.3.6.2.3 Tract 3 - Wolf Lands

Surface Water Features

Coyote Creek is the only surface water feature within the Wolf Lands 3 and 4. Wolf Lands 1 and 2 do not have surface water features. Coyote Creek is a headwater stream that begins in Wolf Lands 3 where it flows north for 0.1 mile within the parcel boundary and includes approximately 32.8 acres of unmapped floodplain. Coyote Creek continues north and flows for 0.9 mile within Wolf Lands 4 before continuing further north, and includes approximately 79.4 acres of unmapped floodplain. The heavily vegetated riparian habitats and associated floodplains adjacent to the river's edge likely provide important fish and macroinvertebrate habitats. Coyote Creek flows through two of the three lakes in the McDougal Lakes chain and becomes a third-order stream (see Figure 4.3.6-3) at its confluence with the Stony River approximately 4 river miles downstream from the northern boundary of Wolf Lands 4. Wolf Lands 3 and 4 contain a combined 16.1 ft of river frontage per acre. Aerial photograph review indicates a wide riparian vegetative buffer with minimal human disturbance where emergent sedge-meadow wetlands are adjacent to the creek within the Wolf Lands 3 parcel, and both emergent and scrub-shrub wetlands are adjacent to the creek within the Wolf Lands 4 parcel (AECOM 2011c). The riparian vegetative buffer adjacent to the creek segments offers shade, structure, and erosion control.

Much of the emergent wetlands adjacent to Coyote Creek within the Wolf Lands 3 parcel exhibited 18 to 24 inches of standing water (AECOM 2011c), which could provide high-quality headwater stream fish and macroinvertebrate habitats because wetlands provide nutrient-rich environments that would be accessible to fish and macroinvertebrates at the documented water depth. Additionally, these wetlands likely provide potential spawning habitat for some warmwater fish species that require headwater wetland habitats for spawning.

The USFS MIH categories within the combined Wolf Lands parcels 3 and 4 boundaries include approximately 10,560 linear ft of creek shoreline.

Aquatic Biota Studies

No fish or macroinvertebrate studies have been completed along Coyote Creek within the two parcels; however, two MPCA aquatic biota studies (MPCAB_05RN024 and MPCAB_05RN074) were completed within the third- and fourth-order stretches of the Stony River, approximately 2 river miles and 4 river miles, respectively, downstream of the Coyote Creek and Stony River confluence, as indicated in Figure 4.3.6-3 (6 and 8 miles downstream of northern boundary of parcel Wolf Lands 4) (MPCA 2011c). Results from the two sampling events are summarized below in Table 4.3.6–6 and Table 4.3.6-7. The fish communities for both sampling sites appeared diverse and abundance was high. IBI scores for each site were high, indicating good to excellent fish habitat was likely present. Although high-quality fish habitat likely exists at the Coyote Creek stream locations within Wolf Lands 3 and 4, some, but not all, of the fish species observed at the Stony River sampling locations are likely present, as fish community diversity is likely less in headwater stream habitats.

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Non-federal Lands
Monitoring Station
Stream / River
Section Boundary
Section Label
Stream Order Number

US Army Corps of Engineers St. Paul District

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0 0.25 0.5 1 1.5 Miles

Figure 4.3.6-3
Monitoring Sample Site Locations
Tract 3 - Wolf Lands
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

176 -Page Intentionally Left Blank-

A qualitative assessment of the benthic macroinvertebrate data presented in Table 4.3.6-7 indicates a diverse community with attributes indicating little human disturbance or sedimentation at the Stony Creek sampling sites. The Coyote Creek headwater stretches of stream likely exhibit more siltation due to slower moving water typically observed in headwater streams in the region and, therefore, likely offer less diverse habitats for benthic macroinvertebrates compared to the two sampling sites summarized below.

Table 4.3.6-6 Fish Species Collected at Two Sites in the Vicinity of the Wolf Lands Parcels within the Stony River

			Site	
Scientific Name	**Common Name**	**Tolerance Designation[1]**	**MPCAB_ 05RN024 (number recorded)**	**MPCAB_ 05RN074 (number recorded)**
Catostomus commersonii	White sucker	Tolerant	21	4
Luxilus cornutus	Common shiner	Intermediate		23
Notemigonus crysoleucas	Golden shiner	Tolerant	2	84
Notropis hudsonius	Spottail shiner	Intermediate	19	11
Notropis heterolepis	Blacknose shiner	Intolerant	1	123
Notropis volucellus	Mimic shiner	Intolerant	6	29
Etheostoma nigrum	Johnny darter	Intermediate	8	2
Perca flavescens	Yellow perch	Intermediate	31	93
Sander vitreus	Walleye	Intermediate		2
Percina caprodes	Logperch	Intermediate	4	3
Lota lota	Burbot	Intermediate	85	3
Ambloplites rupestris	Rock bass	Intermediate		2
Esox lucius	Northern pike	Intermediate		12
Umbra limi	Central mudminnow	Tolerant	1	
Pimephales promales	Fathead minnow	Tolerant	6	
Rhinichthys cataractae	Longnose dace	Intolerant	177	
Noturus gyrinus	Tadpole madtom	Intermediate	7	7
Cottus bairdii	Mottled sculpin	Intolerant	19	
Study year			2005	2005
Species observed			14	14
# intolerant species			4	2
Total Abundance			387	398
Index of Biological Integrity (IBI)[2]			86	77
Predominant Substrate			rubble/cobble	na

Source: MPCA 2011c.

Notes:
[1] Adapted from NCDENR 2006, Ohio EPA 1989, and Hubbs and Lagler 2007. Tolerance values indicate qualitative tolerances of physical and chemical disturbances.
[2] IBI is the sum of study specific metrics where 0 represents the worst fish assemblage conditions and 100 represents the best fish assemblage conditions (USEPA 2011b).
na = Not available
-- = no designation assigned.

Table 4.3.6-7 Benthic Macroinvertebrate Attributes for Aquatic Biota Sampling Sites within the Stony River

Benthic Macroinvertebrate Attributes[1]	MPCAB_ 05RN024	MPCAB_ 05RN074
EPT (mayfly, stonefly, caddisfly) Taxa	11	11
Ephemeroptera (mayfly) Taxa	5	5
Hilsenhoff's Biotic Index (HBI)	5.9	5.2
Intolerant Families	4	1
% Pollution Tolerant	10.3	26.1
% Chironomidae (midges)	55.5	17.2
% Diptera (true flies)	58.7	17.5
% Dominant Taxa	55.5	18.8
% Dominant Two Taxa	63.7	36
% Filterers	11.7	17.8
% Gatherers	75.4	50.2
% Hydropsychidae (net- spinning caddisflies)	1.4	11.9
% Scraper	5	25.4
Plecoptera (stonefly) Families	0	0
Total Families	23	27
Trichoptera (caddisfly) Families	6	6

Source: MPCA 2011c.

<u>Special Status Fish and Macroinvertebrates</u>

No SGCN, state, federal, or RFSS species are known to occur at or in the immediate vicinity of Tract 3. Of the species listed to potentially occur in the Laurentian Uplands ecoregion (see Figure 4.3.6-4) or Superior National Forest (see Table 4.3.6-8), the northern brook lamprey and creek heelsplitter are the most likely species to occur within Tract 3.

Suitable habitat for northern brook lamprey is likely to exist in Tract 3, although the nearest known occurrence of this species is more than 52 miles from the Wolf Lands parcels.

The creek heelsplitter has historically been found near the east and west confluence of the northernmost lake in the chain of McDougal Lakes and the Stony River in the third-order stretch of the Stony River (see Figure 4.3.6-5). The aquatic species habitat in the stretches of Coyote Creek within Wolf Lands 3 and 4 is unknown, but likely would display first-order headwater stream characteristics; it is unknown if the necessary aquatic species habitat for the creek heelsplitter is present on the parcels. However, the presence of the creek heelsplitter within the parcel boundary is possible but not likely, since Coyote Creek is a first-order stream.

Habitats for the other special status species described in Table 4.3.6-8 likely do not exist within the parcel boundary.

No invasive fish or macroinvertebrate species are known to exist on Tract 3.

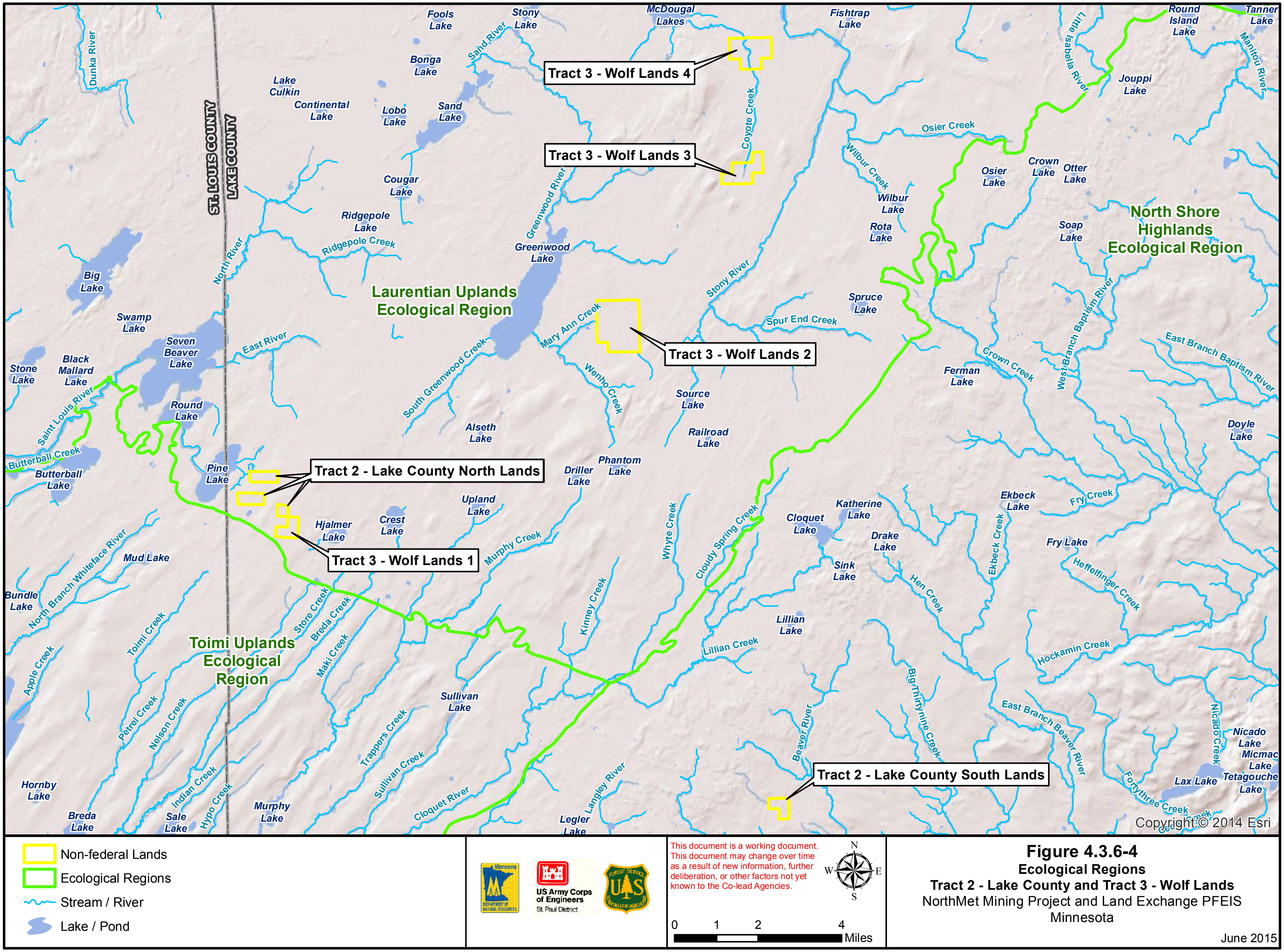

Figure 4.3.6-4
Ecological Regions
Tract 2 - Lake County and Tract 3 - Wolf Lands
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

214

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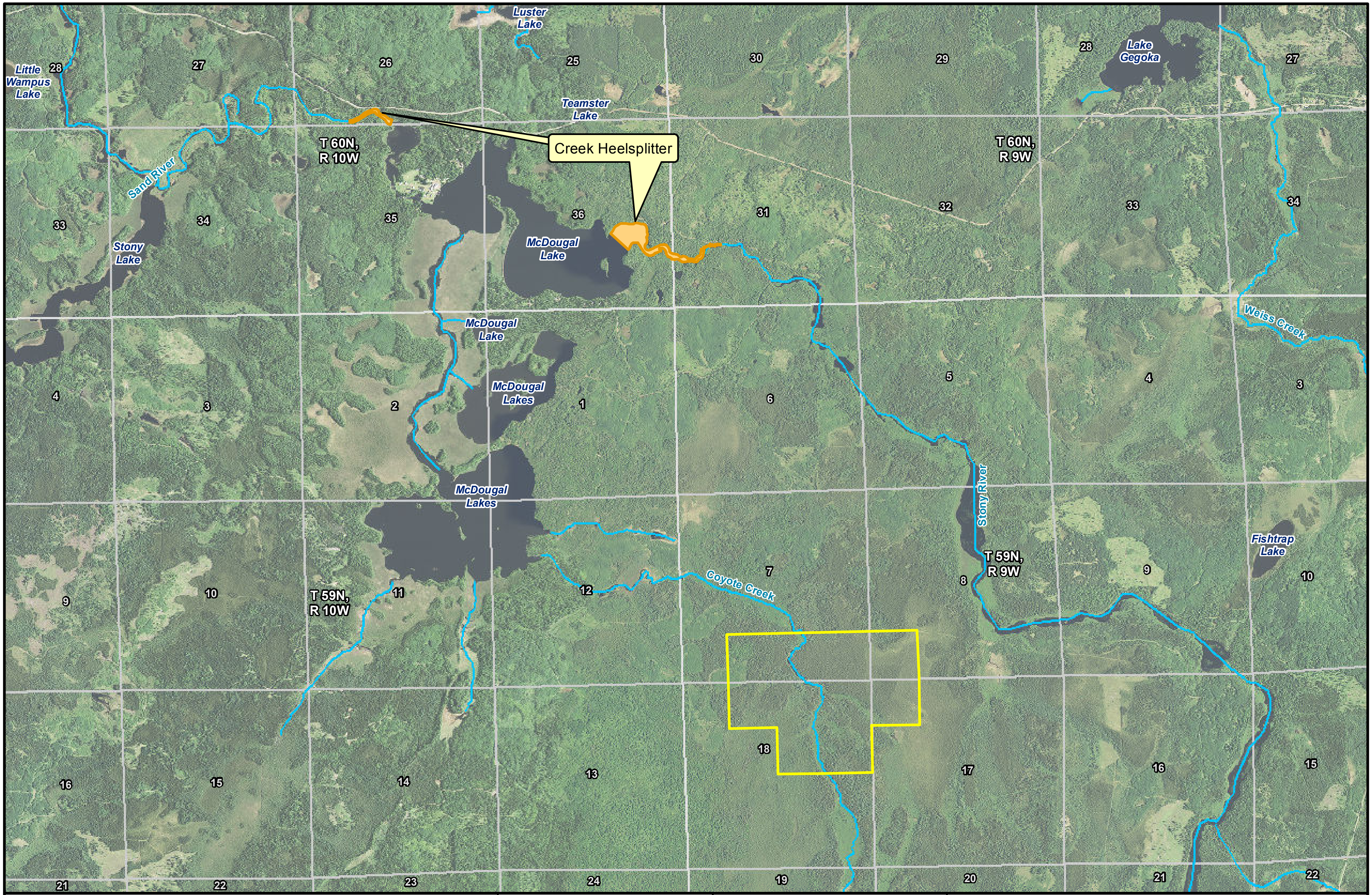

Non-federal Lands
Creek Heelsplitter
Stream / River
Section Boundary
1 Section Label

US Army Corps of Engineers
St. Paul District

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Figure 4.3.6-5
Creek Heelsplitter Locations Near
Tract 3 - Wolf Lands 4
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

216 -Page Intentionally Left Blank-

Table 4.3.6-8 SGCN and RFSS Species Identified Within Portions of the Laurentian Uplands Ecoregion or Superior National Forest

Scientific Name	Common Name	Laurentian Uplands Ecoregion SGCN	RFSS
Insects			
Chilostigma itascae	Headwaters chilostigman caddisfly		X
Somatochlora brevicincta	Quebec emerald		X
Williamsonia flechen	Ebony boghaunter		X
Fish			
Acipenser fulvescens	Lake sturgeon		X
Coregonus nipigon	Nipigon cisco		X
Coregonus zenithicus	Shortjaw cisco		X
Ichthyomyzon fossor	Brook lamprey		X
Mussels			
Lasmigona compressa	Creek heelsplitter	X	X
Ligumia recta	Black sandshell	X	X

Source: MDNR 2006d; USFS 2015a.

4.3.6.2.4 Tract 4 - Hunting Club Lands

Surface Water Features

No lakes or waterbodies are known to exist within Tract 4 (AECOM 2011d); therefore, no fish or macroinvertebrate habitats exist.

4.3.6.2.5 Tract 5 - McFarland Lake Lands

Surface Water Features

The only surface water feature within Tract 5 is the 990 ft of shoreline associated with McFarland Lake along the eastern parcel boundary. McFarland Lake is classified as an oligotrophic lake (MPCA 2011c) with a surface area of 384 acres and a maximum depth of 49 ft (MDNR 2011c). Aerial photograph review indicates minimal shoreline disturbance and a wide riparian vegetative buffer along the entire parcel boundary with McFarland Lake.

The USFS MIH represented in Tract 5 (MIH 14, Aquatic Habitats) would include 990 linear ft of lake shoreline.

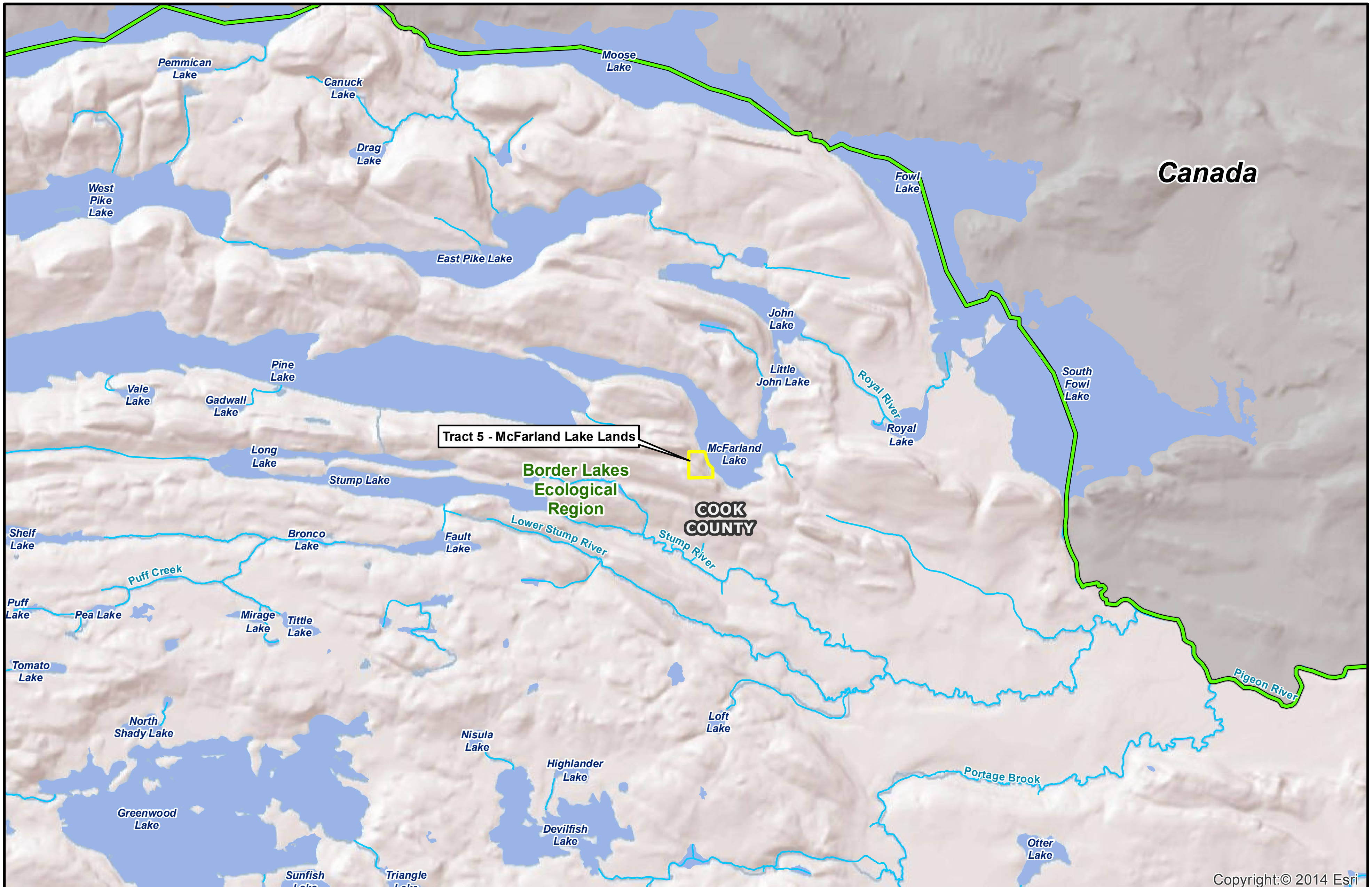
Aquatic Biota Studies

MDNR conducted a fishery assessment within McFarland Lake in 2003 and reported several game fish species including lake whitefish, northern pike, smallmouth bass, walleye, and yellow perch (MDNR 2011c). Tulibee and white sucker were also recorded. These species are typical for large and deep lakes within the region.

Special Status Fish and Macroinvertebrates

No special status fish or macroinvertebrates are known to exist within Tract 5. A summary of the SGCN and RFSS species is provided in Table 4.3.6-9. The spoonhead sculpin, lake chub, and longear sunfish are known to occur within the Border Lakes ecoregion and could occur at Tract 5 (see Figure 4.3.6-6). These species are described below. Due to limiting habitat requirements and limited distribution, the remaining species listed in Table 4.6.3-9 likely are not present in McFarland Lake.

The invasive species, spiny water flea (*Bythotrephes longimanus*), has been documented in McFarland Lake. The spiny water flea is a species of zooplankton native to Europe and Asia that competes for food sources with other zooplankton species and fish.



Non-federal Lands
Ecological Regions
Stream / River
Lake / Pond

US Army Corps of Engineers St. Paul District

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Figure 4.3.6-6
Ecological Regions
Tract 5 - McFarland Lake Lands
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

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Table 4.3.6-9 SGCN Species for the Border Lakes Ecoregion and the USFS RFSS Species List

Scientific Name	Common Name	Border Lakes Ecoregion SGCN	RFSS
Insects			
Chilostigma itascae	Headwaters chilostigman caddisfly		X
Somatochlora brevicincta	Quebec emerald		X
Williamsonia flechen	Ebony boghaunter		X
Fish			
Acipenser fulvescens	Lake sturgeon	X	X
Coregonus nipigon	Nipigon cisco	X	X
Coregonus zenithicus	Shortjaw cisco	X	X
Cottus ricei	Spoonhead sculpin	X	
Couesius plumbeus	Lake chub	X	
Ichthyomyzon fossor	Brook lamprey	X	X
Lepomis megalotis	Longear sunfish	X	
Mussels			
Lasmigona compressa	Creek heelsplitter	X	X
Ligumia recta	Black sandshell	X	X

Sources: MDNR 2006d; USFS 2015a.

Spoonhead Sculpin

The spoonhead sculpin is a bottom dwelling fish that inhabits rocky areas of swift creeks and rivers; however, this species can also be found in lakes. They primarily feed on planktonic crustaceans and aquatic insect larvae and are native to Minnesota (Froese and Pauly 2011). Little is known about the habitat and macroinvertebrates in McFarland Lake. Although the habitat characteristics for McFarland Lake are not completely known, it is possible the spoonhead sculpin species exists in McFarland Lake.

Lake Chub

Lake chubs have a secure distribution in Lake Superior, but have shown declining distribution in Minnesota inland lakes. Their preferred habitat includes shallow areas of deep lakes, especially near river mouths (Stasiak 2006). Habitat for lake chub may exist in McFarland Lake.

Longear Sunfish

The longear sunfish is found in lake and stream habitats, which include high-quality waters with shallow (less than 3 ft) shorelines exhibiting firm, detritus rich substrates and extensive submerged vegetation. Only 37 Minnesota lakes and streams have confirmed populations of this fish species (Porterfield and Ceas 2008). Habitat for longear sunfish may exist in portions of McFarland Lake.

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4.3.7 Air Quality

Regional air quality, including for the federal and non-federal lands, is discussed in Section 4.2.7. The federal lands of the Land Exchange Proposed Action are similar to the Mine Site previously discussed, but exclude the privately owned land bordering Dunka Road to the south of the Mine Site. The non-federal parcels are all privately owned and there are currently no activities on these parcels that affect ambient air quality.

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4.3.8 Noise and Vibration

4.3.8.1 Federal Lands

The topography and land cover of the federal lands in the Land Exchange Proposed Action and the Land Exchange Alternative B are similar to that of the Mine Site, as previously discussed, but extend further north and west (mostly wetlands) and exclude the privately owned land bordering Dunka Road to the south of the Mine Site. Section 4.2.8.2 provides a discussion of the existing noise and vibration conditions on the federal lands.

4.3.8.2 Non-federal Lands

The non-federal lands in the Land Exchange Proposed Action consist of up to five tracts totaling 7,075.0 acres that are located within the Superior National Forest proclamation boundary, a sparsely populated rural region in northeast Minnesota. The tracts are predominantly forest and wetland habitat. Tracts 1, 2, and 3 are 13 to 27 miles from the federal lands, while Tracts 4 and 5 are 46 and 91 miles from the federal lands, respectively (see Table 4.3.8-1 and Figure 4.3.8-1).

Table 4.3.8-1 Approximate Distances and Direction of Non-federal Lands to Federal Lands and the Plant Site

Tract	Approximate Distance to Federal Lands (miles)	Approximate Distance to Plant Site (miles)	Direction from Federal Lands and Plant Site
Tract 1 – Hay Lake	15	10	West
Tract 2 – Lake County			
Lake County North	13	20	Southeast
Lake County South	27	34	Southeast
Tract 3 – Wolf Lands			
Wolf Lands 1	14	20	Southeast
Wolf Lands 2	18	26	Southeast
Wolf Lands 3	18	26	Southeast
Wolf Lands 4	18	26	East
Tract 4 – Hunting Club	46	43	Northwest
Tract 5 – McFarland Lake	91	100	Northeast

Review of the most-up-to-date aerial maps indicates that there are no noise-sensitive areas or receptors (e.g., residences, schools, campgrounds, or national wilderness areas) within the non-federal lands. However, people currently hunt within Tract 1 and Tract 4 due to the presence of wildlife. Wildlife species within each tract are described in Section 4.3.5. There are a few residential receptors outside the non-federal lands. Figure 4.3.8-1 shows the locations of the closest receptors to the non-federal lands.

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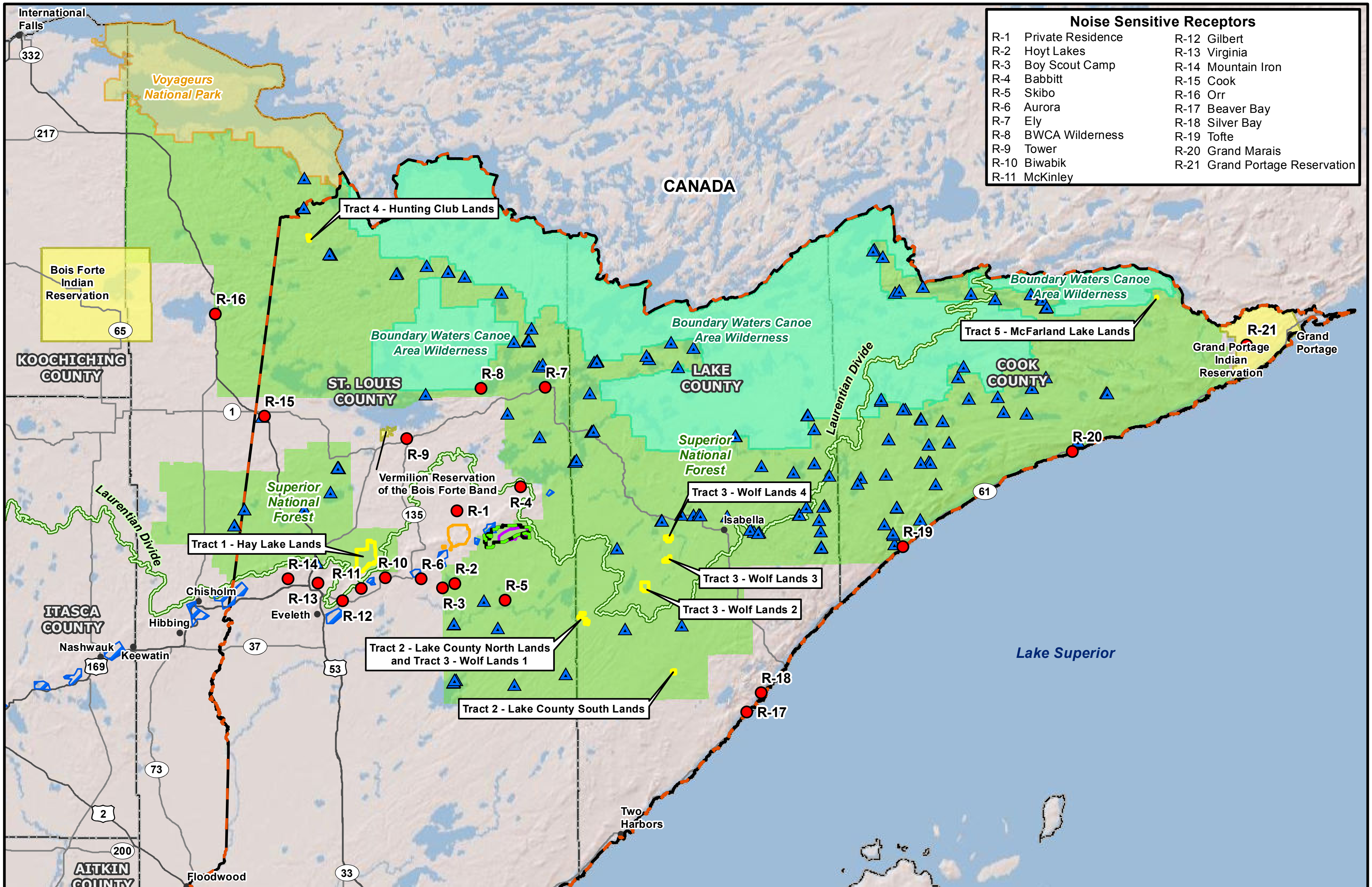

Non-federal Lands
Federal Lands
Mine Site
Plant Site
Recreational Site
Noise Sensitive Receptor
Wildlife Corridor
1854 Treaty Territory
Boundary Waters Canoe Area Wilderness
Native American Reservation
National Forest
National Park

Minnesota Department of Natural Resources
US Army Corps of Engineers St. Paul District
Forest Service U.S. Department of Agriculture

This document is a working document. This document may change over time as a result of new information, further deliberation, or other factors not yet known to the Co-lead Agencies.

N S W E

0 5 10 20 Miles

Figure 4.3.8-1
Nearest Noise Sensitive Receptors to the Non-federal Lands
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

24 -Page Intentionally Left Blank-

The non-federal lands would be managed consistent with the adjacent forest lands (see Section 4.3.1), and the USFS currently has no plans for operations on the non-federal lands. Since the non-federal lands are located in a forested and rural environment, the existing ambient L_{eq} at the five tracts has been assumed to be 5 dB lower than the levels shown in Table 4.2.8-2 for the Mine Site and Plant Site. This means that existing daytime and nighttime ambient L_{eq} for all non-federal lands are not expected to exceed 40 and 30 dB, respectively. The estimated L_{eq} for the statistical distribution was converted to other noise percentile metrics, such as L_{50} and L_{10}, using a USEPA calculation methodology (USEPA 1974). The calculation was based on an assumed standard deviation of 3 dB for the sound level statistical distribution. A summary of the estimated daytime and nighttime ambient L_{eq}, L_{50}, and L_{10} levels expected at the tracts is presented in Table 4.3.8-2.

Table 4.3.8-2 Summary of Estimated Existing Ambient Noise Levels at the Non-federal Lands

Ambient Noise Level Metric	Daytime (dBA)	Nighttime (dBA)
L_{eq}	40	30
L_{50}	39	29
L_{10}	42.8	32.8

Currently, no ground- or air-vibrating sources or activities (e.g., mine blasting or pile driving) exist within a 15-mile radius of the non-federal lands. The closest vibration-generating activities include operation of the coal and flux pulverizer and rotary hearth furnace at the Mesabi Phase I Plant in Hoyt Lakes (approximately 9 miles west of Tract 1, which is the closest non-federal tract) and blasting at the Northshore Mine (approximately 16 miles northwest of the closest tract [Tract 2]). Since ground and air vibration effects diminish with distance from the source, existing levels of vibration at the sensitive receptors are expected to be negligible.

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4.3.9 Cultural Resources

4.3.9.1 Federal Lands

4.3.9.1.1 Land Exchange Proposed Action

The federal lands within the Land Exchange Proposed Action area is similar to the Mine Site portion of the NorthMet Project area previously discussed, but extends further north and west and excludes the privately owned land bordering Dunka Road to the south of the Mine Site. The Land Exchange Proposed Action APE for both direct and indirect effects consists of the entire land exchange boundary (Figure 4.2.9-1). Section 4.2.9 provides further discussion of the existing conditions on the Mine Site and associated federal lands. Cultural resources identified within the Land Exchange Proposed Action area consisted of archaeological sites and properties and natural resources of religious and cultural significance to the Bands.

As a result of Phase I cultural resources surveys and consultation with the Bands and the SHPO concerning the results of identification efforts for properties of religious and cultural significance to the Bands, three cultural resources have been identified within the Land Exchange area: the BBLV Trail Segment, NorthMet Archaeological Site, and Knot Logging Camp. For detailed property descriptions and discussions of eligibilities, please see Section 4.2.9.

The federal Co-lead Agencies continue consultation with the Bands and the Minnesota SHPO as determinations are made concerning NRHP eligibility of identified resources, NorthMet Project Proposed Action effects on historic properties, and resolution of any adverse effects.

The investigations completed to date in the Land Exchange Proposed Action area have identified cultural resources as summarized in Table 4.3.9-1 below.

Table 4.3.9-1 Cultural Resources Identified in the Land Exchange Area

Resource ID	Resource Name	Resource Type	NRHP Determination by Co-lead Agencies	SHPO Concurrence with Co-lead Agencies' Findings
SL-HLC-pending	BBLV Trail Segment[1]	Archaeological Site	Eligible	Concur
21SLpending	NorthMet Archaeological Site	Archaeological Site	Not Eligible	Concur
21SLmn	Knot Logging Camp	Archaeological Site	Not Eligible	Concur

Note:
[1] USFS designation BBLV Trail Segment #1 (USFS #01-569).

The 1854 Treaty resources located within the Land Exchange Proposed Action would be similar to the Mine Site portion of the NorthMet Project area previously discussed in Section 4.2.9. Section 4.2.9 provides further discussion of the existing conditions on the Mine Site and associated federal lands.

An analysis of whether any particular property associated with the Bands' exercise of their usufructuary rights may be considered a TCP is limited by lack of available information regarding Band members' traditional exercise of those rights. Determining how the Bands have traditionally conducted their usufructuary rights on or near the Land Exchange Proposed Action area would only be available through a detailed ethnographic study of individual Band members and their families. The cultural resources investigations included Band member interviews with Bois Forte, Fond du Lac, and Grand Portage, although only Bois Forte's results were made available. The results of the interviews and the cultural resources investigation did not find any natural resources that would be considered a TCP or other traditional cultural place.

4.3.9.1.2 Land Exchange Alternative B

All of the cultural resources and 1854 Treaty resources identified and discussed in Section 4.3.9.1.1 are located within the Land Exchange Alternative B.

4.3.9.2 Non-federal Lands

There are no known cultural resources on the non-federal lands.

4.3.10 Socioeconomics

The Land Exchange Proposed Action study area for socioeconomics is the same as for the NorthMet Project Proposed Action: all of Cook, Lake, and St. Louis counties, as well as individual cities in St. Louis County (see Figure 4.2.10-1). This geography includes the federal and non-federal tracts. Socioeconomic data are not available, and thus are not reported, for the individual non-federal tracts and their parcels.

The federal lands are similar to that of the Mine Site previously discussed, but exclude the privately owned land bordering Dunka Road to the south of the Mine Site. Section 4.2.10.1 provides additional discussion of the existing conditions on the federal lands. The socioeconomic information in Section 4.2.10.1 broadly applies to the study area, which encompasses all of the non-federal parcels involved in the Land Exchange Proposed Action. The following provides additional information as it relates to the federal and non-federal parcels.

4.3.10.1 Economic Activity

There is no ongoing forestry activity on the federal lands and no evidence of recent past forestry activity. The non-federal parcels are all privately owned or otherwise have no official public access. There is some evidence of timber harvesting on Tracts 2, 3, and 4; this activity could generate income, employment, or revenue.

4.3.10.2 Recreation

Recreation in national forests can generate direct revenue to the USFS and the state in the form of entry fees and hunting and fishing license fees, as well as via indirect economic activity related to the multiplier effect of such activity (e.g., purchase of fishing tackle and bait).

In 2006 (the most recent year for which data are available), there were approximately 1,376,000 recreational visits to Superior National Forest (USFS 2012a). “Recreational,” as used in USFS 2010, is very broadly defined, and primarily distinguishes (and excludes) transient visitors such as commuters or for restroom visits. On average, visitors to the forest spent $643 per visiting party per day (i.e., the group participating in the visit, such as a family).

Currently, the federal lands are not easily accessible. The non-federal parcels are all privately owned or otherwise have no official public access, although evidence of recreational activity has been observed on some of these parcels. Such activity is discussed in Section 4.2.11.

4.3.10.3 Other Socioeconomic Characteristics

Currently, there is no demand for public safety services on the inaccessible federal lands and only limited demand on the non-federal lands. As described in Section 4.2.11, the non-federal parcels generally consist of undeveloped woodlands, wetlands, and other natural features. There is evidence of past extractive activity (quarrying and/or borrowing of sand and gravel) and ongoing private recreational hunting and fishing on Tract 1. Tract 5 was previously used by Wheaton College. In their current state, the non-federal parcels have minimal, if any, effect on public services and facilities.

Subsistence activity, as it relates to the federal lands, is described in Section 4.2.10.1.6. There is no available information that any of the non-federal tracts are being used for this purpose.

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4.3.11 Recreation and Visual Resources

4.3.11.1 Federal Lands

4.3.11.1.1 Land Exchange Proposed Action

Recreational Resources

The federal lands fall within the Semi-Primitive Motorized and Roaded Natural ROS designations, as shown in Table 4.3.11-1. These designations are defined in Section 4.2.11.1.1.

Table 4.3.11-1 Recreational Opportunity Spectrum Designations within the Land Exchange Proposed Action and Land Exchange Alternative B

Recreational Opportunity Spectrum Designation	Total Acreage
Land Exchange Proposed Action Federal Lands	
Semi-Primitive Motorized	5,528.4
Roaded Natural	967.0
Land Exchange Alternative B Federal Lands	
Semi-Primitive Motorized	4,276.5
Roaded Natural	476.1

Visual Resources

The visual resources surrounding the federal lands, visual receptors near the federal lands, and SIO designation of the federal lands are discussed in Section 4.2.11.1.2. SIO designations are also summarized in Table 4.3.11-2.

Table 4.3.11-2 Scenic Integrity Objective Designations for Lands under the Land Exchange Proposed Action and Land Exchange Alternative B

Scenic Integrity Objective Designation	Total Acreage
Land Exchange Proposed Action Federal Lands	
Low Scenic Integrity Objective	6,495.6
No Designation[1]	30.5
Land Exchange Alternative B Federal Lands	
Low Scenic Integrity Objective	4,743.7
No Designation[1]	8.9

Note:
[1] USFS does not designate SIO for bodies of water, such as Mud Lake, which is part of the federal lands. Only a portion of Mud Lake falls within the footprint of the Land Exchange Alternative B.

4.3.11.1.2 Land Exchange Alternative B

The recreational and visual conditions for the federal lands in Land Exchange Alternative B are similar to the federal lands in the Land Exchange Proposed Action. Acreage of ROS and SIO designations for the Land Exchange Alternative B are summarized in Tables 4.3.11-1 and 4.3.11-2.

4.3.11.2 Non-federal Lands

All of the non-federal lands are privately owned; those not already owned by PolyMet are under options to purchase by PolyMet. Thus, there are no current public recreation opportunities on any of the tracts. Observed and likely private recreational activity on the non-federal lands is described below, based on aerial photography, research, and field visits conducted in October 2011. For reference, ownership surrounding the non-federal lands is shown in Figures 4.3.1-2, 4.3.1-3, and 4.3.1-4.

4.3.11.2.1 Forest Service Recreation Designations

The ROS designations for areas surrounding the non-federal lands are summarized in Table 4.3.11-3. The Semi-Primitive Motorized and Roaded Natural ROS designations are defined in Section 4.2.11.1.1. The Semi-Primitive Non-Motorized designation is similar to the Semi-Primitive Motorized, except that motor vehicles are not permitted.

Table 4.3.11-3 Recreational Opportunity Spectrum Designations in the Vicinity of Non-federal Lands

Tract	Adjacent/Nearby ROS Designations
1 – Hay Lake Lands	Semi-Primitive Motorized, Semi-Primitive Non-Motorized, and Roaded Natural
2 – Lake County Lands	Semi-Primitive Non-Motorized (Lake County South); Semi-Primitive Motorized, and Semi-Primitive Non-Motorized (Lake County North)
3 – Wolf Lands	Semi-Primitive Motorized and Roaded Natural
4 – Hunting Club Lands	Semi-Primitive Motorized
5 – McFarland Lake Lands	Semi-Primitive Non-Motorized and Semi-Primitive Motorized

4.3.11.2.2 Regional Recreational Resources

The Superior National Forest, including the BWCAW, and Voyageurs National Park are important recreation areas in northeastern Minnesota. The Superior National Forest includes approximately 3 million acres and provides recreation opportunities for camping, boating, fishing, hiking, viewing scenery, off-highway vehicle riding, wilderness related recreation, snowmobiling, and cross country skiing. Located 20 miles to the north of the NorthMet Project area, the million-plus-acre BWCAW is protected as part of the National Wilderness Preservation System. Voyageurs National Park is located approximately 50 miles north of the NorthMet Project area (see Figure 1.1-1). In addition, there are year-round recreation opportunities at Giants Ridge (approximately 15 miles east of the Mine Site) that include downhill skiing, snowboarding, cross-country skiing, snowmobiling, mountain biking, hiking, and golf. There are also opportunities for biking, hiking, roller-blading on the Mesabi Trail which spans 70 miles across the Iron Range.

4.3.11.2.3 Forest Service Scenic Integrity Designations

The non-federal lands are all within the Superior National Forest proclamation boundary, and are surrounded by relatively flat terrain covered in forests and wetlands. Some of the tracts are located within a few miles of towns, mines, and active forestry activity. The Mine Site would not be visible from any of the non-federal tracts. SIO designations for portions of Superior National Forest surrounding the five tracts are summarized in Table 4.3.11-4. Definitions of the SIO designations are provided in Section 4.2.11.1.2.

Table 4.3.11-4 Scenic Integrity Objective Designations in the Vicinity of Non-federal Lands

Tract	Adjacent/Nearby SIO Designations
1 – Hay Lake Lands	High, Moderate, Low
2 – Lake County Lands	Moderate (Lake County South); Low, Moderate (Lake County North)
3 – Wolf Lands	Low (Wolf Lands 2, 4); Low, Moderate (Wolf Lands 1); Low, High (Wolf Lands 3)
4 – Hunting Club Lands	Moderate
5 – McFarland Lake Lands	High

4.3.11.2.4 Tract 1 – Hay Lake Lands

Recreation

Tract 1 exhibits evidence of recreational activity. Several trails cross the parcel, including trails that intersect with County Road 715; most of these trails are either bermed or gated and some have posted No Trespassing signs. Hay Lake and Rice Lake are accessible by canoe on the Pike River. Deer and evidence of bear were observed, as were two deer stands (others are believed to exist) (Lisson and Gawtry 2011). A sand and gravel pit in the northeastern portion of the parcel show evidence of use as a shooting range and/or hunting site. A boat landing and small parking area (not listed or mapped as a MDNR access point) are present near the southeastern corner of the parcel on Rice Lake.

Visual Resources

Tract 1 covers 4,926.3 acres that contain three lakes (see Figure 4.3.11-1). This tract is crossed by County Road (CR) 175 and CR 135 (both of which are known as Pike River Road) and the Pike River. Tract 1 can be viewed from Pike River Road and nearby Pike Mountain, as well as the waterways within the tract. Tract 1 is roughly 3 miles north-northwest of Biwabik; however, the flat terrain prevents the tract from being viewed from the town. The portions of Superior National Forest surrounding this parcel generally have Low SIO designations, with some Moderate designations near the northeastern and southwestern corners, and High designations to the north.

Figure 4.3.11-1 The Hay Lake Tract: Looking North along the Pike River

4.3.11.2.5 Tract 2 – Lake County Lands

Recreation

The Tract 2 parcels all have very limited access. There is no evidence of recreational activity or hunting on any of these parcels.

Visual Resources

Tract 2 consists of four individual parcels, referred to as Lake County North and Lake County South, totaling 381.9 acres. The three Lake County North parcels are located southeast of Pine Lake and approximately 13 miles southeast of the federal lands, and are not visible from Pine Lake Road, the nearest public road. The portions of Superior National Forest surrounding these parcels have Low and Moderate SIO designations (see Figure 4.3.11-2). The Lake County South parcel is approximately 27 miles southeast of the federal lands. Due to flat terrain and the remote nature of the southern site, it is not visible from public roads or other public areas. The portions of Superior National Forest surrounding this parcel have Moderate SIO designations.

Figure 4.3.11-2 Looking East from the Northwest Corner of Lake County North, Southern Sub-Parcel

4.3.11.2.6 Tract 3 – Wolf Lands

<u>Recreation</u>

The Tract 3 parcels all have very limited access. A rough forest road provides access to Wolf Lands 3, and a trail accesses Coyote Creek. No trails were observed on any of the other parcels during site visits, and there is no evidence of recreational activity or hunting on any of the Tract 3 lands.

<u>Visual Resources</u>

Tract 3 consists of four separate parcels totaling 1,575.8 acres, and consists of level land containing wetlands, bogs, and forests. Wolf Lands 1 is located southeast of Pine Lake and may be visible from Nelson Road. The portions of Superior National Forest surrounding this parcel have Low and Moderate SIO designations. Wolf Lands 2 is due east of Greenwood Lake and may be visible from a private road to the east of the property. The portions of Superior National Forest surrounding this parcel have Low SIO designations. Wolf Lands 3 has recently been logged and may be visible from Forest Route 393 (see Figure 4.3.11-3). The portions of Superior National Forest surrounding this parcel have Low SIO designations, with a corridor of High SIO land along the southeastern boundary. Wolf Lands 4 is visible from Forest Routes 103 and 393. The portions of Superior National Forest surrounding this parcel have Low SIO designations.

Figure 4.3.11-3 The Wolf Lands, Looking Northwest along Coyote Creek

4.3.11.2.7 Tract 4 – Hunting Club Lands

Recreation

Tract 4 is currently accessible via a private road. One trail passes close to the southern boundary of the site. There is no evidence of recreational activity or hunting on this parcel.

Visual Resources

Tract 4 is comprised of 160.2 acres and is approximately 50 miles northwest of the federal lands. It is level, remote, and surrounded by other forested lands (see Figure 4.3.11-4). There are no public roads leading into or directly around the parcel. Two small public roads are within two miles of the parcel but are screened from view by vegetation and terrain. The portions of Superior National Forest surrounding this parcel have Moderate SIO designations.

Figure 4.3.11-4 Wetland on the Hunting Club Lands Parcel

4.3.11.2.8 Tract 5 – McFarland Lake Lands

Recreation

Legal access to Tract 5 is limited to water access, although a private cart road exists at the edge of the property, as does a trail along the lake shore. There is no evidence of current recreational activity or hunting on this parcel; however, Tract 5 was previously owned by Wheaton College. A bunk house, fire pit, outhouse, and cistern (all unused and in disrepair) remain on site, indicating past use for recreational activities. All structures would be removed upon completion of the Land Exchange Proposed Action.

Visual Resources

Tract 5 encompasses 30.8 acres situated on the western shore of McFarland Lake (see Figure 4.3.11-5). The parcel is visible from the northern, eastern, southern, and portions of the western shore of McFarland Lake. County Road 74 and Woolys Bluff run along the southern and southeastern perimeter of McFarland Lake, but are substantially screened from viewing the parcel due to vegetation and flat terrain. A limited number of lakefront homes, private piers, and a public access point on the eastern shore of the lake have views of the McFarland Lake property. The portions of Superior National Forest surrounding this parcel have High SIO designations.

Figure 4.3.11-5 McFarland Lake from the McFarland Lake Tract

4.3.12 Wilderness and Other Special Designation Areas

4.3.12.1 Federal Lands

4.3.12.1.1 Land Exchange Proposed Action

The federal lands of the Land Exchange Proposed Action are similar to the Mine Site previously discussed, but exclude the privately owned land bordering Dunka Road to the south of the Mine Site. Section 4.2.12.1 provides a discussion of the existing conditions on the federal lands.

4.3.12.1.2 Land Exchange Alternative B

The federal lands included in the Land Exchange Alternative B are similar to the federal lands in the Land Exchange Proposed Action. Section 4.2.12.1 discusses the existing conditions on the federal lands.

4.3.12.2 Non-federal Lands

The non-federal lands comprise five tracts (groups of parcels) assembled by PolyMet for the purpose of the Land Exchange Proposed Action.

4.3.12.2.1 Tract 1 – Hay Lake Lands

Adjacent cRNAs include the Pike Mountain and Loka Lake cRNAs (southwest corner and northeast corner of the tract, respectively). Pike Mountain is a 709-acre research area located on top of the Mesabi Range, characterized by old growth northern hardwood communities (sugar maple and red oak), paper birch forest, and rock/talus communities. The Loka Lake cRNA is part of an extensive peatland dominated by stunted black spruce and tamarack with interspersed upland islands (USFS 2011h).

4.3.12.2.2 Tract 2 – Lake County Lands

There are no wilderness or other special designation areas in or adjacent to Tract 2.

4.3.12.2.3 Tract 3 – Wolf Lands

There are no wilderness or other special designation areas in or adjacent to Tract 3.

4.3.12.2.4 Tract 4 – Hunting Club Lands

There are no wilderness or other special designation areas in or adjacent to Tract 4.

4.3.12.2.5 Tract 5 – McFarland Lake Lands

This tract includes lakefront property on McFarland Lake, an entry point to the BWCAW. Access to the property is available by water from a landing off County Road 16 (Arrowhead Trail) approximately 10 miles north of Hovland, Minnesota. While near the BWCAW, this tract is located outside the BWCAW boundary. There are no other wilderness or other special-designation areas in or adjacent to Tract 5.

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4.3.13 Hazardous Materials

There are no proposed operations or activities that involve the use of hazardous materials on the federal or non-federal lands associated with the Land Exchange Proposed Action. AOCs associated with contamination by hazardous materials from former activities and operations on these lands are discussed in Section 4.3.1.

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4.3.14 Geotechnical Stability

The Land Exchange Proposed Action does not include the creation or modification of geotechnical features. As such, the current geotechnical conditions at lands proposed for exchange are not considered relevant to the EIS. The existing geotechnical conditions underlying the NorthMet Project Proposed Action stockpiles that would be located on federal lands proposed for exchange are discussed in Section 4.2.14.

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5.0 ENVIRONMENTAL CONSEQUENCES

5.1 INTRODUCTION

Pursuant to the requirements of NEPA regulations at 40 CFR 1502.16 and *Minnesota Rules*, part 4410.2300, Chapter 5 describes the potential environmental consequences of the NorthMet Project Proposed Action and Land Exchange Proposed Action on the affected environment as described in Chapter 4.

As defined in 40 CFR 1508.8, this chapter addresses the following types of effects:

- Direct effects, which are caused by the action and occur at the same time and place; and
- Indirect effects, which are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable. Indirect effects may include growth-inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems, including ecosystems.

Evaluation criteria and analysis methodology are identified where applicable for each resource topic. Environmental effects were determined based on qualitative and/or quantitative assessment.

As listed in Table 5.1-1, this chapter follows the same structure and order of resource topics as Chapter 4. Section 5.2 describes the environmental consequences of the NorthMet Project Proposed Action and the NorthMet Project No Action Alternative. Section 5.3 describes the environmental consequences of the Land Exchange Proposed Action, Land Exchange Alternative B, and Land Exchange No Action Alternative.

The proposed lands to be exchanged are described in below in Section 5.3; however, the ROD will require an updated and current appraisal, approved by the USFS, to verify equal value. Appraisal reports completed in 2013 indicate that the Land Exchange Proposed Action would meet federal value requirements if all five non-federal land tracts offered by PolyMet were exchanged for the federal lands. The appraisal reports also indicated that the Land Exchange Alternative B would meet the federal value requirements if non-federal Tract 1 offered were exchanged for the smaller federal parcel. Appraisals must conform to Uniform Appraisal Standards for Federal Land Acquisitions and the Uniform Standards of Professional Appraisal Practice of the Appraisal Foundation. The final proposed configuration of land would be determined after the market value of the parcels is determined by appraisals and the environmental analysis has been completed. This information will be presented in the ROD.

As previously indicated, the land exchange acreages used in the Project Description section are described in GLO acreages, while the acreages used in the Affected Environment and Environmental Consequences sections are described in GIS acreages. The environment consequences presented in Section 5.3 are based upon GIS data. GIS values indicate the size of the federal and non-federal parcels as computed geometrically using mapping software, which may be different than the GLO legal acreage. Unless noted as GLO acres, all values shown are derived from GIS data.

Table 5.1-1 Resource Topic Areas Discussed in Chapter 5

Resource Topic	NorthMet Project Proposed Action	Land Exchange Proposed Action
Land Use	5.2.1	5.3.1
Water Resources	5.2.2	5.3.2
Wetlands	5.2.3	5.3.3
Vegetation	5.2.4	5.3.4
Wildlife	5.2.5	5.3.5
Aquatic Species	5.2.6	5.3.6
Air Quality	5.2.7	5.3.7
Noise and Vibration	5.2.8	5.3.8
Cultural Resources	5.2.9	5.3.9
Socioeconomics	5.2.10	5.3.10
Recreation and Visual Resources	5.2.11	5.3.11
Wilderness and Special Designation Areas	5.2.12	5.3.12
Hazardous Materials	5.2.13	5.3.13
Geotechnical Stability	5.2.14	5.3.14

5.2 NORTHMET PROJECT

5.2.1 Land Use

This section evaluates the NorthMet Project Proposed Action against existing and applicable land use plans. The specific focus is on the consistency of the NorthMet Project Proposed Action with accepted plans, zoning ordinances, or land use agency management plans. It also addresses the legacy contamination and how it would be affected by proposed activities.

Summary

Components of the NorthMet Project Proposed Action are subject to the requirements of local comprehensive land use plans or the Superior National Forest Plan. In all cases, the NorthMet Project Proposed Action activities are consistent with the formally adopted plans. The NorthMet Project Proposed Action would decrease the amount of land available for public access and use, and would decrease portions of the 1854 Ceded Territory available for use by the Bands. Given the historic use of the federal lands within the Mine Site for mineral exploration and ongoing restrictions on public access (see Section 4.2.11), the NorthMet Project Proposed Action would result in little or no change in actual public use of these lands.

5.2.1.1 Methodology and Evaluation Criteria

The USFS uses the management area framework to broadly define the desired conditions and activities on lands within national forests. Land use outside the Superior National Forest is governed by local zoning and comprehensive plans. The management area designations applicable to the Mine Site and portions of the Transportation and Utility Corridor, as defined in the Forest Plan, are described in Section 4.2.1, as are zoning designations for land outside of the Superior National Forest.

The NorthMet Project Proposed Action is evaluated against the following evaluation criteria:

- Compatibility of proposed land use with existing land use, land use plans, zoning ordinances, 1854 Treaty obligations, and adjacent USFS management areas;
- Anticipated outcomes related to identified contaminated lands; and
- The degree to which past, ongoing, or planned investigation and remediation actions at legacy contamination sites would be affected by disturbance associated with the NorthMet Project Proposed Action.

5.2.1.2 NorthMet Project Proposed Action

5.2.1.2.1 Consistency with Zoning and Comprehensive Plans

The NorthMet Project area lies within the Mineral Mining zoning districts of the cities of Babbitt and Hoyt Lakes (Arrowhead 2014; Hoyt Lakes Planning Commission 2010), and an industrial use district of St. Louis County (St. Louis County 2011). Therefore, the NorthMet Project area is compatible with the zoning ordinance and draft revised Comprehensive Land Use Plan, and would not require an amendment of the respective zoning ordinances or Comprehensive Land Use Plans (Arrowhead 2014; City of Babbitt 1996). Both the county and municipal zoning districts surrounding the Plant Site are designated for industrial or mining use; the NorthMet

Project area is compatible with these designations and would not require amendments to current land uses. Privately owned parcels adjacent to the Mine Site fall under the same or similar zoning and land use designations; therefore, the NorthMet Project Proposed Action would not have the potential to conflict with surrounding land uses.

5.2.1.2.2 Consistency with Superior National Forest Plan

The Mine Site is located within the Superior National Forest and on lands designated as a General Forest-Longer Rotation Management Area (USFS 2011a). In such areas, the USFS allows exploration, development, and processing of mineral resources under conditions where activities are consistent with sound environmental management so as to contribute to economic growth. In addition to managing project development, the USFS also requires preparation of associated reclamation plans to ensure the long term protection and restoration of the natural resources (USFS 2004b). The NorthMet Project Proposed Action would be consistent with these policies.

The NorthMet Project Proposed Action would represent a reactivation of the Transportation and Utility Corridor (including the Dunka Road and the associated rail line) for mining, which would be compatible with existing corridor land uses. Under the NorthMet Project Proposed Action, Dunka Road would remain private for mine operation use. Superior National Forest lands to the east, south, and southwest of the Transportation and Utility Corridor are accessible by forest roads and are not dependent on Dunka Road for access (see Figure 4.3.1-1), although Forest Road 113 connects Dunka Road to CR 110 near Skibo, Minnesota. The NorthMet Project Proposed Action represents no anticipated change in the level of public access to either of these adjacent Superior National Forest parcels.

5.2.1.2.3 Areas of Concern

Upon the purchase of a portion of the site, PolyMet became responsible for 29 AOCs (see legacy contamination discussion in Section 4.2.1.4.2). Of these, six have already been closed or have received a No Further Action letter from the MPCA (see Table 4.2.1-2). Additional investigation would be required to determine whether the remaining AOCs require further action. The NorthMet Project Proposed Action offers no direct resolution for the 33 AOCs that are designated as the responsibility of parties other than PolyMet (see Table 4.2.1-2). The MPCA VIC program would be utilized to facilitate and oversee remediation activity for any remaining potential historical releases on the 29 AOCs under the NorthMet Project Proposed Action.

5.2.1.3 NorthMet Project No Action Alternative

The NorthMet Project No Action Alternative would not result in any change in land management at the Mine Site or Transportation and Utility Corridor. Land at the Plant Site would continue to be managed in accordance with the existing closure plan and Consent Decree. The existing 1854 Treaty obligations for the Mine Site and Plant Site would remain unchanged.

5.2.2 Water Resources

This section is organized into a description of the criteria used for evaluating NorthMet Project Proposed Action-related effects, the methodologies used to predict these effects, and a discussion of the effects resulting from the NorthMet Project Proposed Action. A summary of the primary effects of the NorthMet Project Proposed Action on water resources is provided below.

Summary

The NorthMet Project Proposed Action would be located in an historic mining area, known as the Mesabi Iron Range, and in the vicinity of other past, present, and potential future mining projects. Although the Mine Site would be on undeveloped land, PolyMet proposes to re-use many of the former LTVSMC facilities at the brownfield Plant Site, which is located about 8 miles west of the Mine Site. While reusing the existing LTVSMC Tailings Basin for tailings deposition offers environmental benefits (e.g., reducing wetland effects and addressing legacy water quality issues), it does create challenges because the existing LTVSMC Tailings Basin is not lined and currently releases seepage with elevated concentrations of sulfate, TDS, and hardness, among other constituents. Many of the engineering controls proposed by PolyMet at the Plant Site are related to managing seepage from both the existing LTVSMC tailings and the future NorthMet tailings.

The NorthMet Project Proposed Action would have the potential to affect groundwater and surface water hydrology and quality in both the Partridge River and Embarrass River watersheds. These two rivers are both tributaries to the St. Louis River and within the Lake Superior Basin. They are not located within the Hudson Bay Basin and do not drain to or affect the water quality of the BWCAW.

The presence of perennial streams and watershed divides at both the Mine Site and Plant Site constrain the hydrologic effects of the NorthMet Project Proposed Action to the Partridge River and Embarrass River watersheds. There are two hydrologic barriers between the Mine Site and the Rainy River Watershed (which is hydrologically connected to the BWCAW), including:

- High ground north of the Partridge River that creates a watershed divide separating the Superior and Rainy River Watershed, and prevents surface water from passing between the two. This major watershed divide is included in the National Atlas, as well as USGS and MDNR data.
- Yelp Creek and the Partridge River encircle the northern, eastern, and southern sides of the Mine Site. These streams are thought to be hydrologic sink for groundwater and surface water originating at the Mine Site. Surface runoff or groundwater seepage leaving the Mine Site would follow a gradient into Yelp Creek or the Partridge River, as opposed to continuing towards the watershed divide. The position of the One Hundred Mile Swamp as continuous across this watershed divide does not imply that there is groundwater or surface water flow across the divide.

The NorthMet Project Proposed Action would represent the first copper-nickel-PGE mine in Minnesota, with the ore and waste rock containing various amounts of sulfide minerals. Sulfide minerals, when exposed to oxygen and water, have the potential to release soluble metals and sulfate and produce acid mine drainage. The sulfide sulfur (S) concentrations of the NorthMet waste rock would be relatively low compared to many other mines with sulfide-bearing rock around the world. The NorthMet waste rock is predicted to average 0.15 percent sulfide S, while concentrations in other mines with sulfide-bearing rock can be as high as 40 percent (Minesite Drainage Assessment Group 2013).

Most of the bedrock in and around the NorthMet Deposit contains silicate minerals that have a small but measurable potential to neutralize acidity. Multi-year weathering tests demonstrate that the acid-generating potential of the Category 1 waste rock stockpile and the tailings (i.e., material containing less than or equal to 0.12 percent sulfide S) would be low enough that these facilities would not produce acidic leachate (PolyMet 2015q).

Where the pore water pH remains near-neutral, metal mobility tends to be limited as some metals released by oxidation are removed from solution by adsorption or co-precipitation. The Category 2/3 and Category 4 waste rock would have sulfide S concentrations that could produce acid drainage if exposed to oxygen and water; however, the mine plan calls for temporary storage (less than 12 years) of this waste rock in geomembrane lined stockpiles with a seepage collection systems, and then subaqueous disposal in the East Pit where oxidation would be very limited and acid drainage would not occur.

The sulfate released from the NorthMet waste rock and tailings is especially important because there are waters supporting the production of wild rice downstream from both the Mine Site and Tailings Basin. Research indicates that elevated sulfate concentrations can affect the growth and viability of wild rice. The MPCA has established a 10 mg/L sulfate water quality standard for waterbodies designated as waters used for production of wild rice. If the sulfate concentration in a water body used for production of wild rice currently exceeds the 10 mg/L water quality standard, MPCA requires that discharges to that water from a proposed activity cannot cause or contribute to an exceedance of the standard.

In MPCA staff-recommended wild rice waters along the Partridge River, the sulfate concentration currently exceeds the 10 mg/L standard about half of the time, largely due to sulfate loading associated with water discharges from the Northshore Mine operation located upstream of the proposed NorthMet Mine Site.

In MPCA staff-recommended wild rice waters along the Embarrass River, the sulfate concentration exceeds the 10 mg/L standard nearly all the time due to discharges from Cliffs Erie Area 5 NW mine pit to an upstream tributary of the Embarrass River. Given the 10 mg/L sulfate exceedances that occur on both the Partridge River and Embarrass River, it must be demonstrated that the NorthMet Project Proposed Action would not cause or contribute to exceedances of an effluent limit based on the 10/mg/L standard for permitting. In addition, for the Embarrass River and several of its tributaries at the Plant Site, the MPCA has developed supplemental requirements for acceptable sulfate concentrations and mass loadings.

As described in Section 2.3.2.1, the Co-lead Agencies prompted PolyMet to substantially modify the NorthMet Project Proposed Action between and the DEIS and SDEIS. Additional modifications were made between the SDEIS and the FEIS to further protect of water resources. The proposed engineering controls would provide a high degree of reliability and flexibility to ensure that the evaluation criteria would continue to be met in the future, when nearly all contact/process water at the NorthMet Project Proposed Action area would be treated at the WWTF or the WWTP before release to the environment.

At the Mine Site, the more reactive types of waste rock types (Category 2/3 and 4) and some of the less reactive Category 1 waste rock is now proposed for subaqueous disposal in the East Pit to limit oxidation of sulfide minerals and associated release of soluble metals. The majority of the less-reactive waste rock, Category 1 waste rock, would be permanently stored in a stockpile that is at the surface covered by a geomembrane with a vegetated soil cover (to reduce infiltration), and surrounded by a groundwater containment (capture) system.

The Category 1 containment system would consist of a barrier wall keyed into bedrock and an interior collection trench backfilled with permeable material and containing necessary pipes and pumps to remove the collected water. It is estimated that more than 98 percent of affected groundwater seepage from the Category 1 stockpile would be captured by the containment system or would migrate as groundwater into the West Pit and East Pit (PolyMet 2015h). The affected water collected by the containment system and mine pits would be pumped to a WWTF, treated to acceptable chemical concentrations, and either sent to the Plant Site for process water or discharged to the West Pit Outlet Creek that flows into the Partridge River. The WWTF would use chemical precipitation and filtration up to the end of reclamation (approximately mine year 55) and then be converted to RO to provide water treatment during post-closure maintenance. For RO operation, a distillation process would reduce the concentrate to a moist solid that would be disposed of off site. After project operations, the only appreciable non-treated mine water leaving the Mine Site would be about 10 gpm of groundwater seepage in the surficial aquifer that would migrate south and eventually be released to the Partridge River.

At the Plant Site, it is estimated that the existing LTVSMC Tailings Basin produces about 200 gpm of groundwater seepage and about 2,400 gpm of surface water seepage, most of which reaches the Embarrass River. While this seepage has a high sulfate load, it appears that most of the sulfate is sequestered by natural processes in wetlands between the Tailings Basin and the Embarrass River.

The surface water and groundwater seepage containment systems along the northern, northwestern, and western portions of the proposed NorthMet Tailings Basin would capture about 99 percent of the seepage from the Tailings Basin (i.e., 100 percent of surface seepage and greater than 90 percent of groundwater seepage). As a consequence, the flow of tailings water towards the Embarrass River would be reduced to zero surface seepage and about 20 gpm of affected groundwater. The water collected by the seepage containment system would be sent to a WWTP operating with an RO system, and the treated effluent would be sent either to the Mine Site to accelerate flooding of the West Pit or to tributaries of the Embarrass River to replace the flow captured by the containment system or both. On the eastern side of the Tailings Basin, a seepage containment system would be installed that due to the hydrogeologic conditions would be expected to capture 100 percent of tailings surface seepage and groundwater seepage.

On the Tailings Basin itself, PolyMet proposes bentonite amendments on the side slopes (installed as they are constructed during operations) and on the beaches after the end of operations to reduce infiltration and oxygen diffusion into the tailings. A layer of bentonite would also be placed at the bottom of the Tailings Basin pond to reduce leakage. The objective of the bentonite amendments is to reduce tailings seepage and its chemical load during reclamation and post-closure. This would have the long-term effect of reducing influent flow rates and chemical loads to the WWTP.

During post-closure, the WWTF and the WWTP (both mechanical treatment facilities) would continue operating until monitoring and pilot-testing demonstrated that a transition could be made to non-mechanical treatment systems, which may consist of constructed wetlands, permeable reactive barriers (PRBs), permeable sorptive barriers (PSBs), and/or other technologies to be identified. Based on the results of field demonstrations, non-mechanical treatment systems would be implemented only when monitoring at mine facilities indicated that the water quality and flow rates were amenable to these measures. In this FEIS, non-mechanical treatment systems are not described in detail because the potential effects of the NorthMet Project Proposed Action are based on mechanical treatment that would operate indefinitely. However, implementation of non-mechanical systems is considered a long-term goal for closure.

The objective of closure is to provide mechanical or non-mechanical treatment for as long as necessary to protect regulatory water quality at applicable groundwater and surface water compliance points. Both mechanical and non-mechanical treatments would require periodic maintenance and monitoring activities. Mechanical water treatment is part of the modeled NorthMet Project Proposed Action for the duration of the simulations—these are 200 years at the Mine Site and 500 years at the Plant Site, respectively. The duration of the simulations ensured that peak groundwater concentrations at the locations of release to surface water would occur during the model simulations..

Water quality modeling performed in support of the FEIS indicates that water treatment systems would be needed indefinitely at the Mine Site and Plant Site. The water models constructed to assess the potential effects from the NorthMet Project Proposed Action were not designed to predict the duration of treatment nor do they capture all the factors that influence the duration of treatment (e.g., potential future regulatory and technological changes). Therefore, the models cannot be used to predict when treatment would end. Actual treatment requirements would be assessed on a recurring basis throughout operations, reclamation, and closure considering influent and effluent water quality and monitoring results. Those periodic assessments would be carried out to ensure continuous protection of groundwater and surface water quality and compliance with water quality-based effluent limits. The periodic assessment process would rely on monitoring results coupled with predictive modeling rather than the results of the predictive modeling alone. Regardless of the precise duration of effects or water treatment at either the Mine Site or Plant Site, there are measures available to address impacts to natural resources, such as those identified in this FEIS. PolyMet would be held accountable for maintenance and monitoring required under any permit and would not be released from financial assurance until all permit conditions have been met.

Several groundwater, surface water, and water quality models (MODFLOW, XP-SWMM, and GoldSim, respectively) were used to predict the potential hydrologic and water quality effects of the NorthMet Project Proposed Action. GoldSim independently modeled 27 chemical parameters and provided values to further calculate two more chemical parameters, TDS and hardness. GoldSim uses probabilistic (Monte Carlo) simulations that take into account the uncertainty of the model inputs and generated outputs taking the form of cumulative probability distributions. The Co-lead Agencies have selected the 90th percentile probability (P90) as their evaluation threshold in determining whether the model results meet established evaluation criteria (i.e., there is at least a 90 percent probability that a constituent would not exceed the water quality evaluation criteria) when the waterbody does not currently exceed the evaluation criteria. In instances where the waterbody exceeds the applicable evaluation criteria, the FEIS assesses whether the NorthMet Project Proposed Action discharges would cause or contribute to the exceedance. A 5 percent frequency-of-exceedance criterion was used for metals with hardness-dependent evaluation criteria. The 5 percent threshold was selected because it is sufficiently conservative for purposes of identifying solutes where additional discussion is necessary to understanding potential environmental effects. Probabilistic chemical concentrations predicted by GoldSim were compared against water quality criteria and the Continuation of Existing Conditions (CEC) model results at eight groundwater and eight surface water evaluation locations at the Mine Site, and three groundwater and ten surface water evaluation locations at the Plant Site.

All of the 29 water quality parameters were screened against evaluation criteria to determine which ones require further analysis. A small subset of these parameters was identified for futher assessment in the FEIS that at an initial screening appeared to approach or exceed their respective evaluation criteria.. In the Embarrass River Watershed these parameters include aluminum, lead, and sulfate in surface waters and fluoride, manganese, sulfate, and TDS in groundwater. In the Partridge River Watershed, the parameters include aluminum and sulfate in surface water, with none for groundwater. In Colby Lake surface water, these include aluminum, arsenic, iron, and manganese.

For all solutes, the model predicted that the NorthMet Project Proposed Action would not cause any significant water quality impacts because: 1) exceedances of the P90 threshold did not occur, 2) the NorthMet Project Proposed Action concentrations were no higher than concentrations predicted for the CEC scenario, or 3) the frequency of exceedances for NorthMet Project Proposed Action conditions was within an acceptable range or not attributable to NorthMet Project Proposed Action discharges or both.

Flow modeling indicated that the NorthMet Project Proposed Action would not result in any substantial changes at the Mine Site nor at the Plant Site to groundwater and surface water flows based upon established evaluation criteria when compared to the continuation of existing conditions.

Many of the lakes and rivers in the NorthMet Project Proposed Action area are classified as “impaired waters” by the MPCA because of elevated mercury in fish. There are several factors that cause elevated mercury in fish, including the increased availability of methylmercury. The production of methylmercury is dependent on sulfate concentrations and environmental conditions required for sulfate-reducing bacteria to live (e.g., sufficient organic carbon and lack of oxygen).

The NorthMet Project Proposed Action area is located within the Lake Superior Basin, so it is subject to the Great Lakes Initiative mercury water quality standard of 1.3 ng/L. The NorthMet ore and waste rock contain trace amounts of mercury, but mass balance modeling and analog data from other natural lakes and mine pit lakes in northeastern Minnesota suggest that the mercury concentration in the West Pit Lake would stabilize at approximately 0.9 ng/L.

There would also be mercury in the tailings, although about 92 percent of the mercury in the ore is predicted to remain in the ore concentrate and the mercury concentration in seepage from the Tailings Basin is expected to be less than the standard. Overall, the NorthMet Project Proposed Action is predicted to increase mercury loadings in the Embarrass River. The WWTF and the WWTP would be designed to meet water quality based effluent limits that are protective of the Great Lakes Initiative 1.3 ng/L mercury standard. Mercury loadings in the Partridge River would decrease. The net effect of these changes would be an overall reduction in mercury loadings to the downstream St. Louis River upstream of the Fond du Lac reservation boundary. Therefore, the Fond du Lac mercury water quality standard of 0.77 ng/L would be protected.

PolyMet would be required by its permits to monitor the NorthMet Project Proposed Action's effects on hydrology and water quality in order to refine modeling to help predict future conditions. In the event that the monitoring identifies the potential for any water quality exceedances, PolyMet has proposed an Adaptive Water Management Plan (AWMP) that identifies additional measures that could be taken, if necessary, to prevent any exceedances of water quality standards (see Section 5.2.2.3.5).

5.2.2.1 Evaluation Criteria

In general, water resource evaluation criteria focus on groundwater and surface water hydrology and water quality and are defined as thresholds or changes in the existing physical, chemical, and biological environment with the goal of protecting overall waterbody health.

5.2.2.1.1 Groundwater

This section discusses evaluation criteria for the effects of the NorthMet Project Proposed Action on groundwater hydrology (primarily groundwater levels) and water quality.

Hydrogeologic Evaluation Criteria

There are no state or federal regulatory standards for the maximum allowable change in groundwater levels. It is recognized that groundwater elevations would be decreased within a small area around the mine pits. Groundwater elevations may also decrease near the Tailings Basin's containment system as a result of pumping on the basin's side of the cutoff wall. The significance of any changes in groundwater levels is evaluated in terms of its effects on other resources (e.g., wetlands) and these potential effects are discussed in the appropriate resource sections. The magnitude of any changes in groundwater levels are quantified in this section.

Water Quality Evaluation Criteria

A total of 27 analytes were selected to be directly modeled because concentrations of those analytes could be altered by the NorthMet Project Proposed Action. The list of analytes was constructed considering host rock mineralogy and the results of geochemistry analyses. It includes the following analytes:

- Alkalinity
- Calcium
- Chloride
- Fluoride
- Sulfate
- Magnesium
- Potassium
- Sodium
- Aluminum
- Antimony
- Arsenic
- Barium
- Beryllium
- Boron
- Cadmium
- Chromium III
- Cobalt
- Copper
- Iron
- Lead
- Manganese
- Nickel
- Selenium
- Silver
- Thallium
- Vanadium
- Zinc

This suite of directly modeled solutes does not include hardness and TDS. Hardness was calculated from the directly modeled constituents calcium and magnesium. TDS was estimated by summing its constituent concentrations that were directly modeled, including calcium, chloride, fluoride, magnesium, potassium, sulfate, and a portion of alkalinity.

This FEIS assesses effects by comparing the predicted NorthMet Project Proposed Action-related water quality with a modeled existing water quality (as characterized by groundwater quality monitoring) and applicable Minnesota groundwater quality standards, which are based on Minnesota water use classifications (*Minnesota Rules* 7060, 7050, and 7052). Groundwater quality standards are USEPA primary MCLs (pMCL), USEPA sMCL, and MDH HRLs. The groundwater quality evaluation criteria, for the purposes of this FEIS, are defined as the strictest (i.e., lowest) concentration among the USEPA pMCLs, USEPA sMCLs, and the MDH HRLs, with the following exceptions:

- Human health-based primary drinking water standards for copper and lead are "at the tap" values applicable to treated water systems and not to "in situ" groundwater values (see Note 3 to Table 5.2.2-2). *Minnesota Rules* addressing the water quality standards applicable to Class 1 waters used for domestic consumption specifically state that the primary drinking water standards for copper and lead do not apply to Class 1 surface waters or groundwater. The FEIS uses the USEPA sMCL of 1,000 µg/L as the groundwater evaluation criteria for copper. Modeling predictions for lead are presented but without a groundwater evaluation criterion because no sMCL or an HRL is available for this analyte.
- Natural (unaffected) groundwater concentrations for aluminum and iron at the Mine Site and Plant Site are greater than secondary drinking water standards. The concentrations for these two solutes in groundwater are heavily influenced by processes not readily captured in water quality models (e.g., site-specific redox reactions). Furthermore, these sMCLs were established by the USEPA as guidelines to assist public water systems in managing their drinking water for aesthetic considerations, and can be removed from groundwater with simple readily available treatment technologies, and are not enforced by the USEPA. For example, concentrations above the aluminum sMCL (200 µg/L) may result in colored water and concentrations above the iron sMCL (300 µg/L) may result in rusty color, metallic taste, and reddish or orange staining.
- Natural (unaffected) groundwater concentrations for beryllium, manganese, and thallium (bedrock unit only) at the Mine Site and beryllium and manganese at the Plant Site are greater than secondary drinking water standards and/or the HRL (see Table 5.2.2-1). These elevated concentrations are consistent with concentrations seen elsewhere in the Iron Range and northeast Minnesota. *Minnesota Rules*, part 7060.0600, subpart 8, states that "where the background level of natural origin is reasonably definable and is higher than the accepted standard for potable water and the hydrology and extent of the aquifer are known, the natural level may be used as the standard."

The evaluation criteria for these solutes were set at either 1) the 95 percent Upper Prediction Limit, 2) the second-highest value when there was a limited number of measured concentrations above the detection limit, or 3) half the detection limit when there were no detected concentrations pursuant to USEPA guidance (USEPA 2009b) (see Table 5.2.2-1).

Table 5.2.2-1 Beryllium, Manganese, and Thallium Evaluation Criteria

	Units	USEPA pMCL	USEPA sMCL	HRL	# samples	Range	Mean[5]	Recommended Evaluation Criteria
Mine Site		**Surficial**						
Beryllium	µg/L	4	--	0.08	320	ND–1.6	0.13	0.39[(1)]
Manganese	µg/L	--	50	100	311	ND–1,900	288	1,002[(1)(2)(6)]
Mine Site		**Bedrock**						
Beryllium	µg/L	4	--	0.08	49	ND–0.2	0.11	0.2[(3)]
Manganese	µg/L	--	50	100	49	ND–383	112	307[(1)(2)]
Thallium	µg/L	2	--	0.6	49	ND (0.2–2.0)	0.37	1.0[(4)]
Plant Site		**Surficial**						
Beryllium	µg/L	4	--	0.08	50	ND–2.72	0.20	0.54[(3)]
Manganese	µg/L	--	50	100	50	4.3–2,140	271	704[(1)]

Source: PolyMet 2015m and PolyMet 2015j.

ND = Non-detect
[1] 95 percent Upper Prediction Limit (UPL) used as evaluation criteria.
[2] Kaplan-Meier Method used to determine UPL.
[3] Second-highest detected concentration used as evaluation criteria.
[4] One half of the highest detection limit used as evaluation criteria.
[5] Where non-detects occur, the mean was calculated using half the detection limit.
[6] Risk Assessment Advice (RAA) levels of 100 µg/L for infants and 300 µg/L for children and adults.

Table 5.2.2-2 presents the pMCL, sMCL, HRL, and the evaluation criteria used in this FEIS.

Table 5.2.2-2 Groundwater Evaluation Criteria Applicable to the NorthMet Project Proposed Action

Solute	Units	USEPA pMCL	MDH HRL	USEPA sMCL	FEIS Evaluation Criteria
General Parameters					
Alkalinity	mg/L	--	--	--	--
Calcium	mg/L	--	--		
Chloride	mg/L	--	--	250	250
Fluoride	mg/L	4	--	2	2
Hardness	mg/L	--	--	--	--
Magnesium	mg/L	--	--	--	--
Potassium	mg/L	--	--	--	--
Sodium	mg/L	--	--	--	--
Sulfate	mg/L	--	--	250	250
Total Dissolved Solids	mg/L	--	--	500	500
Metals					
Aluminum	µg/L	--	--	50-200[(4)]	--[4]
Antimony	µg/L	6	6	--	6
Arsenic	µg/L	10	--	--	10
Barium	µg/L	2,000	2,000	--	2,000

Solute	Units	USEPA pMCL	MDH HRL	USEPA sMCL	FEIS Evaluation Criteria
Beryllium	µg/L	4	0.08	--	0.39/0.2/0.54[(1)]
Boron	µg/L	--	1,000[(2)]	--	1,000
Cadmium	µg/L	5	4	--	4
Chromium[6] III	µg/L	100	--	--	100
Cobalt	µg/L	--	--	--	--
Copper[3]	µg/L	--[3]	--	1,000	1,000
Iron	µg/L	--	--	300[(4)]	--[4]
Lead[3]	µg/L	--[3]	--	--	--
Manganese	µg/L	--	100	50	1,002/307/704[(1)]
Nickel (soluble salts)[5]	µg/L	--	100	--	100
Selenium	µg/L	50	30	--	30
Silver	µg/L	--	30	100	30
Thallium (salts)[5]	µg/L	2	0.6	--	0.6/1.0[(1)]
Vanadium	µg/L	--	50	--	50
Zinc	µg/L	--	2,000	5,000	2,000

Source: pMCLs (40 CFR 141), sMCLs (40 CFR 143), and HRLs (*Minnesota Rules*, part 4717.7500).

1 Beryllium, manganese, and thallium (Mine Site bedrock unit only). The evaluation criteria differ by location (reported here as Mine Site Surficial Aquifer/Bedrock Aquifer/Plant Site Surficial Aquifer) based on background water quality (see Table 5.2.2-1 above). Criteria are based on dissolved concentrations unless otherwise noted (MPCA 2014g).

2 Boron. See MDH guidance: www.health.state.mn.us/divs/eh/risk/guidance/gw/boron.html.

3 Lead and copper. Lead and copper enter drinking water primarily through plumbing materials. In 1991, the USEPA published the Lead and Copper Rule (USEPA 1991). This rule requires water systems to monitor drinking water at customer taps. The 1,300µg/L copper concentration and 15µg/L lead concentration represent action levels that, when exceeded at 10 percent of customer taps, require the water system to take additional actions to control corrosion. Therefore, these values reflect concentrations at the customer tap. Additionally, *Minnesota Rules*, part 7050.0221, subpart 1B, states that the primary drinking water standards for copper and lead are not applicable to Class 1 groundwater.

4 Aluminum and iron. These parameters were excluded from groundwater evaluation criteria due to baseline USEPA sMCL standard exceedances in the Iron Range and Northeast Minnesota and because these concentrations are heavily influenced by processes not captured in the proposed models (e.g., site-specific redox reactions). Further, standards for these parameters were established for management of aesthetic conditions in treated drinking water and are readily removed from groundwater with simple readily available treatment technologies. This policy was adopted by the Co-lead Agencies in the NorthMet EIS Groundwater Impact Assessment Planning Final Summary Memo (June 27, 2011).

5 Nickel and thallium. The MDH HRL is based on the salt form of this parameter. It is conservatively assumed, for purposes of the FEIS, that the salt form is equivalent to the total concentrations of this parameter.

6 Chromium III is used in the FEIS because it is the most likely form of chromium to be present at NorthMet Project Proposed Action project site.

These groundwater quality evaluation criteria are assessed at the following evaluation locations (see Figures 5.2.2-7 and 5.2.2-9):

- Partridge River Watershed:
    - Surficial Aquifer
        - East Pit and Category 2/3 Flowpath – at the Partridge River (coinciding with property boundary)
        - Ore Surge Pile Flowpath – at the Partridge River
        - WWTF Flowpath – at the property boundary

          Overburden Storage and Laydown Area Flowpath – at the old property boundary (a short distance south of Dunka Road) which is the FEIS Mine Site boundary

        - West Pit Flowpath – at the property boundary
    - Bedrock
        - East Pit Bedrock Flowpath – at the property boundary
        - West Pit Bedrock Flowpath toward SW-004 – at the property boundary
        - West Pit Bedrock Flowpath toward SW-004a – at the property boundary
- Embarrass River Watershed (all surficial aquifer, see Section 5.2.2.2.3):
    - North Flowpath – at the north property boundary
    - Northwest Flowpath – at the northwest property boundary
    - West Flowpath – at the west property boundary

5.2.2.1.2 Surface Waters

This section discusses evaluation criteria for the effects of the NorthMet Project Proposed Action on surface water hydrology and quality.

<u>Hydrologic Alteration of Streams and Lakes Evaluation Criteria</u>

Hydrologic evaluation criteria include a comparison of proposed hydrologic changes with both existing natural conditions and historic hydrologic alterations from permitted mining practices, an assessment of present and predicted channel stability, and review of any appropriate physical or biological stream data. Evaluation criteria for streamflows in the Partridge River Watershed and changes in lake or reservoir levels in the NorthMet Project Proposed Action area are those developed by (Richter et al.1996; 1998) related to alteration of hydrology and were adopted by the Co-lead Agencies during the IAP process (MPCA 2011d). The main parameters recommended for this “range of variability” approach include:

- Annual mean daily flow by month;
- Annual maximum 1-day, 3-day, 7-day, 30-day, and 90-day flows;
- Annual minimum 1-day, 3-day, 7-day, 30-day, and 90-day flows;
- Number of high pulses (i.e., the number of times per year the mean daily flow increases above the 75th percentile of all simulated mean daily flows);
- Number of low pulses (i.e., the number of times per year the mean daily flow falls below the 25th percentile of all simulated mean daily flows);
- Duration of high pulses (i.e., the number of days per year with mean flows above the 75th percentile of all simulated daily mean flows);
- Duration of low pulses (i.e., the number of days per year with mean flows below the 25th percentile of all simulated daily mean flows);
- Mean duration of high pulses (i.e., the ratio of duration of high pulses to number of high pulses);

- Mean duration of low pulses (i.e., the ratio of duration of low pulses to number of low pulses); and
- Annual mean, annual maximum, and annual minimum lake levels in Colby Lake and Whitewater Reservoir.

The magnitude of deviation from existing conditions in the hydrologic parameters, based on XP-SWMM modeling prepared for the Partridge River watershed, helps determine the degree of potential effect on stream ecology. These values are not expressed as compliance standards, but would assist in monitoring effects and recommending potential mitigation measures as appropriate.

Flow characteristics for different reaches of the Embarrass River and selected tributaries were estimated by extrapolating flows from USGS gaging station 04017000 (located just downstream of PM-12.3) on a unit-area basis. Flow parameters estimated in the Embarrass River Watershed include groundwater baseflow, annual 1-day minimum flow, annual 1-day maximum flow, and annual daily mean flow.

The MDNR also has recommended maintaining surface flows within plus or minus 20 percent of existing conditions in NorthMet Project Proposed Action-affected streams to maintain existing aquatic ecology (Chisholm 2006). See section 5.2.6 for more details.

Water Quality Evaluation Criteria

This FEIS assesses effects on water by comparing the predicted water quality under the NorthMet Project Proposed Action against evaluation criteria based on the State of Minnesota water quality standards and use classifications (*Minnesota Rules* 7050 and 7052). Applicable use classifications of the primary surface waters potentially affected by the NorthMet Project Proposed Action are described in Section 4.2.2 and are summarized in Table 5.2.2-3.

Table 5.2.2-3 Applicable Use Classifications of the Primary Surface Waters in the NorthMet Project Proposed Action Area

		Domestic Consumption	Aquatic Life and Recreation			Industrial Consumption		Agriculture and Wildlife		Aesthetic Enjoyment	Other uses
Watershed	**Stream Name**	**1B**	**2A**	**2B**	**2Bd**	**3B**	**3C**	**4A**	**4B**	**5**	**6**
Partridge	Partridge River			X			X	X	X	X	X
Partridge	West Pit Outlet Creek			X			X	X	X	X	X[1]
Partridge	Wetlegs Creek			X			X	X	X	X	X
Partridge	Longnose Creek			X			X	X	X	X	X
Partridge	Wyman Creek	X	X			X	X	X	X	X	X
Partridge	Colby Lake	X			X		X	X	X	X	X
Embarrass	Embarrass River			X			X	X	X	X	X
Embarrass	Trimble Creek			X			X	X	X	X	X
Embarrass	Mud Lake Creek			X			X	X	X	X	X
Embarrass	Second Creek			X			X	X	X	X	X
Embarrass	Unnamed Creek			X			X	X	X	X	X

[1] The WWTF would discharge to the West Pit Outlet Creek.

In *Minnesota Rules* part 7050.0221, the USEPA primary and secondary drinking water standards are adopted for Class 1B waters (i.e., those treated with simple chlorination for domestic consumption). The USEPA primary drinking water standards (40 CFR 141) set mandatory MCLs for drinking water contaminants to protect the public from consuming water that presents a risk to human health. The USEPA has also established secondary drinking water standards (40 CFR 143) for 15 contaminants that are intended to assist public water systems in managing their drinking water for aesthetic considerations such as taste, color, and odor. These contaminants are not considered a risk to human health.

The same suite of solutes was modeled for surface waters as described above for groundwater. As mentioned above, hardness and TDS concentrations were not directly modeled.

Because the NorthMet Project Proposed Action area is located in the Lake Superior Basin, the Great Lakes Initiative (Lake Superior) water quality standards also apply (*Minnesota Rules* chapter 7052). These Lake Superior standards can differ from the water quality standards for the same parameters in *Minnesota Rules* chapter 7050. Where different, the 7052 standards supersede the 7050 standards, even if the 7052 rules are less stringent. For parameters not listed in chapter 7052, the standards from chapter 7050 apply.

Surface water standards are "in-stream" standards applicable at the surface water in question, which includes the Partridge River and its tributaries for the Mine Site, Transportation and Utility Corridor, and the Plant Site, and the Embarrass River and its tributaries for the majority of the Tailings Basin.

Applicable surface water quality evaluation criteria, for the purposes of this FEIS, are listed by use classification in Table 5.2.2-4, with the strictest (i.e., lowest) concentration from the applicable water use classifications applying.

It should be noted that the water quality standards for metals are expressed for total metals in the table, but are applied as dissolved metal criteria for application to surface waters (*Minnesota Rules*, part 7050.0220). For the majority of metals, the ratio of the total metal criteria to the dissolved metal criteria is sufficiently close to one such that the total standard is adequately representative of the applicable criteria.

Table 5.2.2-4 Surface Water Quality Evaluation Criteria Applicable to Different Classes of Surface Water

Parameter	Units	Class 1B pMCL	Class 1B sMCL	Class 2A	Class 2Bd[3]	Class 2B[3]	Class 3B[4]	Class 3C[4]	Class 4A[5]	Class 4B[5]	Class 5	Class 6
General												
Alkalinity	mg/L	--	--	--	--	--	--	--	--	--	--	--
Calcium	mg/L	--	--	--	--	--	--	--	--	--	--	--
Chloride	mg/L	--	250	230	230	230	100	250	--	--	--	--
Fluoride	mg/L	4	2	--	--	--	--	--	--	--	--	--
Hardness	mg/L	--	--	--	--	--	250	500	--	--	--	--
Magnesium	mg/L	--	--	--	--	--	--	--	--	--	--	--
pH	s.u.	--	6.5–8.5	6.5–8.5	6.5–9.0	6.5–9.0	6.0–9.0	6.0–9.0	6.0–8.5	6.0–9.0	6.0–9.0	--
Potassium	mg/L	--	--	--	--	--	--	--	--	--	--	--
Sodium	mg/L	--	--	--	--	--	--	--	--	--	--	--
Sulfate	mg/L	--	250	--	--	--	--	--	10[(2)]	--	--	--
TDS	mg/L	--	500	--	--	--	--	--	700	--	--	--
Metals Total[7]							--	--	--	--	--	--
Aluminum	µg/L	--	50–200	87	125	125	--	--	--	--	--	--
Antimony	µg/L	6	--	5.5	5.5	31	--	--	--	--	--	--
Arsenic	µg/L	10	--	2.0[(1)]	2.0[(1)]	53[(1)]	--	--	--	--	--	--
Barium	µg/L	2,000	--	--	--	--	--	--	--	--	--	--
Beryllium	µg/L	4.0	--	--	--	--	--	--	--	--	--	--
Boron	µg/L	--	--	--	--	--	--	--	500	--	--	--
Cadmium[6]	µg/L	5	--	2.5[(1)]	2.5[(1)]	2.5[(1)]	--	--	--	--	--	--
Chromium (III)[6]	µg/L	100	--	86[(1)]	86[(1)]	86[(1)]	--	--	--	--	--	--
Cobalt	µg/L	--	--	2.8	2.8	5.0	--	--	--	--	--	--
Copper[6]	µg/L	--[8]	1,000	9.3[(1)]	9.3[(1)]	9.3[(1)]	--	--	--	--	--	--
Iron	µg/L	--	300	--	--	--	--	--	--	--	--	--
Lead[6]	µg/L	--[8]	--	3.2	3.2	3.2	--	--	--	--	--	--
Manganese	µg/L	--	50	--	--	--	--	--	--	--	--	--
Mercury	ng/L	2,000	--	1.3[(1)]	1.3[(1)]	1.3[(1)]	--	--	--	--	--	--
Nickel[6]	µg/L	--	--	52[(1)]	52[(1)]	52[(1)]	--	--	--	--	--	--
Selenium	µg/L	50	--	5.0[(1)]	5.0[(1)]	5.0[(1)]	--	--	--	--	--	--
Silver	µg/L	--	100	0.12	1.0	1.0	--	--	--	--	--	--
Thallium	µg/L	2	--	0.28	0.28	0.56	--	--	--	--	--	--
Vanadium	µg/L	--	--	--	--	--	--	--	--	--	--	--
Zinc[6]	µg/L	--	5,000	120[(1)]	120[(1)]	120[(1)]	--	--	--	--	--	--

Source: *Minnesota Rules*, chapters 7050 and 7052; USEPA pMCL (40 CFR 141); sMCL (40 CFR 143).

All values represent total concentration unless otherwise noted.

[1] Based on *Minnesota Rules*, part 7052.0100, *Water Quality Standards Applicable to Lake Superior Basin*, which supersedes standards listed in *Minnesota Rules*, part 7050.0140.

[2] The quality of Class 4A waters of the state shall be such as to permit their use for irrigation without significant damage or adverse effects upon any crops or vegetation usually grown in the waters or area… The following standards shall be used as a guide in determining the suitability of the waters for such uses… Sulfates (SO_4) - 10 mg/L, applicable to water used for production of wild rice during periods when the rice may be susceptible to damage by high sulfate levels.

[3] *Minnesota Rules*, parts 7050.0222 and 7052.0100.

[4] *Minnesota Rules*, part 7050.0223.

[5] *Minnesota Rules*, part 7050.0224.

[6] Water quality standard for this metal is hardness dependent. The listed value assumes a hardness of 100 mg/L.

[7] Standards for metals are expressed as total metals, but must be implemented as dissolved metal standards. Factors for converting total to dissolved metals are listed in *Minnesota Rules*, parts 7050.0222 and 7052.0360.

[8] Lead and copper enter drinking water primarily through plumbing materials. In 1991, USEPA published the Lead and Copper Rule (http://www.epa.gov/safewater/lcrmr/index.html). This rule requires water systems to monitor drinking water at customer taps. The 1,300-µg/L copper concentration and 15-µg/L lead concentration represent action levels that, when exceeded at 10 percent of customer taps, require the water system to take additional actions to control corrosion. Therefore, these values reflect concentrations at the customer tap. Additionally, *Minnesota Rules*, part 7050.0221, subpart 1B, states that the primary drinking water standards for copper and lead are not applicable to Class 1 surface waters.

Surface Water Quality Evaluation Locations

These surface water evaluation criteria are assessed at the following surface water evaluation locations (see Figures 4.2.2-8 and 4.2.2-16):

- Partridge River Watershed
  - Partridge River – at SW-002, SW-003, SW-004, SW-004a, SW-004b, SW-005, and SW-006; and
  - Colby Lake.
- Embarrass River Watershed
  - Embarrass River – at PM-12, PM-12.2, PM-12.3, PM-12.4, and PM-13 (note that model results for evaluation locations PM-12.3 and PM-12.4 did not show anything different so are not discussed further in the FEIS);
  - Mud Lake Creek – at MLC-2 and MLC-3;
  - Trimble Creek – at TC-1 and PM-19; and
  - Unnamed Creek – at PM-11.

Relationship of Hardness to Evaluation Locations

There are six metals evaluated whose surface water quality standards vary with hardness concentrations: cadmium, chromium III, copper, lead, nickel, and zinc. Calcium and magnesium ions that contribute to water hardness generally lower metals toxicity (i.e., as hardness concentration increases, the water quality standard for these metals also increases). In the case of the FEIS, as hardness increases, evaluation criteria increase simultaneously. Within the water quality modeling, estimated concentrations for these six metals are compared to hardness-based evaluation criteria at each model evaluation location and each model time step to determine the frequency of evaluation criteria exceedances. See Section 5.2.2.2.3 for more information.

Downstream Water Quality Standards

The Fond du Lac Band has promulgated water quality standards that are protective of specific, designated, or beneficial uses for waterbodies on the Fond du Lac Reservation, which is located approximately 70 miles downstream of the NorthMet Project Proposed Action area on the St. Louis River. These standards were approved by the USEPA in December 2001. They apply to all waters, including wetlands, within the Reservation. The Fond du Lac water quality standards include determination of designated or beneficial uses, narrative and numeric criteria to support or sustain those uses, and anti-degradation provisions. The FEIS analyzes compliance with their mercury standard.

Based upon results of Fond du Lac Band water quality monitoring, as well as additional resource investigations, the Reservation's reach of the St. Louis River is attaining all of its beneficial uses and meeting all applicable water quality standards with the exception of mercury. In-stream mercury concentrations in the St. Louis River, measured by the Fond du Lac Band, have been below the Great Lakes Initiative Chronic Wildlife Standard of 1.3 ng/L, but exceed the Fond du Lac Band's human health chronic standard of 0.77 ng/L. For this reason, the Fond du Lac Band is especially concerned about any new or expanded discharges to the St. Louis River upstream of the Reservation that may adversely affect mercury bioaccumulation in fish in the St. Louis River (Schuldt, Pers. Comm., March 6, 2012).

The MDNR conducted studies in the St. Louis River in 2012, which included an unusually wet spring and early summer followed by a long dry period (Berndt et al. 2014). They found that Hg concentrations in filtered samples collected in Cloquet were 3.5 ng/L in May, increased to 7 ng/L in July, and then fell gradually through the rest of the summer to 1.4 ng/L by late October. Upstream from the Partridge River, Hg concentrations over the same period ranged from 5.2 ng/L up to a peak of 11.8 ng/L in late June, eventually decreasing only to 2.3 ng/L by late October when the study ended. Thus, Hg was never below the 1.3 ng/L standard during these study periods. These results indicate the importance of considering seasonal variability when evaluating Hg concentrations in rivers.

Mercury Evaluation Criteria

Mercury numeric standards are based on total (particulate plus dissolved) concentrations. For the Lake Superior Basin, in which the NorthMet Project Proposed Action area is located, the Class 2B (aquatic life and recreation) numeric chronic standard for mercury in the water column protective of wildlife is 1.3 ng/L. This is the evaluation criteria used and is consistent with the Great Lakes Initiative standard. The criterion is applied at in-stream surface water evaluation locations and to modeled WWTF and WWTP effluent. The FEIS also considers the 0.77 ng/L standard at the Fond du Lac Reservation. Mercury was not included in GoldSim modeling and was evaluated separately.There is a relationship, only partially understood, between sulfate concentration and the conversion of inorganic mercury by sulfate-reducing bacteria into methylmercury. The MDNR has been conducting numerous studies in the region that indicate a strong contextual component is needed when considering impacts of sulfate on methylmercury production and transport (Berndt et al. 2014). When, how, and where the sulfate is added to a stream or watershed must be considered to evaluate impacts to the mercury cycle.

Methylmercury is more bioavailable than inorganic mercury, and it can bioaccumulate in the aquatic food chain (e.g., fish, wildlife, and humans) to concentrations of concern. Currently, there is no State of Minnesota surface water quality standard for methylmercury, or for sulfate in the context of its potential for effect on methylmercury concentrations, as the production of methylmercury is not only dependent on sulfate concentrations, but also on environmental conditions required for sulfate-reducing bacteria to live (e.g., sufficient organic carbon and lack of oxygen). However, the State of Minnesota has a fish tissue water quality standard for mercury of 0.2 milligram per kilogram (mg/kg), which was amended in *Minnesota Rules*, chapter 7050, in 2008. In 2006, the MPCA also developed a *Strategy to Address Indirect Effects of Elevated Sulfate on Methylmercury Production and Phosphorus Availability*, which identifies policies and review procedures for evaluating the potential of proposed projects to produce methylmercury. This strategy includes recommendations to avoid or minimize the discharge of water with elevated sulfate concentrations to methylmercury "high-risk" situations (MPCA 2006a).

The *Minnesota Rules* fish tissue standard for mercury of 0.2 mg/kg is lower than the USEPA criterion of 0.3 mg/kg (wet weight, per USEPA criteria) to adjust for the higher per capita consumption of wild-caught fish in Minnesota. Based on the results of scientific investigations, this criterion assumes that all fish tissue mercury is in the methylmercury form.

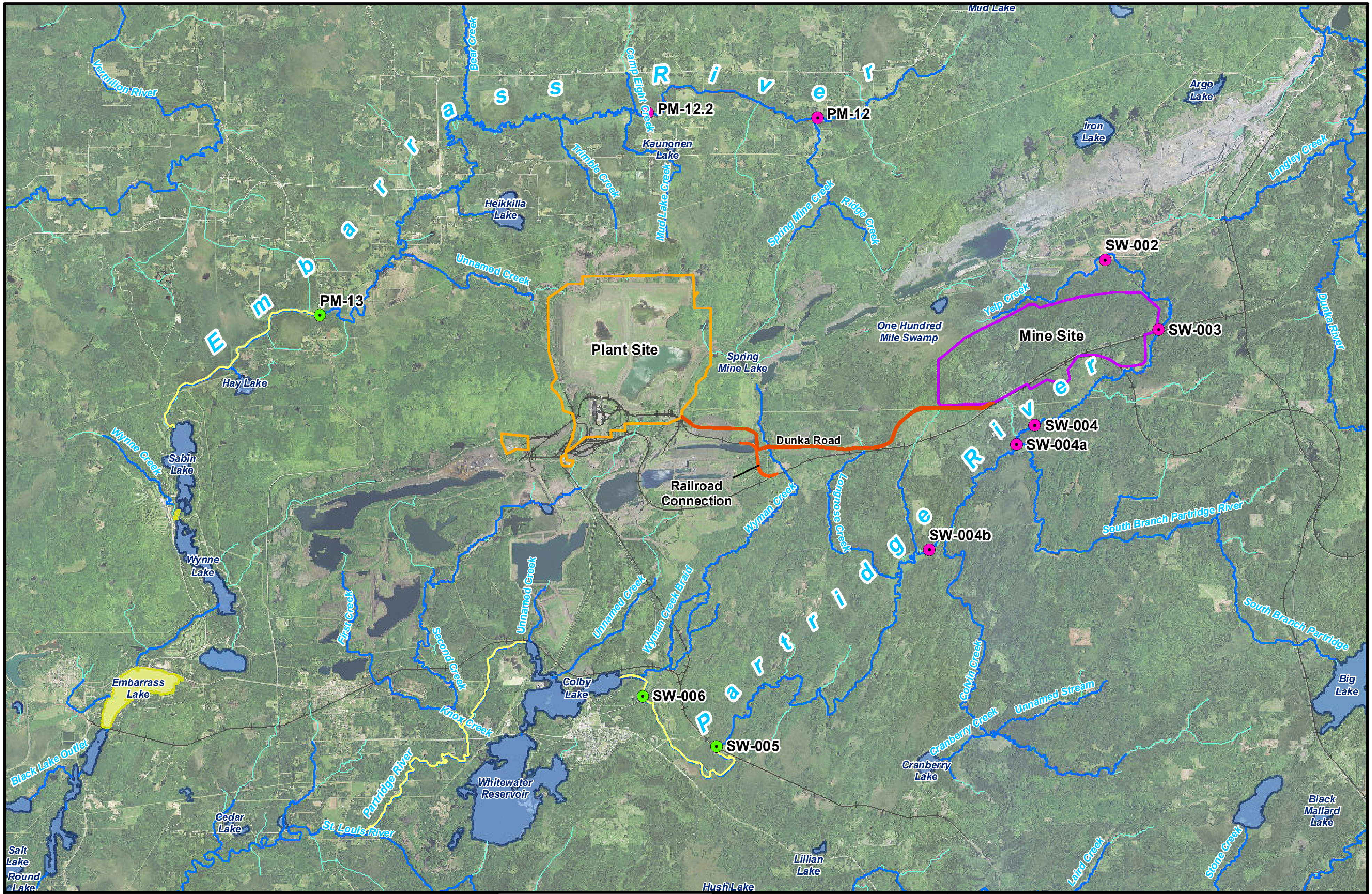
Research suggests that total mercury concentrations in streams and methylmercury content in fish are roughly proportional within individual watersheds (USGS 2010), such that an increase in total mercury in water would be expected to result in an increase in mercury content in fish within that watershed. MPCA’s Mercury Risk Estimation Method (MMREM) was used to assess the potential changes in fish mercury concentrations in nearby lakes (Barr 2015f). The MMREM relies on empirical fish contamination data combined with the principle of proportionality between mercury in fish and atmospheric deposition (MPCA 2006c). The potential incremental change in fish mercury concentration is discussed further in Section 6.2.6.3.3.

Waters Used for the Production of Wild Rice Evaluation Criteria

Minnesota Rules, part 7050.0224, defines the Class 4A water quality standards for the Agriculture and Wildlife Use Classification, which includes a 10 mg/L sulfate standard “applicable to water used for production of wild rice during periods when the rice may be susceptible to damage by high sulfate levels.” Application of this standard is therefore dependent on the identification of specific waters used for the production of wild rice. When evaluating any facility or project with potential effects on wild rice production, the MPCA considers all available information to determine on a case-by-case basis which surface waters are used for the production of wild rice (MPCA 2012b). For the NorthMet Project Proposed Action, the MPCA considered available) lists of wild rice beds not promulgated by rule assembled by the MDNR, the 1854 Treaty Authority and the Wild Rice Management Workgroup (a coalition of federal, state, and tribal resource managers and other wild rice stakeholders), and the results of site-specific wild rice field surveys conducted in 2009, 2010, and 2011 in the Partridge and Embarrass rivers. To date within the NorthMet Project Proposed Action area, MPCA (2012b) has reached a draft staff recommendation that the following are “waters used for the production of wild rice” (see Figure 5.2.2-1):

- Within the Embarrass River Watershed:
  - That segment of the Embarrass River from MN Highway 135 bridge to the inlet to Sabin Lake;
  - The northernmost tip of Wynne Lake (Embarrass River inlet); and
  - Embarrass Lake north of the railroad crossing.
- Within the Partridge River Watershed:
  - That portion of Upper Partridge River from river mile approximately 22, just upstream of the railroad bridge near Allen Junction, to the inlet to Colby Lake;
  - That portion of Lower Partridge River from the outlet of Colby Lake to its confluence with the St. Louis River; and
  - That portion of Second Creek from First Creek to the confluence with Partridge River.

Therefore, of the surface water quality evaluation locations identified in Figure 5.2.2-1, the wild rice evaluation criterion is applied at PM-13 on the Embarrass River, and at SW-005 and SW-006 on the Partridge River. The MPCA may, in the near future and as part of its ongoing rule revision process, propose additional or alternate waters to be protected for wild rice; however, this process is not yet complete. Therefore, the above-described 'waters used for production of wild rice' evaluation criteria will be used for the analyses presented in the FEIS.



MPCA Staff-Recommended Wild Rice Water
MPCA Staff-Recommended Wild Rice Water
MDNR Designated PWI Stream/River
Non MDNR Designated PWI Stream/River
MDNR Designated PWI Lake/Wetland
Existing Railroad
Partridge River or Embarrass River Evaluation Location
Evaluation Location Where Wild Rice Evaluation Criteria Applies
Mine Site
Plant Site
Transportation and Utility Corridor

US Army Corps of Engineers St. Paul District

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N W E S

0 0.5 1 2 3 Miles

Figure 5.2.2-1
MPCA Staff-Recommended Wild Rice Waters
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

560 -Page Intentionally Left Blank-

5.2.2.2 Methodology

There have been substantial changes to the methodology used for predicting NorthMet Project Proposed Action effects on groundwater and surface flow and quality since the DEIS. Terminology necessary to understand the differences between the DEIS and FEIS impact assessment methodologies is provided in Table 5.2.2-5. For example, the DEIS evaluated water quality at the Mine Site using three deterministic cases (i.e., low-, medium-, and high-flow conditions), in an attempt to capture uncertainty associated with some of the input values. This was supplemented by limited uncertainty analysis to help assess whether the deterministic modeling produced conservative values. The uncertainty analysis in the DEIS indicated mixed results regarding the conservatism of the deterministic modeling.

Table 5.2.2-5 Definition of Terminology used in this FEIS

Term	Definition
Uncertainty	Incomplete knowledge of a process, quantity, value, or outcome, which can be quantified as a cumulative probability distribution.
Variability	There is no single correct absolute value; values vary in time and/or space.
Deterministic Simulation	Prediction is made based on a model for which all input parameters are represented as single values; i.e., no uncertainty is applied to the inputs. The model results are expressed as a set of fixed outcomes.
Probabilistic Simulation	Prediction is made based on a model that incorporates the uncertainty of model inputs; i.e., the cumulative probability distributions of input parameters are incorporated into the calculations. The model results are expressed as a set of cumulative probability distributions.

For the FEIS, a probabilistic modeling approach was used for predicting NorthMet Project Proposed Action effects on water resources. Probabilistic modeling is a statistical method that estimates the probability of a given outcome using inputs in a form of probabilistic distributions. It is different than deterministic modeling, where all inputs have single (deterministic) values and the model always produces a single result without explicitly accounting for uncertainty. The probabilistic approach not only enables prediction of effects on groundwater and surface water from the NorthMet Project Proposed Action, but it also helps quantify the probability of the effects occurring. Table 5.2.2-6 compares the modeling approach used in the DEIS with the approach used in the FEIS.

Table 5.2.2-6 Comparison of EIS Modeling Approaches

Previous DEIS	Current FEIS
Stand-alone model components	Linked source-to-evaluation location
Discrete points in time with interpolation	Continuous through time until or near steady-state conditions reached
Deterministic with three cases	Probabilistic, including uncertainty and variability
Separate uncertainty analysis of select components	Fully integrated uncertainty analysis of entire model

The effects of the NorthMet Project Proposed Action on groundwater and surface water quality within the Partridge River Watershed were evaluated using MODFLOW for groundwater hydrologic modeling, XP-SWMM for surface water hydrologic modeling and GoldSim for water quality modeling. MODFLOW and XP-SWMM were used as deterministic models, while GoldSim was run in a probability mode. Detailed descriptions of how these models were applied to the Mine Site are provided in the Mine Site Water Modeling Data Package (PolyMet 2015m) and Mine Site Water Modeling Work Plan (Barr 2012c). At the Plant Site, the modeling consisted of MODFLOW, GoldSim, and a spreadsheet compilation of streamflows for different watersheds based on Embarrass River stream gauging data. Detailed descriptions of how these models were applied to the Plant Site are provided in the Plant Site Water Modeling Data Package (PolyMet 2013j) and Plant Site Water Modeling Work Plan (Barr 2012d). Each of the three model types is summarized below.

5.2.2.2.1 Groundwater Hydrologic Modeling

Regional (large-scale) and site-scale (local-scale) modeling of groundwater flow systems was performed using MODFLOW, a public-domain, numerical, finite-difference groundwater flow model that can simulate three-dimensional saturated flow in heterogeneous media (McDonald and Harbaugh 1988). Input to the model included delineation of the areal and vertical extent of geologic materials, hydrologic characteristics of those materials (e.g., hydraulic conductivity), meteoric recharge, and alignment of hydrologic boundaries (e.g., perennial stream channels). MODFLOW provided estimates of hydraulic head distributions, groundwater flows/directions in the surficial aquifer and bedrock units, and groundwater releases to perennial streams (groundwater baseflow). By adjusting hydraulic conductivity and recharge inputs, the MODFLOW models were calibrated to measured hydraulic heads in monitoring wells and estimated groundwater baseflows in the Partridge River.

MODFLOW modeling results and site characterization data were used to delineate groundwater flowpaths at the Mine Site and Plant Site. The flowpaths were used to model groundwater flow and solute transport from mine facilities to groundwater evaluation locations and to locations where groundwater releases to surface water. Those flowpaths were programmed into the Mine Site and Plant Site water quality models.

Mine Site

For the DEIS, a Regional MODFLOW model was developed to evaluate aerially distributed recharge, hydraulic head distributions, and groundwater flow directions (Barr 2007c). The regional model contained two layers—one for the surficial deposits and one for bedrock. The model boundary conditions were mostly regional drainage divides (treated as no-flow boundaries) and perennial streams (treated as prescribed head boundaries). Revisions to the XP-SWMM model since the DEIS provided groundwater baseflow estimates at different locations along the Partridge River. By varying areal recharge and material hydraulic conductivities, the regional model was roughly calibrated to hydraulic heads measured in monitoring wells.

An important calibration constraint was that the predicted hydraulic head in the surficial aquifer would not be above ground surface.

To evaluate groundwater flowpaths and the hydraulic effects of Mine Site features in more detail, a site-scale MODFLOW model of the Mine Site was developed that was essentially an internal “window” within the regional model. The site-scale MODFLOW model contained eight layers—one for the surficial aquifer and seven for bedrock. Where not coincident with perennial streams or drainage divides, the prescribed head conditions along the external boundaries of the Site model were taken from the head distributions predicted by the regional model. The footprints and vertical extent of the mine features were modified from the DEIS model to reflect the current Mine Plan. The aerial extent of the site-scale MODFLOW model and simulated hydrologic features are shown on Figure 5.2.2-2 and Figure 5.2.2-3.

Revisions to the XP-SWMM model since the DEIS resulted in different groundwater baseflow estimates for the Partridge River. Using the revised XP-SWMM groundwater baseflow estimates, the site-scale MODFLOW model was calibrated using target groundwater baseflow values of 0.41, 0.51, and 0.92 cfs at SW-002, SW-003, and SW-004, respectively. This calibration was performed by varying hydraulic conductivity and stream conductance values, but not aerial recharge. In addition, groundwater elevations measured at Mine Site monitoring wells MW-1 through MW-18 were included as calibration targets. The automated-inverse modeling code PEST (Watermark 2005) was used to complete the model calibration. That calibration involved varying the horizontal and vertical hydraulic conductivities of the different geologic subunits and the conductance of river cells representing the Partridge River to achieve a best fit between predicted and measured hydraulic heads and target groundwater baseflows. The automated PEST calibration used field-measured hydraulic conductivities to help constrain the range of allowed hydraulic conductivities in the model. An important calibration constraint was that predicted hydraulic heads in the shallow aquifer would not be significantly above ground surface. Information on calibration of the site-scale MODFLOW model is provided in PolyMet (2015m).

The calibrated site MODFLOW model provided optimized values for the horizontal and vertical hydraulic conductivities of different subunits of the surficial aquifer and bedrock, which are summarized in Table 5.2.2-7. Specific storage set in the model is $3x10^{-6}$ ft^{-1} for both surficial deposits and bedrock. Specific yield was 0.25 for both surficial deposits and bedrock.

For the surficial aquifer in the Site MODFLOW model, the meteoric recharge flux was 1.8 inches per year (in/yr) for glacial drift and 0.36 in/yr for wetland deposits. The areally-averaged meteoric recharge flux was about 0.75 in/yr, which equates to a groundwater baseflow yield of 0.055 cubic feet per square mile (cfs/mi^2).

Table 5.2.2-7 Mine Site Hydraulic Conductivities Based on Calibration of the MODFLOW Model and Field Testing

Major Unit	Subunit	Horizontal Hydraulic Conductivity Minimum ft/day	Horizontal Hydraulic Conductivity Mean ft/day	Horizontal Hydraulic Conductivity Maximum ft/day	Vertical Hydraulic Conductivity ft/day
Surficial Materials	Glacial drift	0.056	19.2	167	0.0028
	Wetland deposits	0.003	23.7	224	0.0028
Bedrock	Giants Range Batholith	(a)	0.029	(a)	0.0029
	Biwabik Iron Fm.	(a)	0.87	(a)	0.087
	Upper Virginia Fm.	(a)	0.31	(a)	0.031
	Duluth Complex	(a)	0.00044	(a)	0.000044
	Lower Virginia Fm.	(a)	0.079	(a)	0.0079

(a) Single-value calibration values were developed for bedrock units; min/max values were not evaluated.

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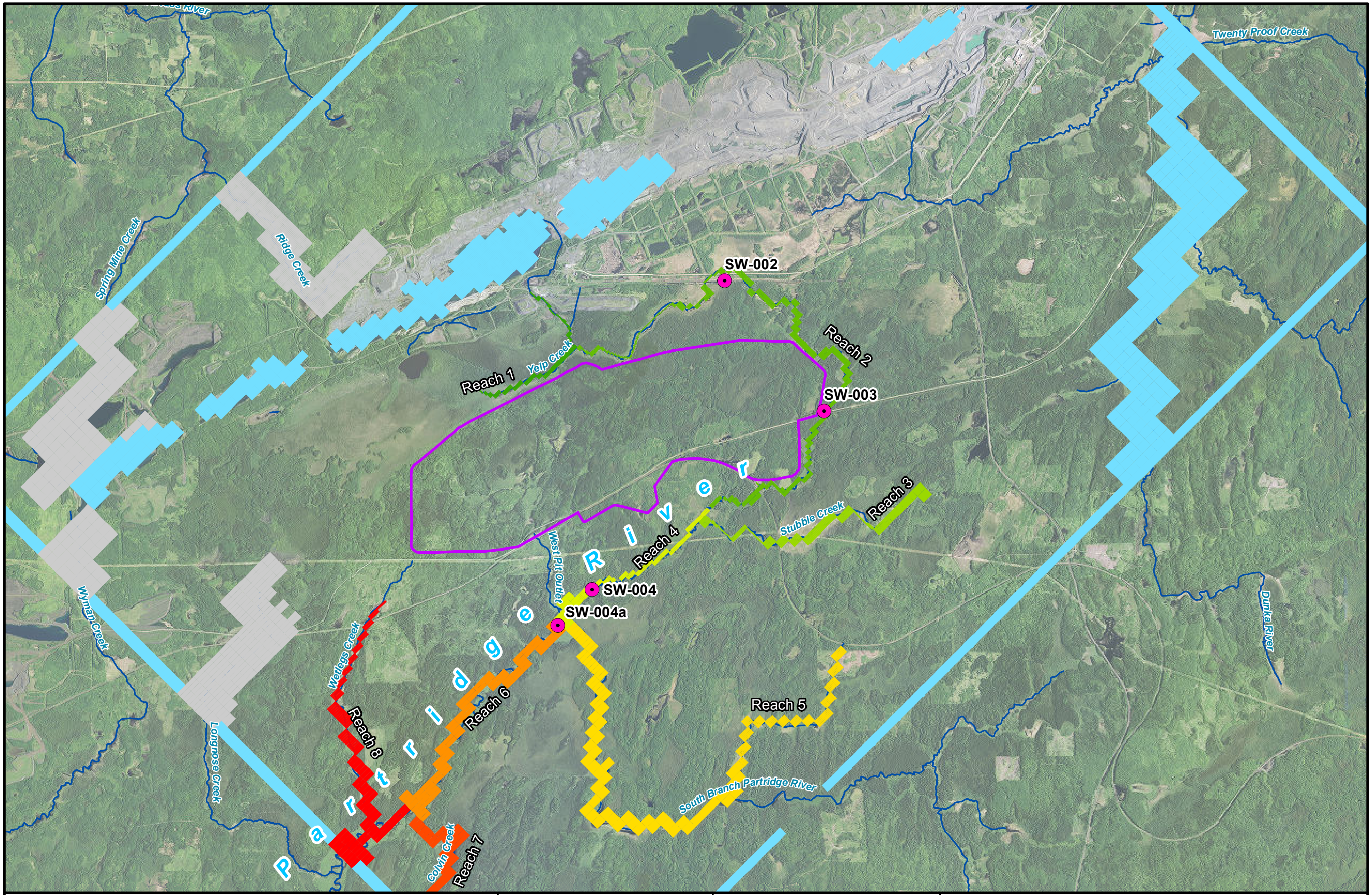

Surface Water Modeling/Monitoring Location
River Cells Not Adjusted During Calibration
River Cells Adusted During Calibration (River Reaches)
1
2
3
4
5
6
7
8
Mine Site
Specified Head Cells
Stream/River

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0 0.25 0.5 1 1.5 Miles

Figure 5.2.2-2
Mine Site Local MODFLOW Model - River Reaches
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

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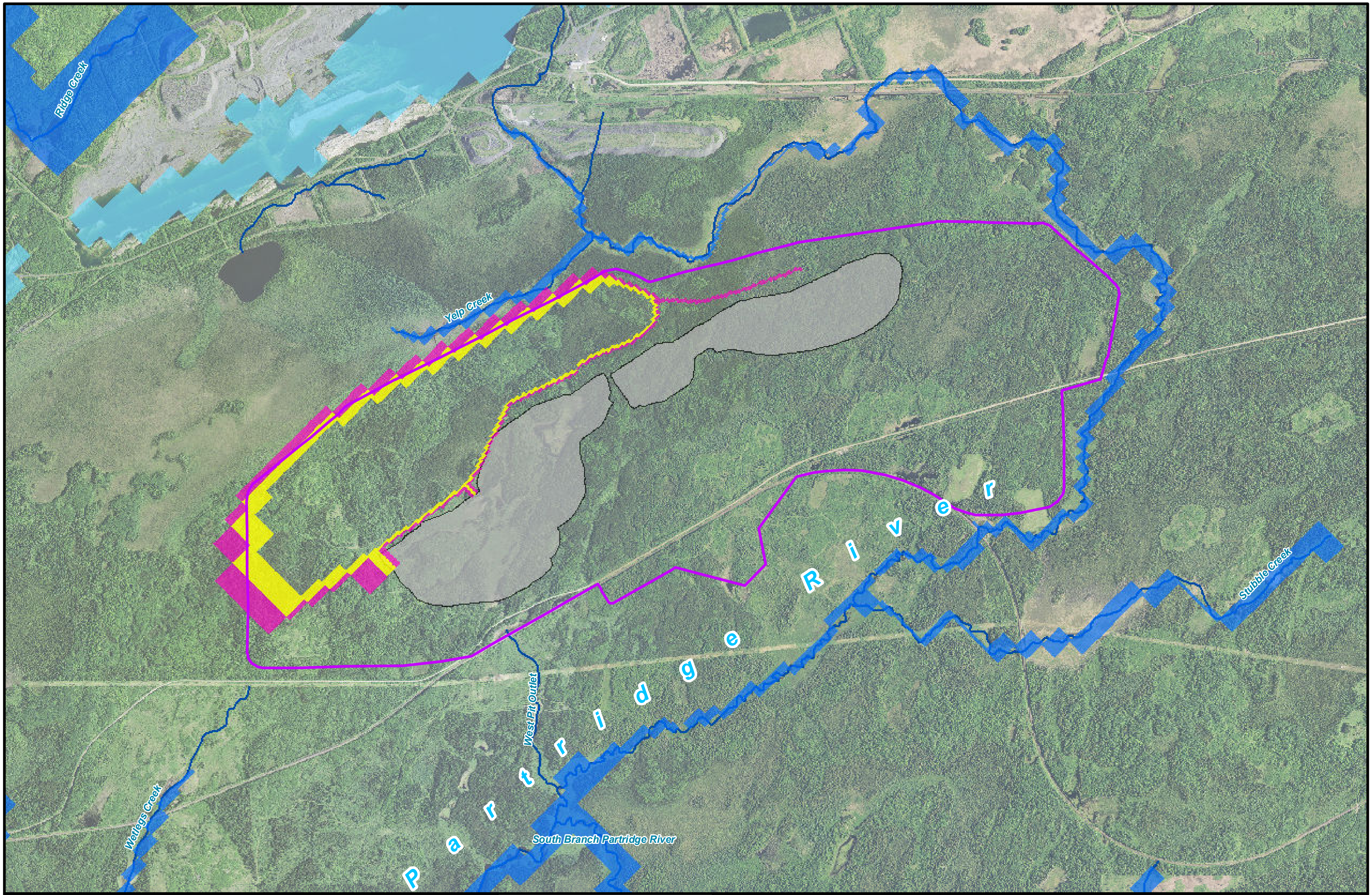

Specified Head Cell
River Cell
Low-K Cell Representing Soil Barrier or Cutoff Wall
Drain Cell Representing Category 1 Drainage Collection System
Mine Site
Mine Pit
Stream/River

US Army Corps of Engineers
St. Paul District

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N
W E
S

0 1,000 2,000 4,000 Feet

Figure 5.2.2-3
Mine Site Local MODFLOW Model - Surface and Groundwater Containment System Features
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

663

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Figure 5.2.2-7 shows surficial groundwater flowpaths with the potential to transport mine-affected groundwater from identified source areas to designated evaluation locations. These surficial groundwater flowpaths were delineated using the results of a steady-state MODFLOW model simulation of existing conditions. The hydrologic characteristics of each surficial flowpath are summarized in Table 5.2.2-8. Three bedrock flowpaths the Partridge River were also delineated in the model: West Pit to SW-004, West Pit to SW-004a, and East Pit to SW-004. Due to the low bulk hydraulic conductivity of Duluth Complex rocks that comprise these bedrock flowpaths, the groundwater flow rates to the Partridge River are very small and travel times are very long. The three bedrock flowpaths are included in the GoldSim water quality model, but results show that these flowpaths do not provide a mine-related chemical load to the Partridge River over the 200 year simulation.

A sequence of steady-state MODFLOW model simulations was used to evaluate groundwater inflows into the West Pit that would occur during its flooding. Figure 5.2.2-4 and Figure 5.2.2-5 shows groundwater inflow rates into the West Pit and East Pit estimated by transient MODFLOW model simulations of the mine operations. Figure 5.2.2-6 shows a plot of inflows versus water surface elevation in the West Pit.

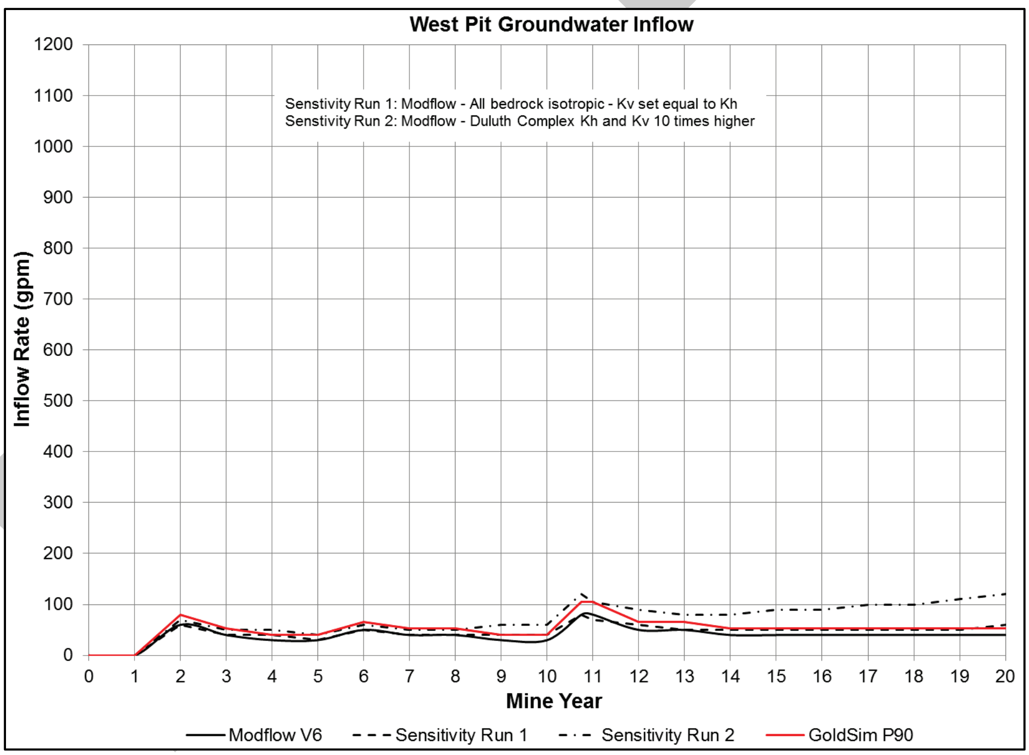
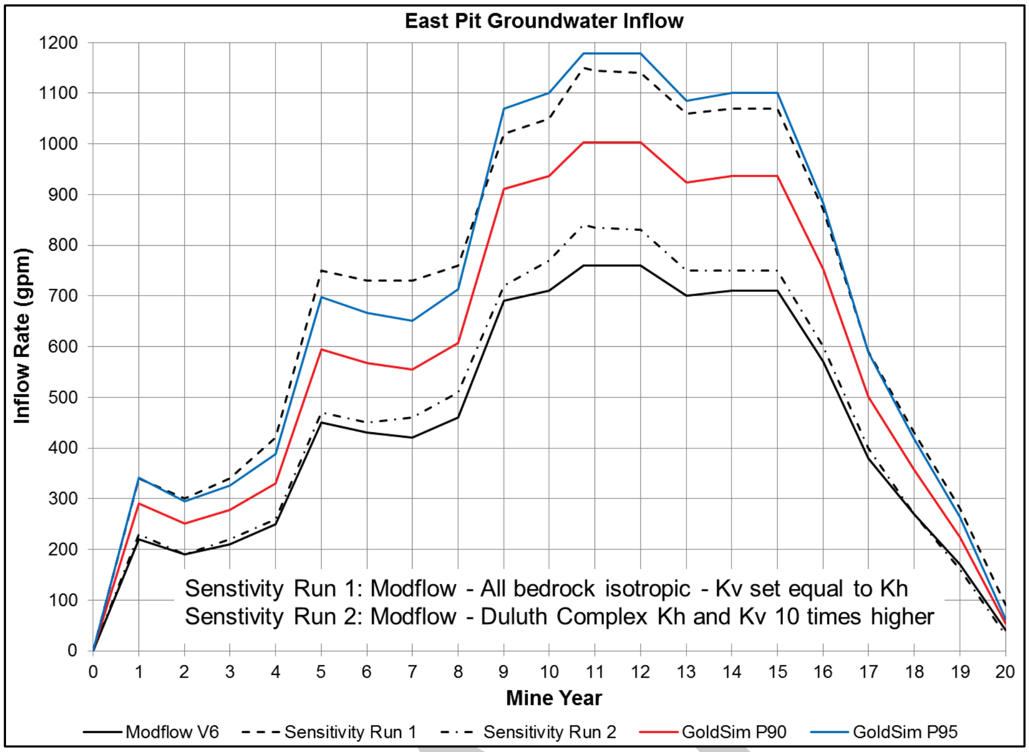
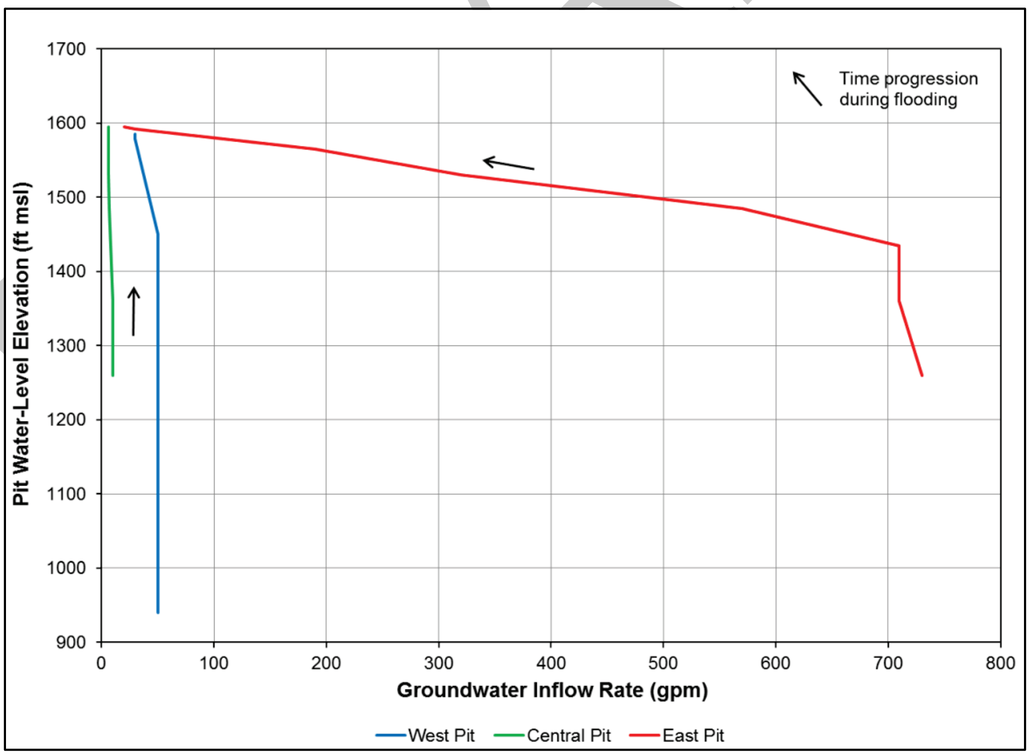


Figure 5.2.2-4 West Pit Groundwater Inflows

683 

684 ***Figure 5.2.2-5 East Pit Groundwater Inflows***

685 

686 ***Figure 5.2.2-6 Groundwater Inflow Rate vs Pit Water-Level Elevation for the West,***
687 ***Central, and East Pits***

The West Pit and Central Pit are surrounded by a low permeability Duluth Complex rock. As a consequence, the model simulated groundwater inflow rates are relatively low. The north wall of the East Pit is excavated into the higher permeability Virginia Formation, and this caused higher estimated inflow rates into the East Pit.

The following key time events during mine operations were represented in transient model simulations and analysis:

Mine Year	**Key Event**
1 – 10	East Pit and West Pit mined and dewatered
11	East Pit reaches a maximum depth
12	Start of backfill placement in East Pit
10 – 20	Continuation of West Pit and Central Pit mining and dewatering
20	East Pit backfilled and re-saturated
20	Start of West Pit flooding

Bedrock flowpaths and evaluation locations were also evaluated, but because the bedrock (primarily the Duluth Complex) is highly competent with very low hydraulic conductivities (see Table 5.2.2-7), very little groundwater transport occurs within the bedrock flowpaths and travel times to evaluation locations are predicted to be in the thousands of years. Attachment B of the Mine Site Water Modeling Data package (PolyMet 2015m) provides a complete description of the Mine Site MODFLOW model.

Concerns have been raised that fractures or faults may exist at the Mine Site that could function as high-permeability conduits for groundwater over long distances through the bedrock. Such features have been identified elsewhere on the Canadian Shield. Most of these features, however, have been associated with tectonic events occurring more than 1.6 billion years ago. These events would not be relevant to the Duluth Complex as they predate its emplacement, which occurred during the Mid-Continent Rift approximately 1.1 billion years ago. A few studies have identified the presence of fracturing and faults in the Duluth Complex, but these structures are believed to have formed during emplacement of the Duluth Complex and are unlikely to transmit water. Where fractures were found, they were largely filled with gouge (Foose and Cooper 1979; 1981), or relate to an unusual cleavage pattern known to occur in one location west of Duluth, about 70 miles from the Mine Site (Foster and Huddelston 1986).

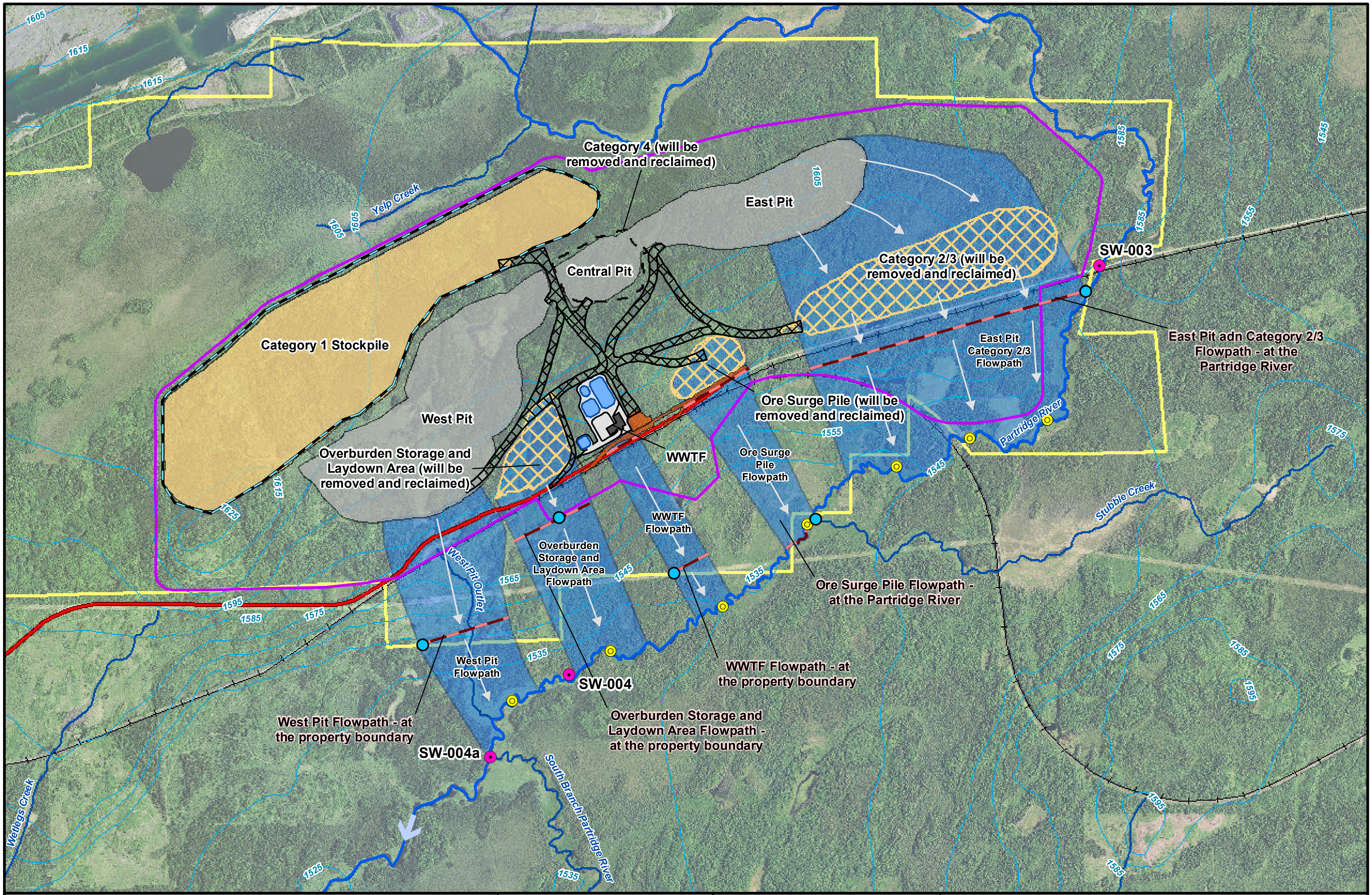
At the Mine Site and Plant Site, there is no field evidence to suggest that bedrock faults or fracture zones provide enhanced groundwater flow to the Partridge and Embarrass Rivers. It is possible that structural features with enhanced groundwater flow exist, but they are improbable given the body of evidence for the Project Site and other mines sites in the Iron Range with similar geology. Further, if such features do exist, it is highly unlikely that they could be intercepted and characterized by any reasonable field program of exploratory boreholes. This FEIS documents the need for a robust monitoring program during operations and closure to provide direct or indirect evidence on the existence of, or lack of, hydrologically significant faults. If significant faults are identified (that is, faults which could lead to violation of water quality standards or dewatered wetlands), then contingency mitigation measures would be employed to mitigate the fault-related effects.

Boring log data indicates that the bedrock appears competent, with only few fractures present near the surface. Hydrogeologic investigations have indicated that the bulk hydraulic conductivity of bedrock at the Mine Site is very low. See Section 4.2.2.2.1 for additional information.

The effects of this limited fracturing are incorporated into the bulk hydraulic conductivity values used to characterize bedrock for the water quality impact assessment modeling (discussed in Section 5.2.2.2.3). This is common practice in large-scale evaluations of bedrock hydraulics. The Mine Site GoldSim model was updated for this FEIS to better represent the likelihood of the presence of an upper bedrock zone that is more fractured than deeper bedrock.

Site characterization data (see Section 4.2.2.2.1 and 4.2.2.3.1) indicate that the bulk hydraulic conductivity of upper bedrock is two to three orders-of-magnitude lower than the hydraulic conductivity of the surficial aquifer. Thus, groundwater flow and transport at both the Mine Site and Plant Site are dominated by the hydraulics of the surficial aquifer and that bedrock plays a negligible role in transporting site-derived contaminants to the Partridge and Embarrass Rivers.

Neither the Mine Site model nor the Plant Site model represents explicitly buried stream channels. It is acknowledged that such channels could exist within surficial deposits. However, given their small thickness, it is unlikely that buried channels (if present at all) would have materials much higher in permeability than adjacent materials. Variation in the hydraulic conductivity of surficial deposits (like that provided by potential buried stream channels) is accounted for by the probabilistic approach used in the GoldSim model, where hydraulic conductivity is input as a probability distribution rather than as a fixed, deterministic value.



Surficial Aquifer Head Contour (m) at Closure
Groundwater Flowpath
Surface Water Evaluation Location
Groundwater Contacts Surface Water
Groundwater Evaluation Locations
Extent of Future PolyMet Lands
Groundwater Containment System
Permanent Stockpiles
Removed and Reclaimed Stockpile
Removed Stockpile
Surface Water Flow
Mine Site
Haul Road
Mine Pit
Groundwater Flow
Dunka Road
Stream/River

Minnesota Department of Natural Resources
US Army Corps of Engineers St. Paul District
Forest Service U.S. Department of Agriculture

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Figure 5.2.2-7
Mine Site Surficial Groundwater Flowpaths
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

751 -Page Intentionally Left Blank-

Table 5.2.2-8 Mine Site Surficial Groundwater Flowpaths used in GoldSim Based on Best-Estimate (P50) Values

Description	**Units**	**West Pit**	OSLA	**WWTF**	**OSP**	**Cat 2/3**[4]	**East Pit**[4]
Flowpath total length	meter	1,505	1,600	1,730	1,415	2,120	2,120
Flowpath width	meter	665	550	240	430	1,440	1,440
Flowpath thickness	meter	5	5	5	5	5	5
Aquifer porosity	---	0.3	0.3	0.3	0.3	0.3	0.3
Aquifer recharge flux	in/yr	0.82	1.15	0.70	0.95	0.91	0.91
Contaminant source begin time	mine yr	48(1)	0	0	0	0	20(1)
Contaminant source end time	min yr	Continuous	20	33	21	20	Continuous
Flowrate of affected water from contaminant source into upgradient portion of flowpath	gpm	6.1(1)	14.0(2) [0]	0.014(3) [0]	0.0012(3) [0]	0.019(3) [0]	3.8(1)
Aquifer recharge flow rate into flowpath	gpm	10.6	9.9 [12.8]	3.9 [3.7]	6.1 [7.3]	28.8 [39.2](5)	35.4
Groundwater discharge rate to Partridge River	gpm	16.7	23.9 [12.8]	3.9 [3.7]	6.1 [7.3]	28.8 [39.2]	39.2
Distance from contaminant source to groundwater evaluation location	meter	860	260	970	1,070	180	910
Distance from contaminant source to surface water discharge (Partridge River)	meter	1,360	1,230	1,310	1,070	910	1,610

Note: Brackets indicate closure value (after facility is decommissioned).

1 Pit water level rises above base of surficial aquifer.
2 Infiltration of meteoric water at top of facility.
3 Liner leakage at bottom of facility.
4 Category 2/3 stockpile and East Pit release affected water into the same flowpath at different times.
5 Includes East Pit discharge into flowpath.

Plant Site

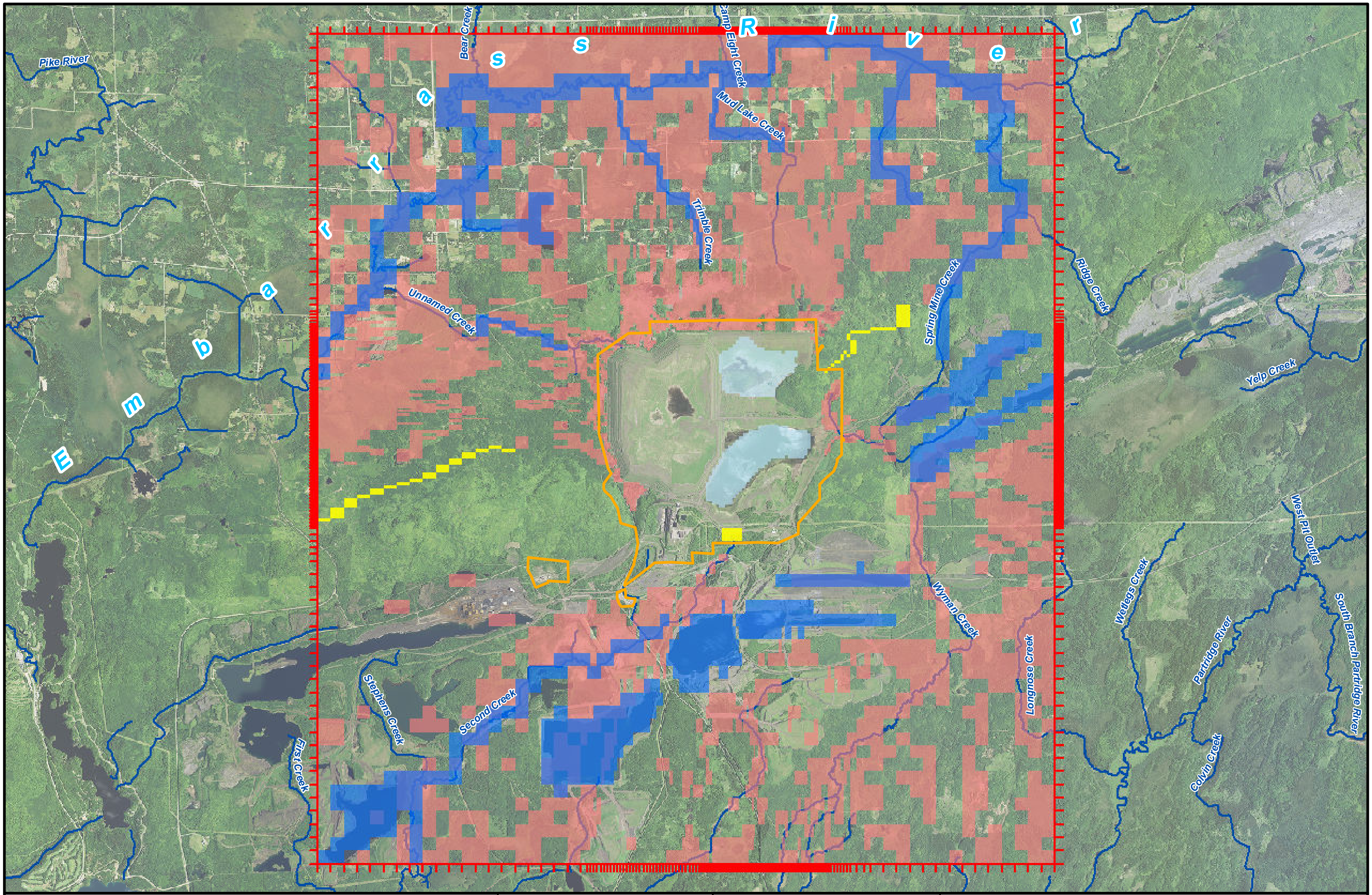
A series of numerical groundwater models were developed for the Tailings Basin's area. All those model versions are collectively referred to as the Plant Site MODFLOW model. The primary objectives for that modeling were to estimate:

- Seepage loss from the LTVSMC Tailings Basin ponds under various conditions;
- Average annual infiltration rate;
- Seepage rates for each of the groundwater flowpaths represented in the GoldSim model;
- Hydraulic conductivities of natural surficial materials, tailings, and bedrock;
- Areal recharge;
- Specific yield;
- Distribution of tailings seepage to different segments of the Tailings Basin perimeter;
- Depth of the phreatic surface; and
- The rate of contaminated groundwater flow at which it would bypass the Tailings Basin seepage containment system.

The Plant Site MODFLOW model's areal extent and simulated hydrologic features are shown on Figure 5.2.2-8.

The initial Plant Site MODFLOW model was constructed with two layers. The upper layer represented the current LTVSMC tailing, while the lower layer represented surficial deposits and bedrock outcrops. The model simulated groundwater flow in tailings materials and in the underlying shallow groundwater system. It did not have layers to represent bedrock below surficial deposits. Thus, the base of surficial deposits was treated as a no-flow boundary. This was justified in view of the fact that the bulk hydraulic conductivity of the upper bedrock is estimated to be about two orders-of-magnitude lower than the hydraulic conductivity of the surficial aquifer. Further, interpretation of available data indicates that deeper bedrock has substantially lower hydraulic conductivity than shallow bedrock. The upper model layer, layer 1, was set inactive outside of the Tailings Basin's footprint.

The areal extent of the Plant Site MODFLOW model and model-simulated hydrologic features are shown on Figure 5.2.2-8.



Plant Site
Constant Head Cell Layer 1
Constant Head Cell Layer 2
River Cells (Wetlands) - Layer 2
Drain Cell - Layer 2
Model Grid

US Army Corps of Engineers
St. Paul District

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Figure 5.2.2-8
Plant Site MODFLOW Model - Extent and Boundary Conditions
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Minnesota

June 2015

790 -Page Intentionally Left Blank-

The original versions of the model were calibrated to simulate steady-state conditions. They did not simulate changes in water levels within the basin. An initial steady-state model calibration was using water level data collected through 2002, measured seepage rates, and leakage from ponds 1E and 2E estimated using water balance analysis. The calibrations were performed by varying input hydraulic conductivities, specific yields, and recharge, such that the model-predicted hydraulic heads reasonably match water levels measured in monitoring wells. One of the emphases of that calibration was to prevent the model from computing water levels that are significantly above the ground surface.

After LTVSMC operations and deposition of tailings ceased in 2001, the groundwater mound beneath the Tailings Basin began to dissipate, and the quantity of seepage leaving the Tailings Basin area has decreased. The original model was calibrated to represent the changing (transient) conditions developing from the time of LTVSMC closure until present and to simulate the observed dissipation of the groundwater mound beneath the basin. Transient model calibration was accomplished using water levels measured in years 2002 – 2013 and the observed seepage flow rates. The results of that calibration included refined horizontal and vertical hydraulic conductivities of various materials present within the Tailings Basin pond area, and their specific yield, and refined recharge rates.

The thickness of surficial deposits at the Plant Site is interpreted to vary below and adjacent to the Tailings Basin. The interpretation relies upon 1) a preconstruction topographic map of the area, 2) a 2014 geotechnical investigation conducted along the Tailings Basin perimeter (PolyMet 2015l), and 3) an interpreted map for the top of the underlying bedrock (PolyMet 2015j). This information allows for the model to at least partially represent the presence of buried stream channels. The variable thickness of surficial deposits interpreted from this data was incorporated into the Plant Site MODFLOW model.

A description of the MODFLOW model and calibration process is provided in the Water Modeling Data Package, Volume 2 – Plant Site (PolyMet 2015j, Attachment A). The MODFLOW-calibrated hydraulic parameters for different geologic units and tailings types are summarized in Table 5.2.2-9 and Table 5.2.2-10.

Table 5.2.2-9 Plant Site Hydraulic Conductivity and Specific Yield Based on MODFLOW Calibration

Model Zone	Hydraulic conductivity		Specific yield (---)
	Horizontal (ft/day)	Vertical (ft/day)	
Cell 2W fine tailings	0.2	0.05	0.033
Cell 2W coarse tailings	4.02	0.07	0.07
Cell 1E fine tailings	0.06	0.0135	0.01
Cell 1E embankments [2]	0.23	0.077	0.01–0.3
Cell 1E coarse tailings	12.55	8.98	0.3
Cell 2E fine tailings	1.07	0.77	0.015
Cell 2E coarse tailings	4.98	3.56	0.024
Cell 2E embankments	0.23	0.77	0.015–0.024
Surficial deposits	68.4	32.53	0.00018[(1)]
Bedrock outcrops	0.0217	0.000602	0.000210

Sources: PolyMet 2015m; Barr 2013i.

[1] Value represents storage coefficient. Specific yield not estimated by MODFLOW model for this material type.
[2] Model zone used in predictive model simulations only.

Table 5.2.2-10 Plant Site Recharge Based on MODFLOW Calibration

Model Zone	Recharge	
	Steady-State Calibration (in/yr)	Transient Calibration (in/yr)
Exterior dams [1]	0.2–6.0	2.0–6.0
Cell 2W coarse tailings	28.4	18
Cell 2W fine tailings	19.7	17.5
1E and 2E fine tailings [1]	0.2–6.0	0.2–6.0
1E and 2E coarse tailings	0.2–0.6	0.2–0.6
Surficial deposits	6.	6
Bedrock outcrops	0.2	0.2

Source: PolyMet 2015j .

[1] Cells 1E and 2E receive 0 in/yr recharge at the ponds. Outside the pond extents, recharge zones are based on the underlying native materials, whether surficial deposits or bedrock outcrops.

The calibrated Plant Site MODFLOW model was used in a predictive mode to evaluate groundwater conditions associated with the NorthMet Project Proposed Action. These predictive simulations evaluated the growth/dissipation of the groundwater mound below the Tailings Basin, pond leakage changing over time, the distribution of groundwater flows, and flow changes over time, from sub-areas of the Tailings Basin to the northern, northwestern, western, southern, and eastern toes of the Tailings Basin. The Plant Site MODFLOW model was not calibrated to groundwater baseflow in the Embarrass River, nor was the model used to estimate groundwater baseflow.

All the model calibrations and predictive simulations were carried out considering the following time benchmarks:

- 2002 – Shortly after the LTVSMC operations ended, the groundwater mound beneath the Tailings Basin pond, pond leakages and seep flows are at their maximum.
- 2002 – 2013 - groundwater mound beneath the LTVSMC Tailings Basin pond is dissipating, pond leakages and seep flows are decreasing.
- 2015 – The start of NorthMet Tailings Basin tailings disposal.
- 2015 to 2035 (mine years 1 to 20) – Slurried NorthMet tailings are deposited in Cells 1E and 2E, ponds increase in size, elevation of the surface of tailings and ponds systematically increase. As new tailings are added to Cells 1E and 2E, groundwater mound beneath the Tailings Basin develops causing an increase of seepage at and outside of the Tailings Basin's toes.
- 2035 (mine year 20) – Disposal of NorthMet tailings stops. Cells 1E and 2E reach the maximum height, groundwater mound begins to dissipate.
- 2075 (mine year 55) – NorthMet reclamation is complete.

Table 5.2.2-11 Results of Steady-State Model Predictive Simulations

Time (Mine Year)	Number of FTB Tailings Model Layers	Elevation of Pond 1E (amsl)	Elevation of Pond 2E (amsl)	Total Model Layers [2]	Pond(s) Boundary Condition
1	2	1,657.8	1,578.75	4	Head
7	5	1,657.8	1,651.75	7	Head
8	5	1,660.25	1,660.25	7	Head
18	6	1,710.25(1)	1,710.25(1)	8	Head
20	6	1,717.25(1)	1,717.25(1)	8	Head
55+ (Closure)	6	1,717.25(1)	1,717.25(1)	8	River Cell (3)

1 Ponds 1E and 2E combine.
2 Includes one layer for LTVSMC Tailings and one layer for surficial deposits and bedrock outcrops' bottom.
3 Conductance term in the model's river cells simulate low hydraulic conductivity (bentonite) layer placed at the bottom of pond during reclamation to achieve a leakage rate of about 6.5 in/year.

Figure 5.2.2-9 was constructed using the results of MODFLOW model simulations. It shows surficial groundwater flowpaths that have the potential to transport Tailings Basin-affected groundwater from contaminant source areas to the Embarrass River or its tributaries. This figure also shows the groundwater evaluation locations (property boundary) used to assess compliance with evaluation criteria. The hydrologic characteristics of each surficial flowpath were estimated based on a combination of MODFLOW results and site characterization information. Deterministic model inputs include length, average width, saturated thickness, hydraulic gradient (essentially ground slope), and effective porosity. Uncertain inputs are hydraulic conductivity and recharge to aquifer.

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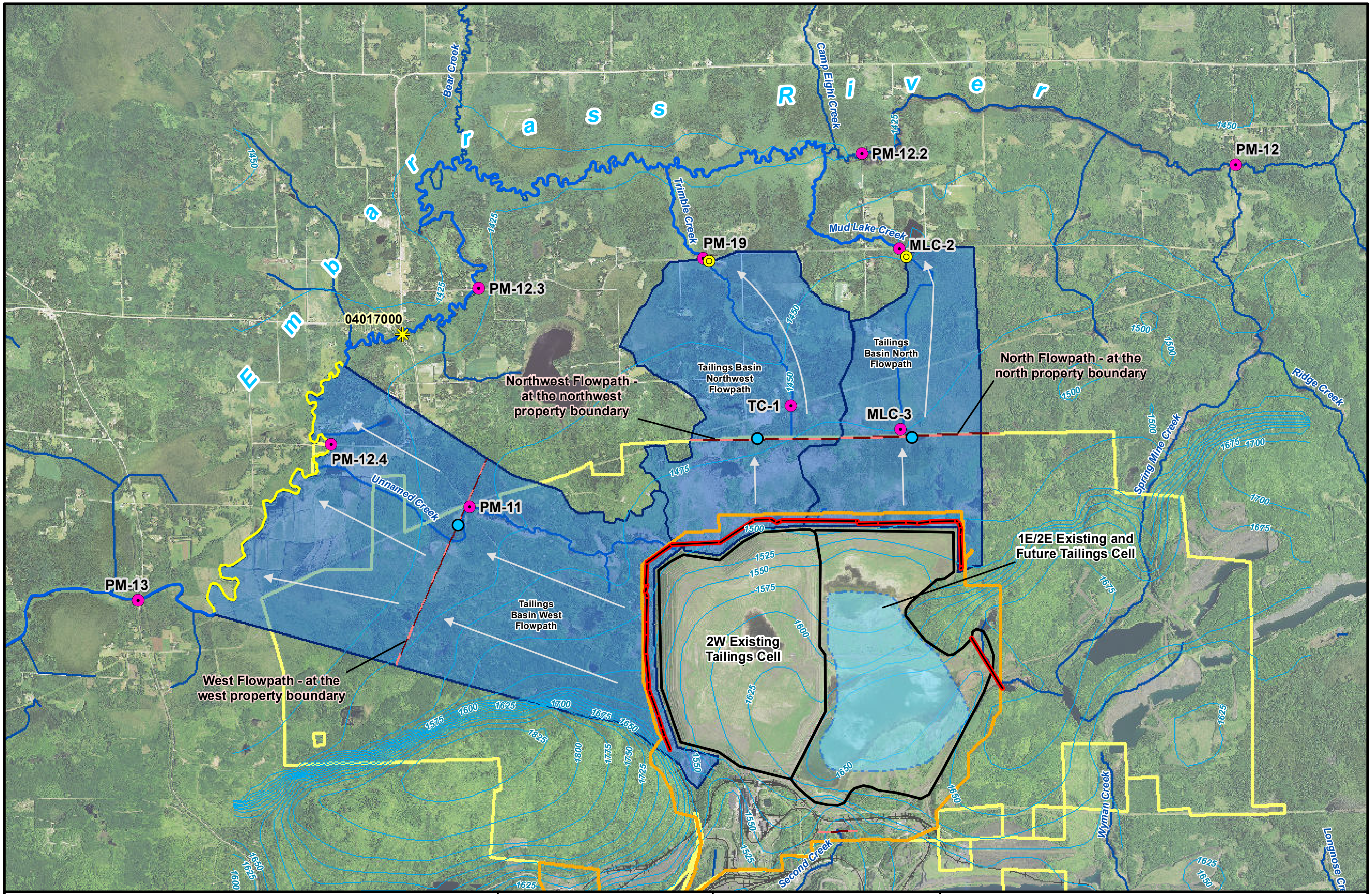

Groundwater Elevation Contours (feet)
Surface Water Evaluation Locations
Groundwater Contacts Surface Water
Groundwater Contacts Surface Water
Groundwater Evaluation Locations
Groundwater Flowpath
Plant Site
Existing Tailings Basin
Approximate Pond Area
Containment System
USGS Gaging Station (not active)
Groundwater Flow
Stream/River
Extent of Future PolyMet Lands

US Army Corps of Engineers St. Paul District

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Figure 5.2.2-9
Plant Site Surface and Groundwater Flowpaths and Final Tailings Design
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June 2015

871 -Page Intentionally Left Blank-

Summary information for the groundwater flowpaths is provided in Table 5.2.2-12. Using deterministic inputs and 50th percentile probability (P50) values for uncertain inputs (including hydraulic conductivity and recharge) produces the model-estimated total release rate of flowpath groundwater into the Embarrass River or its tributaries of approximately 306 gpm for all project phases (operation, reclamation, and closure).

Another set of groundwater models were developed to help estimate the rate of seepage from the Tailings Basin that may bypass its containment system and that system's capture effectiveness (see discussion in Section 5.2.2.2.3). Three cross-sectional MODFLOW models simulated groundwater flow along the three Tailings Basin flowpaths: north, northwest and west. These flowpaths originate at the Tailings Basin dams and terminate at the Embarrass River. Seepage from the Tailings Basin to each flowpath was set using results of the Plant Site MODFLOW model simulations. Each of the three models was developed in three versions, assuming different thickness of the fractured bedrock: 25, 50 and 100 ft. The fractured bedrock medium is represented in the model as an "equivalent porous medium". Its hydraulic conductivity was set equal to 0.14 ft/day, which is a geometric mean value derived from packer tests conducted in borings near the Tailings Basin (see discussion in Section 4.2.2.3.1).

Steady-state model simulations were completed for each flowpath under both operations and closure conditions. In total, 18 model simulations were completed. Model results indicate that all seepage from the Tailings Basin would be captured along the north and northwest flowpaths under all assumptions of the bedrock fractured zone thickness. All the seepage would be captured also along the west flowpath, except when the thickness of fractured zone is assumed to be 100 ft. Under this one particular scenario, the model-computed rate of seepage bypassing the Tailings Basin containment system is the model-predicted 8 gpm for the operations conditions, and 7 gpm for the closure and long-term maintenance conditions. These results indicate that the Plant Site GoldSim model assumption (that groundwater seepage is equal to 10 percent of the aquifer's transmissive capacity bypasses the Tailings Basin Containment System) is conservative. The modeling shows that the seepage bypassing the system represents no more than 7 percent of the aquifer's transmissive capacity (see discussion in Section 5.2.2.2.3)(Barr 2015b).

Table 5.2.2-12 Plant Site Surficial Groundwater Flowpaths used in GoldSim Based on Best-Estimate (P50) Values

Description	Units	North	Northwest	West	Total
Flowpath total length (Tailings Basin toe to Partridge River or surface water discharge location)	Meter	3,260	3,715	5,410	
Flowpath width	Meter	1,920	2,090	2,920	
Flowpath thickness	Meter	7	7	7	
Aquifer porosity	---	0.3	0.3	0.3	
Aquifer recharge flux	in/yr	0.76	0.76	0.76	
Contaminant source begin time	mine yr	0	0	0	
Contaminant source end time	mine yr	Continuous	Continuous	Continuous	
Flow rate of groundwater approaching containment system	Gpm	42.1	52.9	105.0	200.0
Flow rate of groundwater captured by containment system (90% capture efficiency)	Gpm	37.9	47.6	94.5	180.0
Flowrate of groundwater by-passing the containment system (10%)	Gpm	4.21	5.3	10.5	20.0
Aquifer recharge flow rate downgradient of containment system	Gpm	59.7	74.2	151.7	285.6
Groundwater contribution rate to Partridge River or tributary to the River	Gpm	63.9	79.5	162.2	305.6
Tailings surface seepage flow rate captured by containment system (100% capture efficiency) - End of operations	Gpm	1,375.5	385.9	755.6	2,517.0
Tailings Basin surface seepage flow rate captured by containment system (100% capture efficiency) – Closure	Gpm	430.7	354.8	550.8	1,336.3
Distance from containment system to groundwater evaluation location [1]	Meter	1,135	1,255	3,040	
Distance from containment system to surface water discharge (Partridge River or tributary) [1]	Meter	3,190	3,645	5,340	

[1] Assume containment system located 70 meters from Tailings Basin toe

5.2.2.2.2 Surface Water Hydrologic Modeling

This section describes the methods used to model surface water hydrology in the Partridge River and Embarrass River watersheds. The Plant Site represents a very small portion of the natural (pre-LTVSMC Tailings Basin) Second Creek Watershed and, as a consequence, Second Creek was not included in the surface water hydrologic modeling. However, the loss of natural watershed flow to the headwaters of Second Creek is addressed as an impact.

Partridge River Watershed

Surface water flow within the Partridge River Watershed was modeled using XP-SWMM, a model that estimates stormwater runoff, streamflow, and groundwater-controlled baseflow for a network of streams. Input to the model includes sub-drainage delineation, ground conditions, stream channel alignments, and a rainfall database. XP-SWMM estimates monthly average streamflow rates at different locations along the Partridge River and its important tributaries. To improve the results, the model inputs were adjusted so that flow estimates were calibrated to available measured flow rates in the Partridge River at USGS hydrometric station 04015475 in the Partridge River above Colby Lake (Table 5.2.2-13). A description of the XP-SWMM model for the Mine Site is provided in the Mine Site Water Modeling Data Package (PolyMet 2015j). A summary of the model results for seven Partridge River monitoring stations (see Figure 4.2.2-12) is provided in Table 5.2.2-13.

Table 5.2.2-13 Mine Site Surface Water Flows for Existing Conditions Based on XP-SWMM Model Results Adjusted to Match USGS Stream Gaging Data

Stream	Station	Groundwater Baseflow[1]	Annual 7-Day Minimum Flow with 10-year Return Period[2]	Annual 1-Day Minimum Flow[3]	Annual Daily Mean Flow[3]	Annual 1-day Maximum Flow[3]	Annual 1-Day Minimum Flow with 10-year Return Period[2]
		cfs	cfs	cfs	cfs	cfs	cfs
Partridge River	SW-002	0.4	0.4	0.4	6.1	82	118
	SW-003	0.5	0.5	0.5	7.4	93	132
	SW-004	0.9	0.7	0.9	14	156	215
	SW-004a	2.4	1.7	2.1	38	468	678
	SW-004b	3.8	2.8	3.4	58	631	895
	SW-005	4.9	3.6	4.3	75	737	1,081
	SW-006	5.3	3.9	4.7	79	761	1,127

Source: PolyMet 2015m, Appendix J; Barr 2015i.

[1] Average annual 30-day minimum.
[2] 10-year values are based on individual model year flow statistics not published in Attachment J of PolyMet 2015m. Values in Attachment J represent averages of the 10-year model period.
[3] Long-term average.

Embarrass River Watershed

Flow characteristics for different reaches of the Embarrass River and selected tributaries were estimated by extrapolating flows from USGS gaging station 04017000 (located just downstream of PM-12.3) on a unit-area basis. A summary of the flow results for different stations on Embarrass River, Mud Lake Creek, Trimble Creek, and Unnamed Creek is provided in Table 5.2.2-14. Flow contributed by the Tailings Basin seepage is separated from the flows derived using the unit-area basis in the table to provide greater clarity of water origins. Tailings Basin flows presented in the last column of Table 5.2.2-14 can be added to the annual flow characteristics presented in the table to determine the appropriate flow volume.

Table 5.2.2-14 Plant Site Surface Water Flows for Natural Conditions Based on Embarrass River Stream Gaging Results Applied to Contributing Watersheds and Additional from Tailings Basin Seepage and Flowpath Discharge

Stream	Embarrass River or Tributary Surface Water Station	Existing Watershed Area Excluding TB Footprint (mi^2)	Estimated Groundwater Baseflow (cfs)	Annual 7-Day Minimum Flow with 10-year Return Period[1] (cfs)	Annual 1-Day Minimum Flow[1,2] (cfs)	Annual Daily Mean Flow[1,2] (cfs)	Annual 1-day Maximum Flow[1,2] (cfs)	Annual 1-day Maximum Flow with 10-year Return Period[1] (cfs)	Additional Flow to Station from Tailings Basin Seepage (cfs)
Embarrass River	PM-12	19.0	0.86	0.4	0.74	13.8	145	259	0.00
	PM-12.2	34.2	1.55	0.7	1.34	24.9	261	467	0.00
	PM-12.3	83.0	3.76	1.79	3.24	60.5	633	1,135	4.41
	PM-12.4	94.4	4.27	2.07	3.69	68.8	720	1,290	4.43
	PM-13[3]	107	4.83	2.33	4.17	77.8	814	1,457	5.77[4]
Mud Lake Creek	MLC-3	1.40	0.06	0.07	0.05	1.02	10.7	19.2	0.83
	MLC-2	3.57	0.16	0.07	0.14	2.60	27.2	49.1	0.93
Trimble Creek	TC-1	2.18	0.10	0.04	0.09	1.59	16.6	29.6	3.36
	PM-19	3.94	0.18	0.12	0.15	2.87	30.1	53.5	3.48
Unnamed Creek	UC-1a	2.29	0.10	0.09	0.09	1.67	17.5	30.9	1.11
	PM-11	3.37	0.15	0.09	0.13	2.46	25.7	45.9	1.11

Source: Barr 2015i.

1 Based on USGS record applied to watershed area, flow from the Tailings Basin (last column) is in addition to the flow values presented.
2 Long-term average.
3 PM-13 values differ from those in Table 4-5 of the Plant Site Water Modeling Data Package (Barr 2015j), which were based on the historical drainage area of 88.3 mi^2.
4 5.77 cfs (2,590 gpm) is the estimated total seepage from the Tailings Basin.

5.2.2.2.3 Water Quality Modeling (GoldSim)

GoldSim is a commercially available "systems" model that allows for probabilistic simulations and was used by PolyMet to simulate time-varying surface water and groundwater quality. GoldSim was programmed with a suite of algorithms to estimate the release of contaminants from mine facilities (i.e., "sources") and their transport to groundwater and surface water evaluation locations. An overview of the modeling of contaminant release and transport in GoldSim is provided below. The sections below provide a geochemistry overview of the waste rock and tailings, and describe the methodology used to estimate contaminant release and transport at the Mine Site (Partridge River Watershed) and Tailings Basin (Embarrass River Watershed).

Several decisions were made while setting up the GoldSim models. An approach was taken not to represent in those models the interactions between bedrock groundwater and surficial deposits groundwater, or between groundwater and wetlands. Instead, an extensive monitoring was proposed during mine operations and closure to assess if such interactions occur and if they would raise concerns for permitting agencies. If monitoring data indicate trends toward permit non-compliance, adaptive mitigation measures would be implemented to prevent or eliminate what is expected to be a small transport-related bedrock impact relative to surficial flows. See FEIS Section 5.2.2.3.5 for more information on adaptive mitigation measures and Section 5.2.2.3.6 for more information on monitoring.

The pH in leachate from the various mining features was not predicted by the GoldSim model. The permanent storage facilities (Category 1 stockpile and tailings basin) would contain material that is not expected to produce acidic leachate. The non-acid generating waste was identified using multi-year kinetic tests (humidity cells) on NorthMet rock samples. Waste rock with 0.12 percent sulfide S or less is the threshold for selecting non-acid generation mine waste and is supported by long-term humidity cell tests on NorthMet waste (i.e., 42 samples of Category 1 waste rock, with tests now run for over 450 weeks; and 33 humidity cell tests (NorthMet tailings) run between 84 and 304 weeks (PolyMet 2015q).

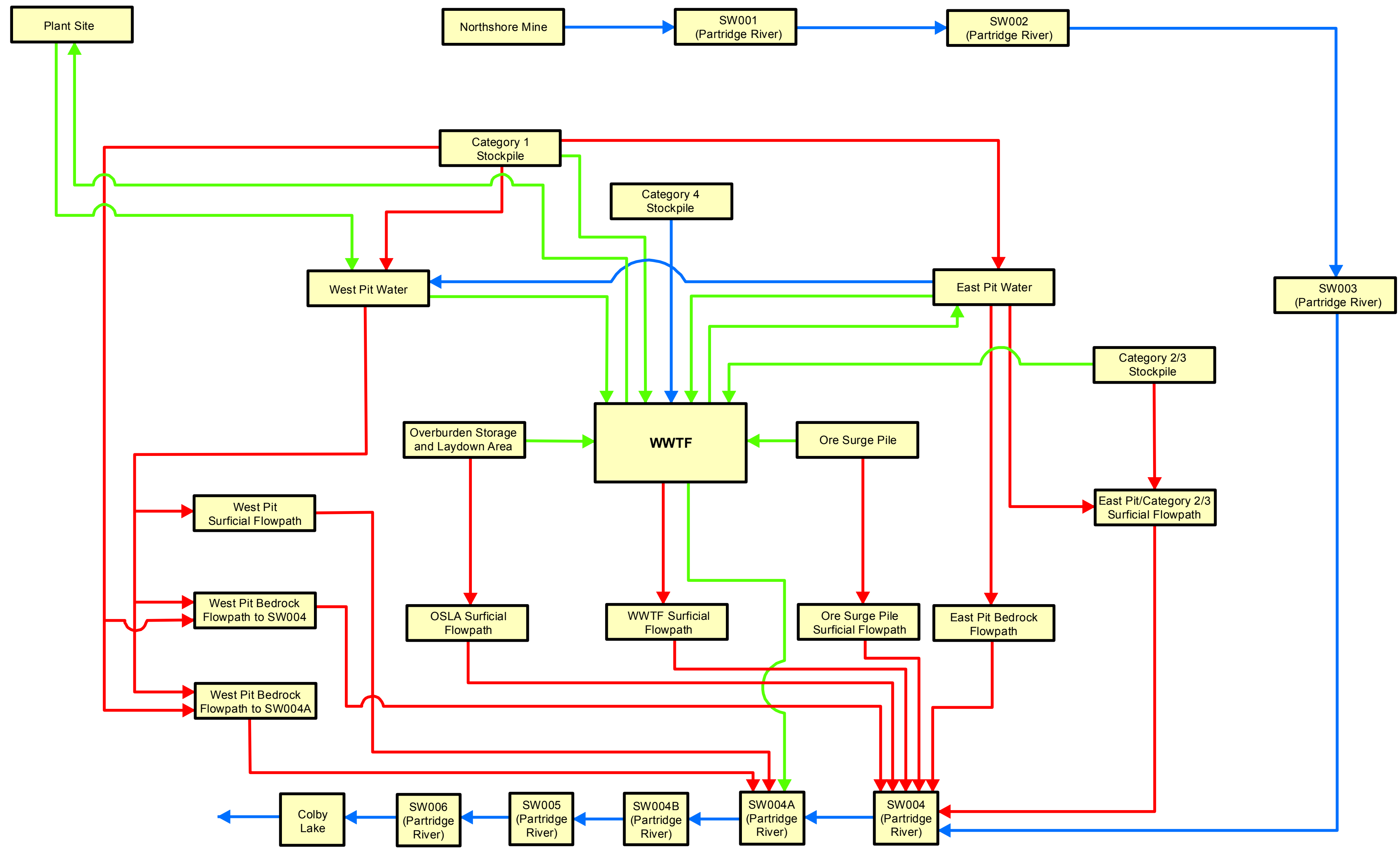
These tests demonstrate that tailings and Category 1 waste rock materials would not generate acidic leachate, and acid generation rates decreases over time as sulfide S minerals are depleted. The NorthMet Project design thus prevents the introduction of acidic leachate to surface water that could affect fisheries.

Regarding the tailings in particular, the pH values in the tailings humidity cells have been observed to be stable or increasing (becoming less acidic) between 100 and 300 weeks of humidity cell testing. However, pH of the tailings in the GoldSim model is not directly based on, or extrapolated from, the observed pH in the humidity cells. This is because the neutralization mechanism for NorthMet tailings is understood to be silicate mineral dissolution, not carbonate weathering.

As noted above, the humidity cells provide information on rates of acid producing and acid neutralizing reactions, which are similar for tailings and Category 1 waste rock due to the similar sulfur content of these materials. A separate geochemical model was used to estimate long-term pH resulting from these reactions, including the conservative assumption that CO_2 is elevated above atmospheric levels throughout the tailings.

Partridge River Watershed

This section describes the geochemistry of the NorthMet Deposit waste rock and the factors affecting contaminant release and transport from the various contaminant sources at the Mine Site. An overall flowchart of the Mine Site GoldSim model is provided as Figure 5.2.2-10.



Surface Water Flow
Seepage or Groundwater Flow
Piped Flow

This document is a working document. This document may change over time as a result of new information, further deliberation, or other factors not yet known to the Co-lead Agencies.

Figure 5.2.2-10
Mine Site GoldSim Overview Flow Chart
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

995 -Page Intentionally Left Blank-

NorthMet Waste Rock Geochemistry

The mechanism most responsible for the release of solutes from waste rock is oxidation of sulfide minerals, primarily pyrrhotite (FeS) in NorthMet Deposit rock. The sulfide-oxidation reaction produces sulfuric acid, and releases soluble metals (e.g., cobalt, copper, iron, and nickel) that were bound in sulfide minerals. Secondary effects include leaching of some metals (primarily nickel and chromium) from silicate minerals, particularly where acidic pore waters increase silicate solubility. Mine-related blasting and excavation dramatically increases the surface area and porosity of the rock, which allows rapid introduction of atmospheric oxygen and flushing of solutes by water. Within the pit walls, the blasting effects are limited in terms of lateral extent and do not have much effect on solute transport in bedrock. Where the pore water pH remains near-neutral, metal mobility can be limited as some constituents released by oxidation are removed from solution by adsorption, co-precipitation, or solubility-controlled precipitation of secondary minerals. The onset of acidic pore water is also of concern, as these conditions cause the rate of sulfide oxidation to increase and the concentration of metals to increase as precipitates dissolves. However, when oxidation is fast enough to overcome acid-neutralization reactions and the pore water becomes acidic, the solubility of most metals increases, previously precipitated metals can re-dissolve, and the rate of sulfide-mineral oxidation increases.

Key environmental characteristics of the NorthMet waste rock include the following:

- Most of the waste rock and pit wall rock would contain some sulfide S, mainly as mineral pyrrhotite, which can produce acid leachate and soluble metals when it oxidizes;
- There are essentially no acid-neutralizing carbonate minerals in NorthMet waste rock, but silicate minerals—including plagioclase feldspar ($[Na,Ca][Si,Al]_4O_8$), olivine ($[Mg,Fe]_2SiO_4$), and pyroxenes (e.g., diopside, $MgCaSi_2O_6$)—neutralize some acid, which would delay acid onset in some rock and would prevent entirely the onset of acidic conditions in rock with less than 0.12 percent sulfur;
- In rock with less than 0.12 percent sulfur (S), the oxidation rate is slow enough that all acid produced during weathering would be completely neutralized by reaction with silicate minerals, so this low-sulfur rock (classified at Category 1 waste rock in the NorthMet Project Proposed Action) is predicted to never generate acidic leachate;
- Sulfide-bearing rock from the NorthMet Project Proposed Action may oxidize for several years before producing acidic leachate;
- The rate of sulfide mineral oxidation in excavated NorthMet waste rock would be approximately proportional to the total sulfur content of the material, and the rate could increase several fold if the pore water were to become acidic;
- Chemical reactions, including mineral precipitation and surface adsorption, would limit the concentration of many contaminants in non-acidic waste-rock effluent and thus would reduce the rate at which contaminants were released; and
- If the pore-water pH were to shift from neutral to acidic, then the rate of sulfide mineral oxidation and associated release of some metal cations (e.g., nickel and copper) would increase dramatically (e.g., average increase in oxidation upon onset of acidic conditions is a factor of 8.2 relative to non-acidic conditions [Table 8-4 in PolyMet 2015q]).

- The environmental classification of NorthMet waste rock is based primarily on the sulfur concentration, and the distribution of sulfur through the deposit is based on spatial interpolation between 24,861 analyses of rock samples collected as part of the exploration drilling (SRK 2007a). Rates of oxidation and contaminant release are based on 78 “humidity cell” tests, which measured solute concentrations in leachate as rocks were subjected to over 4 years of simulated weathering cycles. These include tests on 75 samples of Category 1 through Category 4 waste rock, and 3 samples of ore from the NorthMet Deposit (PolyMet 2015q, Attachment C, Table 2). In addition, splits of 7 waste rock samples were subjected to duplicate humidity cell tests, but these were stopped in 2009 when results indicated good reproducibility in trends of reaction rates and solute release. Estimates for changes in oxidation rates and solute release during long-term weathering were supplemented with 17 independent tests conducted by the MDNR on rock from a similar proximal deposit (the Dunka Blast Hole). These tests on Dunka rock used smaller fragment size rock (termed “MDNR Reactors”), and results were used to refine estimates of oxidation-rate changes during weathering (PolyMet 2015q, Attachment A, Table 3). Total leachable metal concentrations are based on 61 analyses of metals extracted from waste rock by acidic digestions (SRK 2007b). For constituents that are assumed to be released in proportion to dissolution of another constituent (e.g., copper and zinc were always modeled as being released in proportion to sulfide sulfur oxidation), the concentration ratios were estimated using the average total constituent concentrations measured in all available assayed samples of either Category 1, Category 2/3, or Category 4 waste rock; ore, or Category 4 Virginia Formation (i.e., approximately 18,800 total whole-rock analyses, see Large Table 2 and Section 8.1.2.3 in PolyMet 2015q). Finally, the concentration of metals in mineral phases was based on electron microprobe analysis, which measured the concentration of metals in 630 individual mineral grains (74 oxides, 268 sulfides, and 288 silicates [SRK 2007b; SRK 2007c]).

These environmental characteristics have been used to classify NorthMet waste rock into the following four environmental categories (PolyMet 2015q, Figure 4-8 to 4-10):

- Category 1: Sulfide S range is less than or equal to 0.12 percent, and would not produce acidic leachate.
- Category 2: Sulfide S range is greater than 0.12 percent and less than or equal to 0.31 percent, and could produce acidic leachate if allowed to weather for several years.
- Category 3: Sulfide S range is greater than 0.31 percent and less than or equal to 0.60 percent, and could produce acidic leachate if allowed to weather for several years.
  - Categories 2 and 3 are combined to produce the Category 2/3 stockpile with sulfur content greater than 0.12 percent and less than or equal to 0.60 percent, could produce acidic leachate if allowed to weather for several years.
- Category 4 (Duluth Complex): Sulfide S range is greater than 0.60 percent, and would produce acidic leachate if allowed to weather for several years.
- Category 4 (Virginia formation): Sulfide S range is from 0.4 to 5.0 percent, and would produce acidic leachate immediately upon weathering.

- Ore would behave similar to Category 4 Duluth complex waste rock, but other than residual ore in pit wall rock, would not remain on the surface for any extended periods. Ore would move in and out of the Ore Surge Pile (a lined facility) throughout operations.
- The sulfide S concentration of the NorthMet waste rock is relatively low compared to many other mines with sulfide-bearing rock around the world. Data from the International Kinetic Database, which includes humidity cell test results from 71 mines, shows sulfide S concentrations ranging as high as 40 percent, with an average of 3.6 percent (see Figure 5.2.2-11) (Mine Site Drainage Assessment Group 2013). In comparison, most (70 percent) of the NorthMet waste rock would be the low-sulfur, non-acid-generating Category 1 material (i.e., average sulfur would equal 0.06 percent, and range from 0.01 to 0.12 percent). The only NorthMet waste rock that would contain greater on average than 1 percent sulfide is the Virginia Formation waste rock, which has an average sulfide S concentration of 2.43 percent, but it would only comprise about 1.8 percent of the total NorthMet Deposit waste rock. It should be noted, however, that not all sulfide S has the same potential for release.

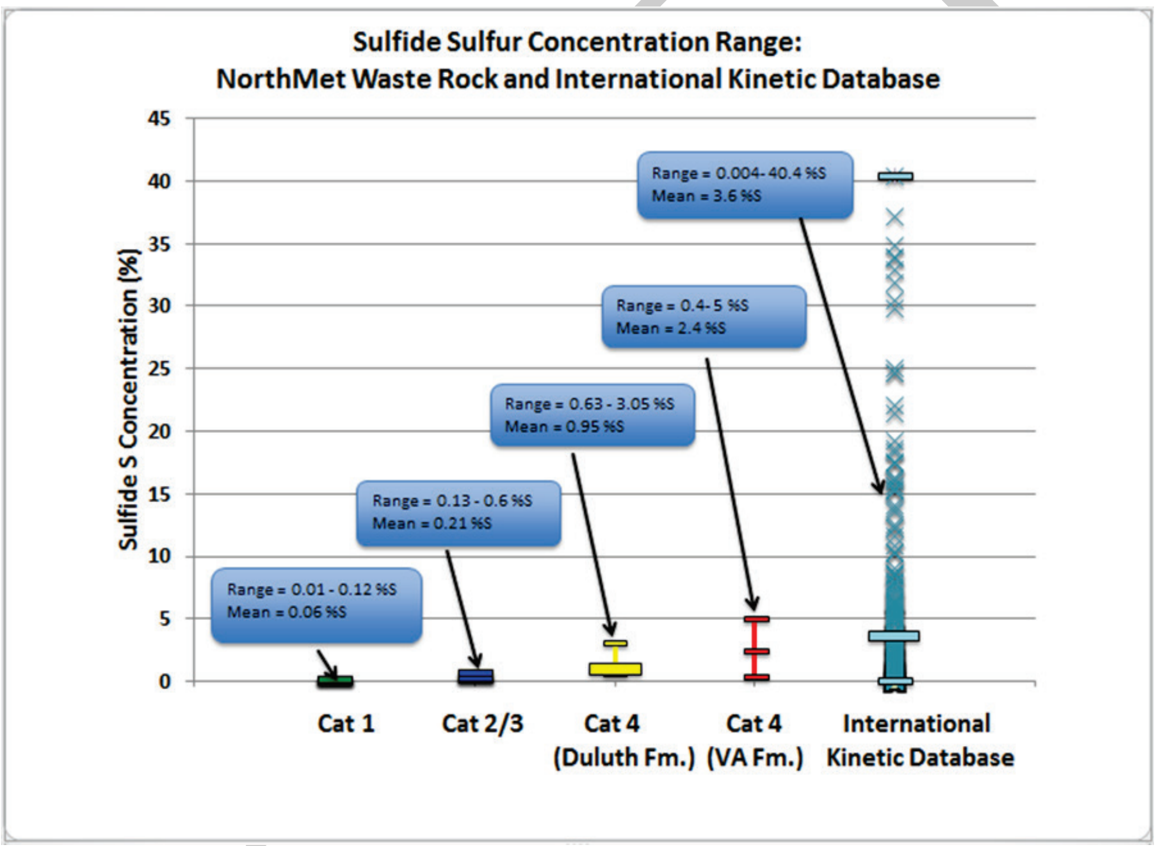


Figure 5.2.2-11 Comparison of NorthMet Project Waste Rock Sulfide Sulfur Concentrations with Other Mines

Constituent Release from Waste Rock

The GoldSim model simulates constituent release from waste rock by applying scaling factors to laboratory tests to provide quantitative estimates of loading that are then combined with hydrologic estimates to predict solute concentrations. The predictive models assume that the entire mass of waste rock in each of the stockpiles is oxygenated and is thus capable of reacting with air (some waste rock stockpiles can have zones with lower than atmospheric oxygen concentrations, so this assumption tends toward producing higher rates of pollutant release than may exist). Field oxidation rates are then estimated by scaling from lab rates to account for effects of temperature (oxidation is slower at the lower temperatures), differences in pH (potential acidification), fragment size (waste rock fragments would be larger than rock tested in the lab, and would thus react more slowly), pore-water pH (oxidation rates in NorthMet rock are assumed to increase when pore water becomes acidic), and the fraction of rock flushed by percolating water (some fraction of waste rock under field conditions is hydraulically isolated).

For the Category 1 waste rock (i.e., the waste rock with the lowest sulfide sulfur content, but which would remain stored permanently on the surface after closure), instead of using lab tests, the rate of oxidation and constituent release in the field was estimated from lab release rates that were scaled using the results of studies of seepage release measured in Dunka Mine rock, which is a nearby source of waste rock with similar chemical composition that has been monitored under field conditions. The rate of contaminant release is modeled as a load rate (e.g., mg contaminant per month), estimated as the product of the mass of the waste (kg waste) and the rate of contaminants are released (mg contaminant per kg waste per month).

This transport simulation assumes that solutes released by oxidation can dissolve when contacted by rain and snowmelt percolating through the waste rock, and dissolved constituents are flushed immediately through the rock. Where the concentration of contaminants in percolating water is not limited, the entire load released over a time step can dissolve in any available water. In this case, decreasing the water flow would still collect the entire contaminant load, producing a more concentrated leachate, but the same solute load rate. In most NorthMet waste rock, however, contaminant concentrations are limited by “concentration caps”—empirical upper-concentration values. Concentration caps are estimated in part using measured behavior of laboratory tests on waste rock from the NorthMet Deposit, but rely heavily on concentrations of dissolved constituents measured in effluent from field-scale facilities of similar waste rock (including rock from the Amax and Dunka mine deposits in Minnesota, and the Whistle and Vangorda mines in Canada (PolyMet 2015q). When solute concentrations are capped in modeling, then solute loads are proportional to flow rate, so that reduced flow rates would result in a proportional reduction in solute load to the environment. The Category 1 Stockpile is the clearest example of this effect, because solutes would be released over time by oxidation, but the pore water would maintain at a near-neutral pH, where many solutes have limited solubility. The effect of concentration caps in the Category 1 Stockpile would be further enhanced in closure and long-term maintenance, when a proposed geomembrane cover would reduce infiltration, producing a proportional reduction in the load rate of those solutes at their pore-water concentration caps. The GoldSim model tracks the total mass of these capped solutes, so that constituents removed from solution to meet concentration caps are retained in the model for later release when solute concentrations would otherwise decrease below the concentration caps. In contrast, for the more acid-generating materials, including the ore and Category 4 waste rock, concentration caps are much higher or may not attain the cap value, and load to the environment is more closely related to the rate of solute release regardless of water flow rate through the waste.

Detailed descriptions of the assumptions and algorithms used to estimate solute release from mine-related facilities is provided in the Waste Characterization Data Package (PolyMet 2015q).

Contaminant Transport in Groundwater from Waste Rock

At the Mine Site contaminated groundwater would seep from the East and West Pits along the surficial aquifer and bedrock groundwater flowpaths. Such seepage would become environmentally important when water levels in the pits would rise above the base of the surficial aquifer. In addition, leakage from the Category 2/3 Stockpile, Ore Surge Pile, Overburden Storage and Laydown Area, and WWTP Ponds would also enter groundwater flowpaths within the surficial aquifer. Finally, water by-passing the Category 1 Stockpile's containment system at a small rate would enter the bedrock groundwater flowpath too. Contaminated water would migrate along the groundwater flowpaths to the property boundary and, ultimately, to the Partridge River.

At the Mine Site, five surficial groundwater flowpaths were identified, as described previously. Groundwater flow rates and flow directions in the GoldSim model were taken directly from the MODFLOW results or were programmed to be consistent with the MODFLOW results. Time-varying surface water flow rates were taken either from the XP-SWMM results or were estimated from stream gaging data.

Site characterization data that indicate the bulk hydraulic conductivity of upper bedrock is two to three orders-of-magnitude lower than the hydraulic conductivity of the surficial aquifer. Thus, groundwater flow and transport at the Mine Site are dominated by the hydraulics of the surficial aquifer. Bedrock plays a negligible role in transporting site-derived contaminants to the Partridge River.

Still, contaminated waters entering the groundwater bedrock flowpaths were also programmed into GoldSim. However, due to the very low bulk hydraulic conductivity of bedrock, groundwater flow rates in these flowpaths were not large enough to affect water quality at the groundwater and surface water evaluation locations.

Solutes, while migrating along the groundwater flowpaths (ether at the Mine Site or Plant Site), would be subject to attenuating processes reducing their concentrations. Attenuating processes slow solute transport by adsorption or sorption onto mineral surfaces in the aquifer. Table 5.2.2-15 defines fate and transport mechanism terminology in this FEIS.

Among those attenuating processes would be:

- Mechanical dispersion, which would spread out the leading front of the contaminant plume; and
- Mixing with meteoric water recharging the aquifer.

In addition, over time the concentration of contaminants leaking from the sources would decrease, as the sources would gradually degrade, diminishing in strength. Those, and other processes would result in contaminant concentrations decreasing with time and distance from the source.

Given these attenuating processes, contaminant transport to evaluation locations can be described by noting the time the contaminant arrives at that point and the time when the contaminant concentration reaches its peak.

Table 5.2.2-15 Definition of Fate and Transport Mechanism Terminology used in this FEIS

Term	Definition
Adsorption (Sorption)	The process by which ions of a solute are attracted to and accumulate at the interface between a solid phase and an aqueous phase.
Attenuation	In groundwater transport this refers to mechanisms that reduce a solute's concentration or rate of migration in groundwater, such as adsorption, degradation, dispersion or dilution.
Constituent-loading	The rate at which a constituent is added or released (mass per unit time).
Groundwater Plume	The spread of contaminated groundwater downgradient of the source.
Mechanical Dispersion	The process whereby solutes spread out because of differences in the groundwater movement's velocity at the pore level and within different sediment/rock strata.
Partition Coefficient (Kd)	The ratio of the sorbed metal concentration (expressed in milligrams of chemical per kilograms of sorbing material) to the dissolved chemical concentration (expressed in milligrams of chemical per liter of solution) at equilibrium.

Some of the constituents modeled as un-attenuated in the GoldSim model may in fact be subject to some attenuation due to adsorption onto surfaces in the surficial and bedrock aquifer. The peak concentrations of these solutes would arrive at the evaluation locations later than estimated in the GoldSim model, and the peak concentrations of such late-arriving solutes would be lower than the concentrations estimated under the assumption in the FEIS of un-attenuated transport.

In the NorthMet Project Proposed Action GoldSim water quality model, four solutes are assumed to be attenuated by adsorption in the aquifer: arsenic, antimony, copper, and nickel. Definition of the metal partition coefficient (K_d) controlling this process is provided in Table 5.2.2-15. Higher K_d values represent higher sorption capacity of the aquifer, and thus slower apparent migration of a solute in groundwater.

Literature values are available for estimating metal partition coefficients (USEPA 1996; 2005). These values have been adopted by MPCA as part of its risk-based guidance for State Superfund and VIC program sites (MPCA 1998). In addition, PolyMet conducted site-specific sorption testing on soil samples collected from the most permeable zone of two borings at the Mine Site. Batch sorption tests were conducted in the laboratory generally using standard ASTM procedures (Barr 2009h). Table 5.2.2-16 presents the USEPA literature values, the results of the site-specific sorption testing, and the K_d values accepted for use in groundwater modeling. The lower K_d values for antimony reflect greater uncertainty regarding antimony sorption in the scientific literature and site-specific testing.

Table 5.2.2-16 Comparison of Site-specific and Literature Sorption Values at the Mine Site

Parameter	USEPA K_d Screening Value Used in DEIS (L/kg)	Site-specific Sorption (K_d) Values[1] Boring RS-22 (L/kg)	Boring RS-24 (L/kg)	Average (L/kg)	K_d used in GoldSim Model (L/kg)	Associated Retardation Factor used in GoldSim Model[2] (---)
Antimony	45	1.6	22	12	1.3, 1.6, 6.1[(3)]	7.5, 9.0, 31[(3)]
Arsenic	25	>52	590	~320	25[(4)]	126[(4)]
Copper	22	1,047	463	755	22[(4)]	111[(4)]
Nickel	16	73	40	56	16[(4)]	81[(4)]

[1] Modified from: Barr 2009h.
[2] Assuming porosity of 0.3 and dry bulk density of 1,500 kg/m^3.
[3] Uncertain input with triangular distribution. Minimum, mode, and maximum values, respectively.
[4] Deterministic value.

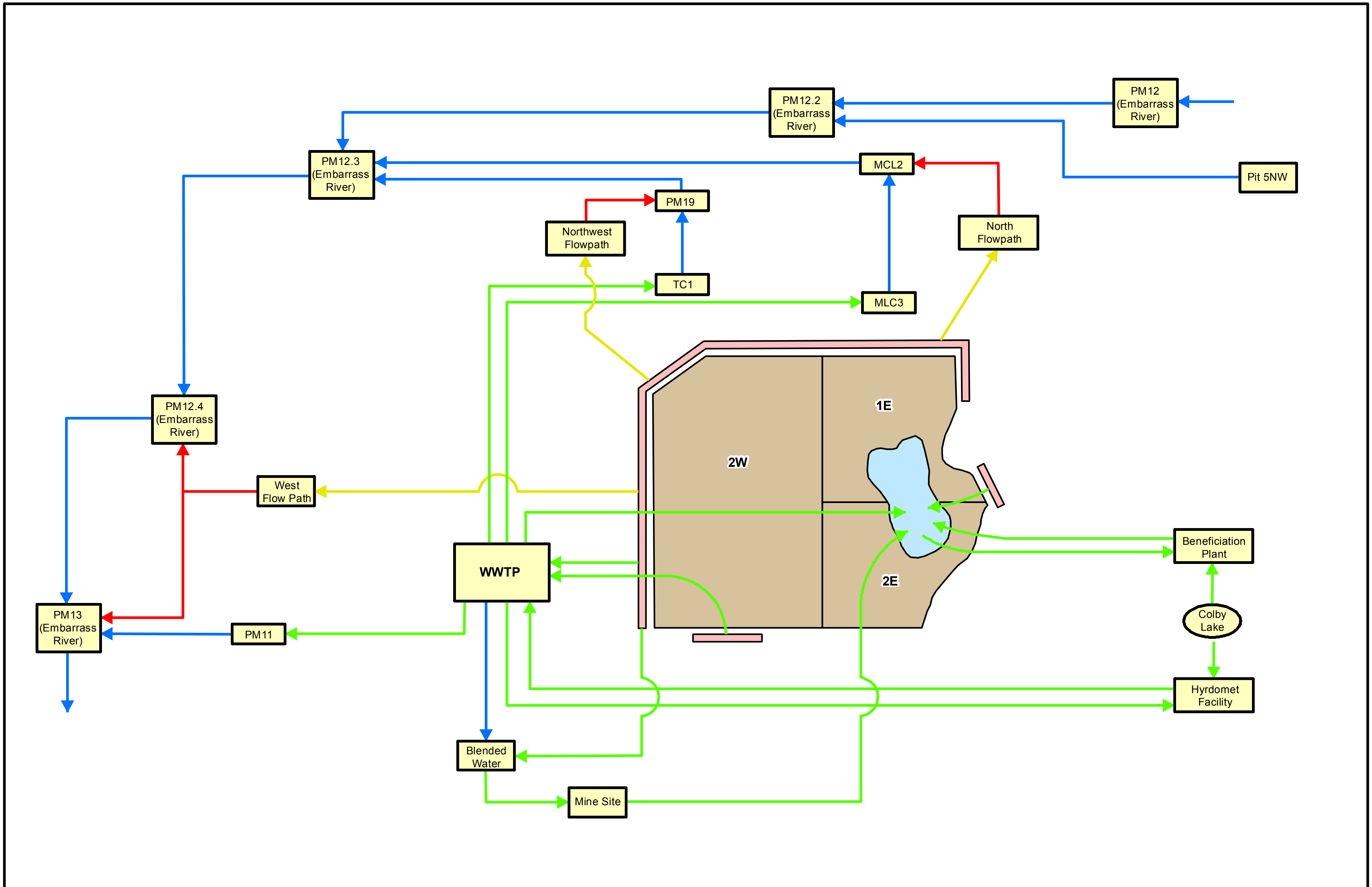
The attenuation effect resulting from sorption is significant enough that arsenic, copper, and nickel are not predicted to travel from source areas to any groundwater evaluation locations or the Partridge River within the 200-year model simulation period (PolyMet 2014v). Analytical calculations suggest that the travel times for these solutes would be on the order of thousands of years.

Antimony, which is modeled with lower K_d values, reaches the groundwater evaluation location in the East Pit Category 2/3 Surficial Flowpath at about 23 years, but the predicted concentration increase is very small. Model results indicate that the 90th percentile concentration of antimony for the West Pit Surficial Flowpath at Dunka Road peaks at the 164th year of model simulation and is below the evaluation criterion of 6.0 µg/L. That concentration would be reduced when the peak arrives at the property boundary due to attenuation processes.

The seepage capture efficiency at the Category 1 Stockpile of the surrounding containment system, West Pit, and East Pit was assessed using a separate three-dimensional MODFLOW model (PolyMet 2015h). The model predicted that during mine operations, when portions of the stockpile would be uncovered, some uncollected affected seepage could migrate north of the Category 1 Stockpile at a flow rate of less than or equal to 0.2 gpm, and this groundwater could be released to bedrock and/or surficial deposits adjacent to the stockpile. Given that this small flow would be distributed over the 2 mile length of the stockpile, it would be unlikely to cause any measureable impact to groundwater or surface water. After operations, when the stockpile is fully covered, the uncollected north seepage from the stockpile is predicted to be less than equal to 0.01 gpm. As such, a north surficial groundwater flowpath was not included in the GoldSim model. During operations and closure, groundwater monitoring would be conducted at three locations adjacent to the north side of the Category 1 Stockpile, and if NorthMet Project Proposed Action effects on groundwater were greater than predicted, mitigation measures would be implemented.

Embarrass River Watershed

GoldSim has been programmed to incorporate surface water flow, contaminant release from tailings, groundwater transport of bypass from the containment system to the Embarrass River system, water transfers between mine facilities, and discharge of WWTP-treated effluent to the Embarrass River tributaries for flow augmentation. An overview flowchart of the GoldSim model is provided as Figure 5.2.2-12. The sources identified above are the only NorthMet Project Proposed Action containment sources considered. The Hydrometallurgical Residue Facility, due to its engineering, is not expected to be a contaminant source. This section describes the geochemistry of the NorthMet Project Proposed Action tailings and the factors affecting contaminant release and transport from the Tailings Basin.



Containment System
Pond
Tailings Basin
Surface Water Flow
Seepage or Groundwater Flow
Piped Flow
Groundwater Flow

US Army Corps of Engineers
St. Paul District

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Figure 5.2.2-12
Plant Site GoldSim Overview Flow Chart
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June 2015

1248 -Page Intentionally Left Blank-

NorthMet Tailings Geochemistry

Figure 5.2.2-13 is a base map of the Plant Site showing the tailings facilities that have the potential to be contaminant sources to groundwater and surface water, including Cell 2W, Cell 1E/2E, and a Tailings Basin pond of varying surface area that would continue to exist on top of Cell 1E/2E. The current tailings in Cell 2W and Cell 1E/2E are referred to as LTVSMC tailings and new tailings that would be generated by the NorthMet Project Proposed Action are referred to as NorthMet tailings.

The NorthMet Project Proposed Action tailings are predicted to have less than 0.12 percent sulfur, which kinetic tests demonstrate is low enough that it would never produce acidic leachate (PolyMet 2015q). The bulk sulfide flotation process used in handling the ore would maintain the sulfide S below 0.12 percent in the tailings discharged to the Tailings Basin.

The assumptions regarding the environmental behavior of the tailings are based on 21 humidity cells (14 for coarse tailings and seven for fine tailings) generated in the pilot-plant processing tests conducted to refine the metal recovery process. The tailings samples were analyzed to determine concentrations of total metals, acid-generating sulfur, and acid-neutralizing carbonate carbon, and were then subjected to humidity cell testing (PolyMet 2015q Attachment F, Table 1). The oxidation rates in tailings are based on multi-year humidity cell tests (individual test durations ranged from 74 to 271 weeks), where solute release rates were used to extrapolate back to estimate the initial oxidation rate in the sample before any of the sulfide sulfur was depleted. In the final waste characterization report used to support this FEIS, the total duration of the humidity cell tests ranged from 113 to 311 weeks (PolyMet 2015q).

Tailings samples subjected to humidity cell tests included a range of sulfide S concentrations (0.06 to 0.14 percent S) and size fractions selected to represent the ranges expected under various depositional environments in the Tailings Basin (PolyMet 2015q, Attachment C, Table 4):

- Coarse (greater than 0.150 mm ["+100 mesh"]),
- Median (less than 0.150 mm and greater than 0.076 mm ["-100+200 mesh"]), and
- Fine (less than 0.076 mm ["-200 mesh"]).

The NorthMet Tailings Basin dam would be constructed with coarse tailings from the LTVSMC facility, which has a size distribution that is approximately 87 percent greater than 0.076 mm (PolyMet 2014x, Table 4-3 Summary of Index Properties of LTVSMC coarse tailings).

Results of the humidity cell tests on pilot-plant tailings had similar results to Category 1 waste rock, with sulfate release rates increasing roughly in proportion to total sulfur, and declining sulfate production over time as the sulfide minerals are consumed (PolyMet 2015q Attachment F, Figure 5). The GoldSim model estimates the moisture content in the tailings and dams materials through time, and uses this to estimate the quantity of tailings oxidizing, the oxidation rate of sulfide minerals, and the associated release of solutes.

The predicted concentration of contaminants in tailings seepage is limited by "concentration caps." Concentration caps are empirical upper-concentration values based primarily on measured effluent from field-scale waste rock facilities that are chemically similar to the NorthMet Deposit. For solutes modeled at their concentration caps, the load leaving the tailings would be proportional to water flow; but the GoldSim model tracks the mass of contaminants stored in the tailings, so reductions in predicted seepage loading due to concentration cap limits are balanced by a longer total duration of contaminant release.

The pH of effluent from oxidizing tailings ranges between 6 and approximately 8.3, though the pH in effluent from tailings with sulfur similar to that of the Tailings Basin (sulfur approximately 0.12 percent) is generally above 7 (PolyMet 2015q). Humidity cell test results indicate that under oxygenated conditions at room temperature, tailings material oxidation releases about 5 mg SO_4 per kg tailings per week (see Tables 1-13 and 1-14 in PolyMet 2015j), and the range in most tests is between approximately 2 and 8 mg SO_4 per kg tailings per week (PolyMet 2015q, Attachment F). In those samples where the oxidation rate was high enough to reduce pH, most showed an associated increase in the concentrations of some metal cations, such as nickel. By the end of the longest humidity cell tests (420 weeks), much of the original sulfide S in the tailings (e.g., ~20 to 40 percent) had been oxidized, and the reacted sulfur leached out as soluble sulfate.

These multi-year humidity cell tests on NorthMet tailings yield two important results. First, the rate at which sulfide minerals oxidize is approximately proportional to the concentration of sulfide remaining in the sample, so that the oxidation rate (and thus the acid-production rate) decreases over time as the sulfide S is consumed (PolyMet 2015q, Attachment C [2015 Update on Kinetic Test Data], Attachment A [Graphs]). Second, at some time between approximately 100 and 200 weeks after starting the kinetic tests, the pH of the effluents reaches a minimum, and thereafter the pH becomes steady or increases slightly (becomes less acidic) (PolyMet 2015q, Attachment F Update on Tailings Humidity Cell Test Data). These long-term weathering tests demonstrate empirically that the NorthMet tailings would oxidize without ever producing acidic leachate. The GoldSim model used to estimate solute release from tailings does not include a prediction of specific pH over time in the tailings effluent. However, the concentration caps of some metals were simulated as being dependent on pH. Thus, the GoldSim model for the tailings incorporates an estimated range for pH, but not a temporal trend. Based on the measured pH in multi-year weathering tests on tailings (and also results from tests on Category 1 waste rock, which also contains <0.12% sulfide S), and incorporating a small correction for the possibility that CO_2 pressure may be higher in the tailings than in the atmosphere, the PolyMet tailings effluent over the long-term (i.e., 50-100 years, and beyond) should range between pH values of ~7.1 and 7.7, and the general trend should be for pH values to increase from the low end to the high end of this pH range with increasing time (PolyMet 2015q, Figure 8-18 Modeled Category 1 Waste Rock pH).

Finally, acid base accounting and humidity cell tests were also conducted on the existing LTVSMC tailings, which would underlie the NorthMet Project Proposed Action tailings. These were produced from a separate deposit and contain enough carbonate minerals to be net-neutralizing, so they have a low risk of producing acidic leachate. Concentrations of specific carbonate minerals in the LTVSMC tailings, based on X-ray diffraction analyses on 16 samples, included from 0.1 to 1 percent calcite ($CaCO_3$), from 2 to 7 percent ankerite ($Ca(Fe^{2+},Mg,Mn)(CO_3)_2$), between 2 and 8 percent siderite ($FeCO_3$; Table 5-1 in SRK 2007c).

Leachate from humidity cell tests produced stable pH (between 7.3 and 8.1) and stable release rates for the primary constituents of concern, which were used as the basis of predicting solute release under field conditions (PolyMet 2015q, Attachment F). The LTVSMC tailings have been in place for years, so the model estimates for effluent release from the LTVSMC tailings are constrained by measured solute concentrations in the receiving waters (e.g., wells GW-001 and GW-012 for release to the north, GW-006 for release to the northwest, and GW-007 for release to the west; Figure 4.2.2-16). The initial model extrapolation of laboratory constituent-release rates measured on LTVSMC tailings overestimated the concentrations of sulfate and several other constituents relative to field measurements, even when the release rates were adjusted for scale factors (primarily oxygen concentration in pore gas, and temperature; PolyMet 2015q). This discrepancy was rectified in part by applying an empirical "correction factor," which reduced the modeled sulfate release from the LTVSMC tailings by factors of approximately 2 to 3 (see Figures 10-4 and 10-5 in PolyMet 2015q). Even after reducing sulfate release rates to match observed concentrations downgradient of the Tailings Basin, the water quality model overestimated the concentrations of several solutes, including many metals. In response, the LTVSMC tailings model was further adjusted by applying empirical "calibration factors" to all remaining constituents that were also overestimated relative to observed concentrations. These calibration factors (listed in PolyMet 2015j, Attachment B, Table 1-21) reduced the concentration of 11 constituents by greater than 90 percent relative to the uncorrected model estimates, including reduction by greater than 99 percent the predicted concentration of seven constituents. The fact that measured solute release rates need to be corrected down an order of magnitude for the model to match observed constituent concentrations in down-gradient waters suggests that there are additional attenuation effects that are not completely accounted for in the NorthMet water quality model.

Pathways within the tailings, from the surface and through the unsaturated and saturated tailings areas, were estimated using groundwater flow models, and these pathways were used to route the solutes released by oxidation in the tailings.

Contaminant Release from the Tailings Basin

GoldSim is programmed with algorithms for estimating the release of solutes from the tailings sources areas. For the NorthMet Project Proposed Action, a groundwater and surface water containment system would be constructed at the beginning of operations along the northern, northwestern, western, and portions of the eastern perimeters of the Tailings Basin to intercept affected water seeping from the facility. The physical and material characteristics of each source area are summarized in Table 5.2.2-17. In GoldSim, the overall Tailings Basin is divided into sub-areas that are described in Table 5.2.2-18. For each sub-area, the contaminant release is associated with a particular material including different types of LTVSMC tailings and NorthMet tailings. The release rate in each sub-area is based on characteristics of the underlying material and the rate of atmospheric oxygen diffusion into the tailings. The proposed bentonite amendments to surface material during operations and closure are intended to reduce oxygen diffusion into the sub-surface and thereby decrease contaminant release rates from the underlying materials. Using the GoldSim model for existing conditions, the contaminant release parameters for LTVSMC tailings were calibrated to measured water quality in current tailings seepage and groundwater. For the future NorthMet tailings, contaminant release parameters are based on a combination of laboratory tests and water quality observations at similar tailings facilities in northern Minnesota. The time-varying chemistry of the tailings pond water is computed during the GoldSim simulation based on evaporation and mixing of rainwater, stormwater runoff, and NorthMet Project Proposed Action-related water transfers to and from the other mining facilities.

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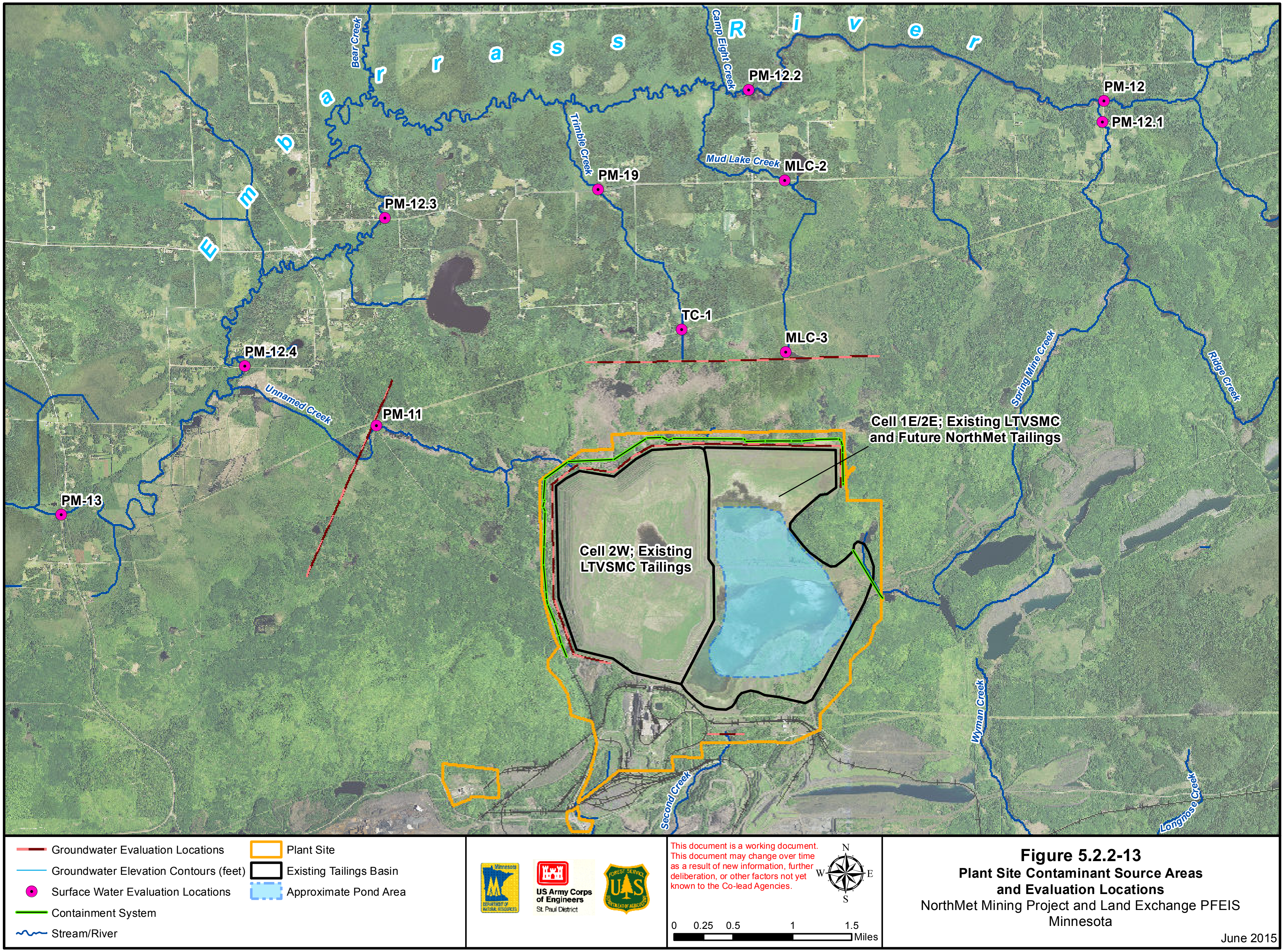

Figure 5.2.2-13
Plant Site Contaminant Source Areas and Evaluation Locations
NorthMet Mining Project and Land Exchange PFEIS
Minnesota
June 2015

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Table 5.2.2-17 General Description and Solute-Release Mechanisms of the Existing LTVSMC Tailings Facilities

Facility	Engineered Features	Chemical Mechanisms
2W	Existing LTVSMC Tailings Basin; would not be used for NorthMet Project Proposed Action. Soil surface has natural vegetation to reduce infiltration. Containment system would collect groundwater and surface seepage.	Sulfide oxidation and associated release of sulfate and metals.
1E/2E	Existing LTVSMC Tailings Basin that would receive new NorthMet tailings generated by NorthMet Project Proposed Action. Containment system would collect groundwater and surface seepage. During operations, new dams built on top of 1E/2E would be amended with bentonite. During closure, surface soils would be amended with bentonite and vegetated to reduce infiltration and oxygen entry.	Sulfide oxidation and associated release of sulfate and metals.
Pond	During closure, pond bottom would be amended with bentonite to reduce seepage.	Seepage of pond water and its associated water quality and dissolved oxygen.

Source: PolyMet 2015i.

Table 5.2.2-18 Tailings Basin Solute Source Sub-areas used in GoldSim for Closure

Source Area	Tailings Basin Sub-area	Tailings Material Assumed to Control Solute Release	Bentonite-Amended	Area (acre)	Recharge[1] (in/yr)	Bottom Seepage[6] (gpm)	Basis for Solute Release Calculations
1E/2E	North Dam banks (outer slopes)	LTVSMC bulk (other)	Operations and closure	249.0	6.07	78.1	Calibration[2]
	East Dam banks (outer slopes)	LTVSMC bulk (other)	Operations and closure	40.0	6.07	12.5	Calibration[2]
	South Dam banks (outer slopes)	LTVSMC bulk (other)	Operations and closure	91.0	6.07	28.5	Calibration[2]
	North Beach	35% NorthMet fine, 65% NorthMet coarse	Closure Only	90.2	6.07	28.3	Lab/other sites[3]
	East Beach	35% NorthMet fine, 65% NorthMet coarse	Closure Only	45.6	6.07	14.3	Lab/other sites[3]
	South Beach	35% NorthMet fine, 65% NorthMet coarse	Closure Only	103.1	6.07	32.3	Lab/other sites[3]
	Closure Beach	35% NorthMet fine, 65% NorthMet coarse	Closure Only	188.6	6.07	59.2	Lab/other sites[3]
	1E coarse	LTVSMC coarse	None	3.4	4.32	0.8	Calibration[2]
	1E fine[5]	LTVSMC fine	NA	NA	NA	NA	NA
	2E coarse[5]	LTVSMC coarse	NA	NA	NA	NA	NA

Source Area	Tailings Basin Sub-area	Tailings Material Assumed to Control Solute Release	Bentonite-Amended	Area (acre)	Recharge[1] (in/yr)	Bottom Seepage[6] (gpm)	Basis for Solute Release Calculations
	2E fine[5]	LTVSMC fine	NA	NA	NA	NA	NA
	2E banks	LTVSMC coarse	None	75.3	6.06	23.5	Calibration[2]
	North Buttress banks	Category 1 waste rock	None	115.0	13.24	78.7	Lab / other sites[3]
Pond	Pond	NA	Closure (after 30 years)	905.3	6.50[7]	304.0	Computed[4]
2W	2W coarse	LTVSMC coarse	None	220.1	17.53	199.1	Calibration[2]
	2W fine	LTVSMC fine	None	748.1	17.63	681.0	Calibration[2]
	2W banks	LTVSMC coarse	None	339.2	9.10	159.3	Calibration[2]
	South Buttress banks	Category 1 waste rock	None	15.0	13.27	10.3	Lab/other sites[3]
Total				**3,229**		**1,710**	

Source: PolyMet 2015i; PolyMet 2015q.

[1] Net infiltration of meteoric water. Based on a percentage of P50 annual rainfall (27.82 in/yr).
[2] Calibrated to water quality of existing affected seepage and groundwater.
[3] Laboratory humidity cell tests and water quality at similar mine sites.
[4] Pond contaminant concentrations computed during GoldSim simulation.
[5] Does not exist in closure.
[6] Bottom seepage assumed equal to recharge multiplied by associated area.
[7] Design specification.

Contaminant Transport from the Tailings Basin

At the Plant Site, most groundwater flow occurs in surficial deposits that constitute a surficial aquifer of about 7 meter saturated thickness. Below the surficial deposits is a low-permeability fractured bedrock, mainly the Giants Range batholith. Groundwater flow rates in the bedrock are much lower than in the overlying surficial deposits. As at the Mine Site, it is assumed that most of the contaminants released, travel in the same direction at the same rate of flow as surficial groundwater flow (accounting for some dispersion) and ultimately emerging in Downgradient surface water. Groundwater flow rates and flow directions in the model were taken directly from the MODFLOW results, or were programmed to be consistent with the MODFLOW results. Unlike at the Mine Site, however, PolyMet proposes to install a containment system along the northern, northwestern, and western perimeters of the Tailings Basin, and at the proposed dam along a portion of the eastern side of the Tailings Basin. This containment system would intercept the seepage migrating away from the Tailings Basin toe via surficial deposits and shallow bedrock. See Figure 5.2.2-14 and Figure 5.2.2-15. The south-side containment system capture efficiency would be improved.

Design and performance modeling of the containment system predict that it would achieve complete capture of approaching seepage-affected groundwater moving via the surficial aquifer and upper bedrock (PolyMet 2015i). In GoldSim, the containment system is conservatively assumed to be 90 percent efficient in the model, which means that 10 percent of the approaching groundwater bypasses the system and continues to migrate toward the Embarrass River. This affected groundwater migrates in the flowpaths to the north, northwest, and west, and concentrations change progressively as the groundwater approaches downgradient evaluation locations. The affected groundwater ultimately reaches and emerges directly into the Embarrass River (West Flowpath) or into its tributaries (Northwest and North flowpaths). Performance modeling has indicated that the proposed systems would provide complete capture of bedrock groundwater to depths of 100 ft below the top of bedrock. Containment systems are assumed to capture 100 percent of tailings surface seepage, which consists of toe seepage and groundwater that upwells to ground surface between the Tailings Basin and the containment system.

Detailed descriptions of the assumptions and algorithms used to estimate solute release from the Tailings Basin are provided in the Waste Characterization Data Package (PolyMet 2015q).

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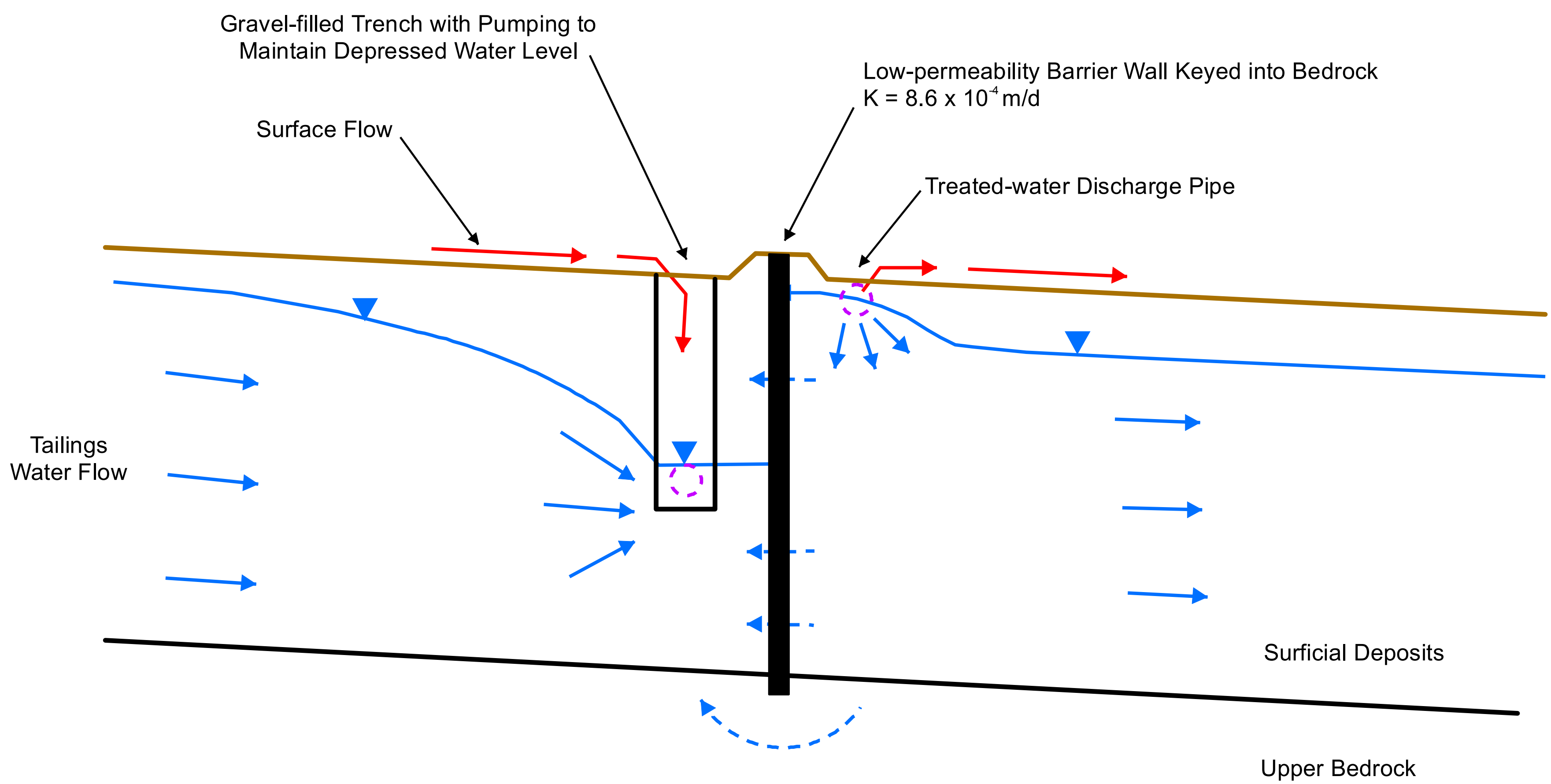

Not to Scale

Groundwater Flow
Very low Groundwater Flow
Surface Water Flow
Water Return Pipe

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Figure 5.2.2-14
North/Northwest and West Tailings Basin Containment System Diagram
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Minnesota

June 2015

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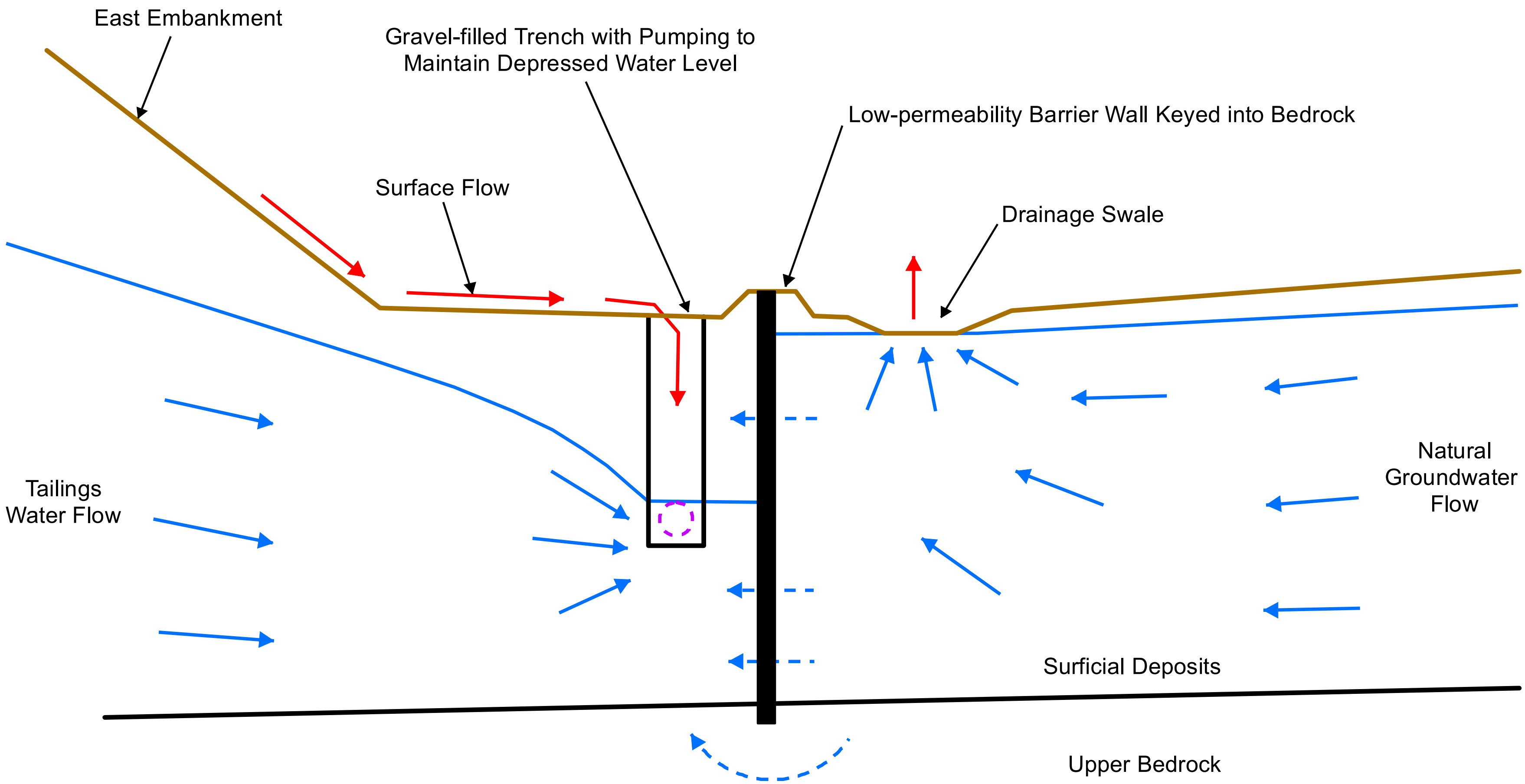

Not to Scale

- Groundwater Flow
- Very low Groundwater Flow
- Surface Water Flow
- Water Return Pipe

US Army Corps of Engineers
St. Paul District

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Figure 5.2.2-15
East Side Tailings Basin Containment System Diagram
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June 2015

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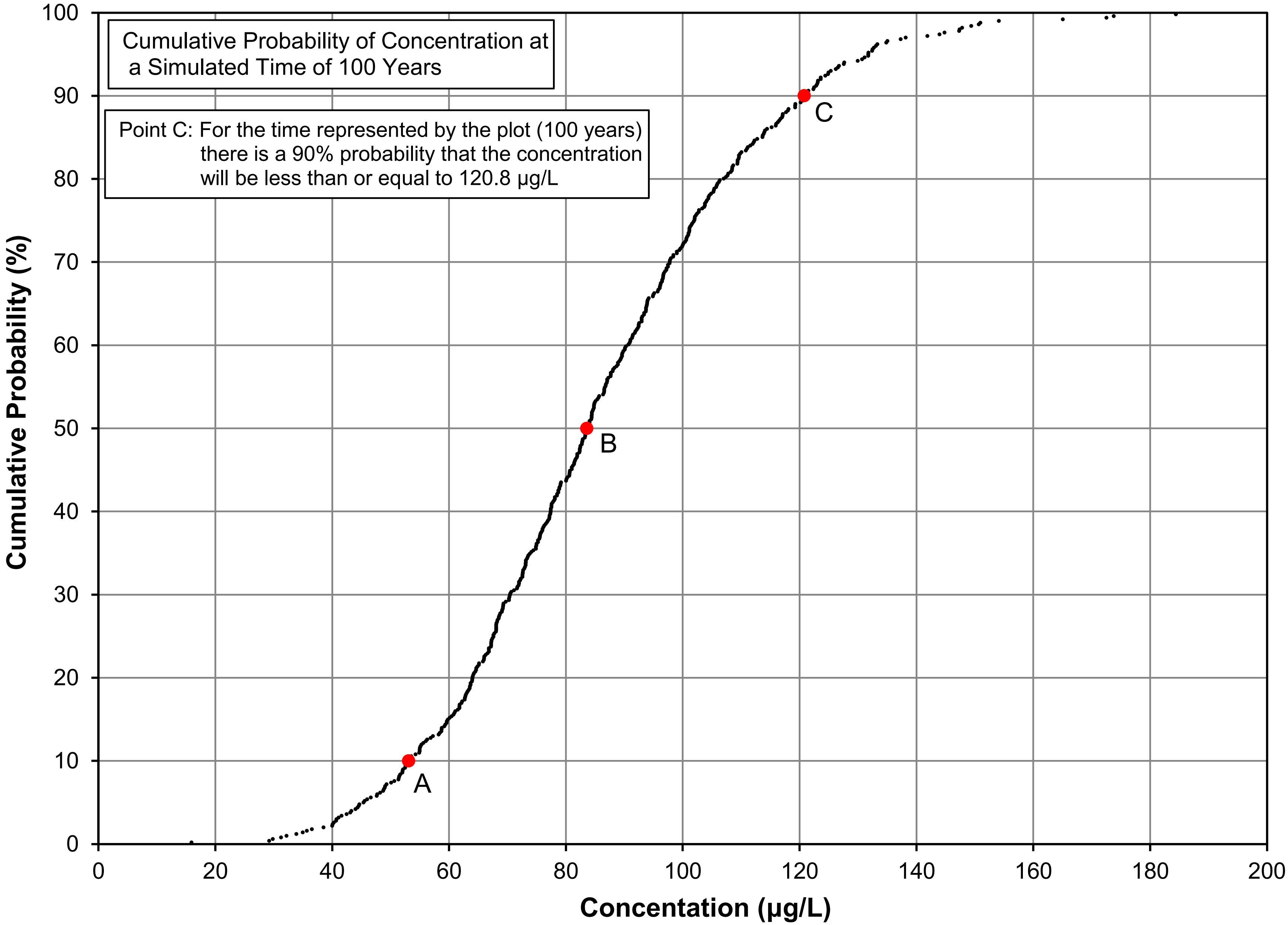

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Figure 5.2.2-16
Cumulative Probability of Concentration at a Simulated Time
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Minnesota

June 2015

1434 -Page Intentionally Left Blank-

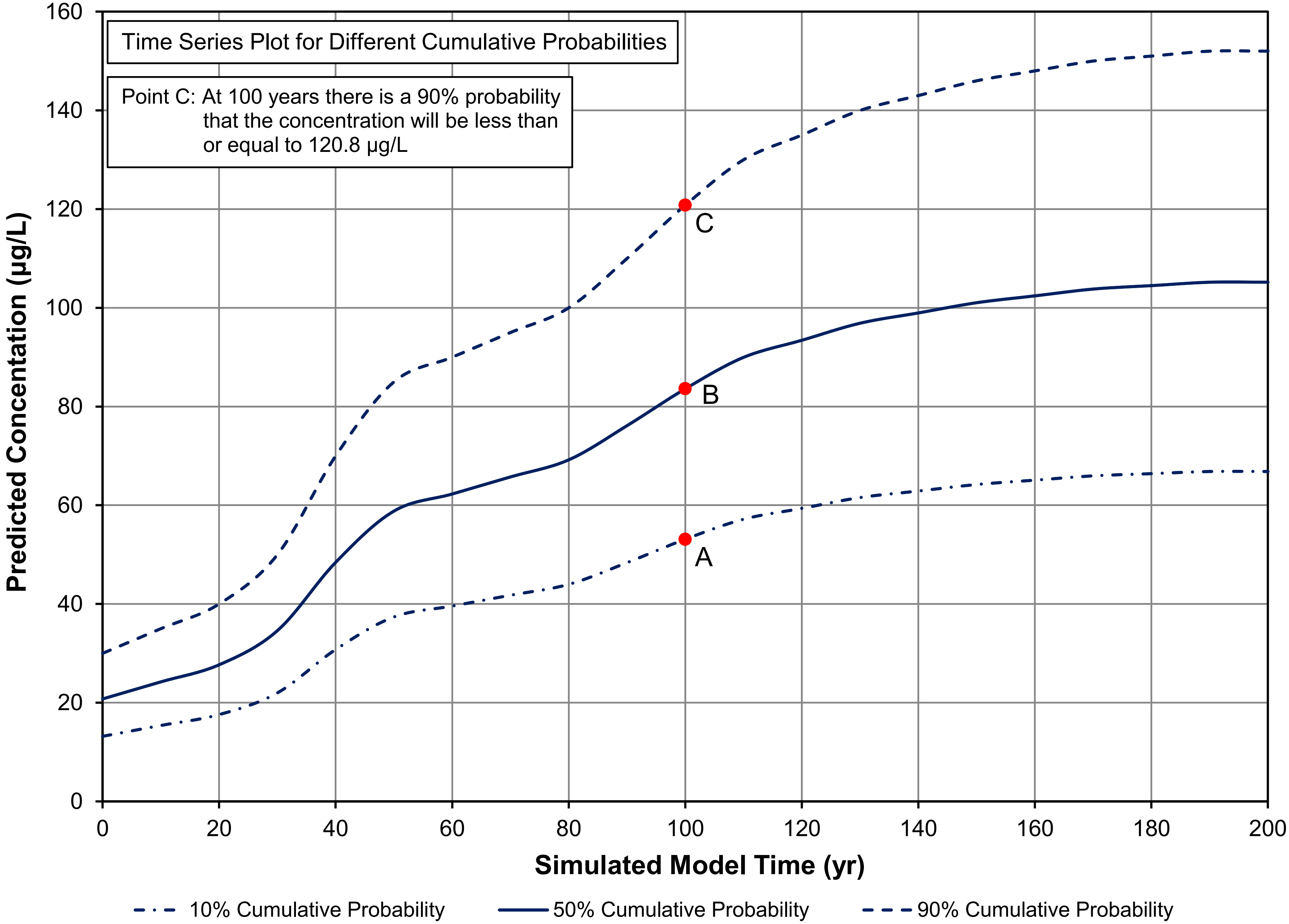

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Figure 5.2.2-17
Time Series Plot for Different Cumulative Probabilities
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Minnesota

June 2015

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GoldSim Model Operations and Output

Within the GoldSim program are utilities for performing probabilistic simulations addressing the uncertainty of inputs. For this method, selected “uncertain” inputs are entered into the program as cumulative probability functions rather than single fixed values. The probability functions are selected considering the variability of measured data, professional judgment, or both. Figure 5.2.2-18 is an example of the cumulative probability function of a hypothetical input. Point A on the figure indicates that there is a 10 percent probability that the true input value is less than or equal to 14. Point B (median) indicates a 50 percent probability that the true input is less than or equal to 22, and Point C indicates a 90 percent probability that the true input is less than or equal to 30.3. At the beginning of a model run, GoldSim selects a random probability number between zero and 100 percent for each uncertain input and uses the associated cumulative probability distribution to determine the numerical input value. If for example, the program-selected random probability is 38.1 percent, the input value for the hypothetical input on Figure 5.2.2-18 would be 20.3 (Point D). For some inputs, such as annual rainfall, the random sampling is performed at the beginning of each simulation year as the program progresses through time. With the resulting suite of inputs, a single transient model run is performed (referred to as a “realization”) and the results are saved. The process of statistical sampling is then repeated using new, randomly selected input values and the next realization is run.

The GoldSim model uses a Monte Carlo simulation approach, where the model is run 500 times, with each of the 500 realizations based on a unique suite of statistically sampled inputs. At the end of the Monte Carlo simulation, the multiple model run results are compiled for each monthly timestep. Consider, for example, a model estimate of contaminant concentration at a particular evaluation location at month 1,200 (year 100). The GoldSim model will provide 500 numerical values for this result, one for each realization. This suite of resulting values is ordered and used to construct a cumulative frequency plot (see Figure 5.2.2-15), which is interpreted in a manner similar to the input plots. The contents of Figure 5.2.2-15, for example, show that there is a 90 percent probability that the concentration at year 100 would be less than or equal to 120.8 (Point C). For results that change over time, a convenient way to present the probabilistic results is to prepare a time-series plot showing the 10, 50, and 90 percent probability results, as shown on Figure 5.2.2-16. Consider point C on the 90 percent probability line on this plot. At a simulation time of 100 years, the value on the curve is 120.8, indicating a 90 percent probability that the true result would be less than or equal to 120.8, which is consistent with Point C on the 100-year frequency plot shown on Figure 5.2.2-15.

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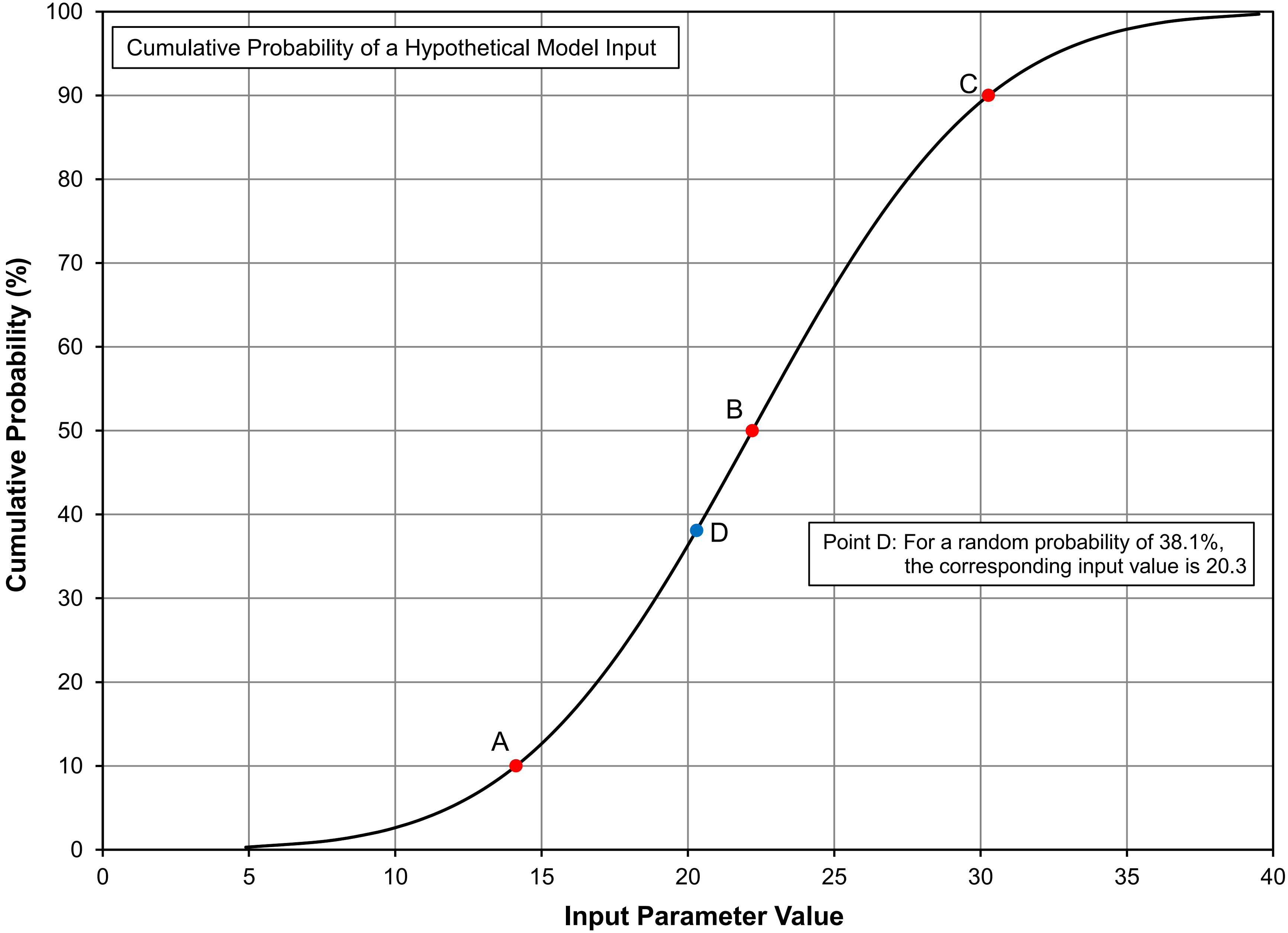

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Figure 5.2.2-18
Cumulative Probability of a Hypothetical Model Input
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Minnesota

June 2015

1474 -Page Intentionally Left Blank-

Application of Evaluation Criteria to Probabilistic Modeling Results

PolyMet used the GoldSim probabilistic model to estimate potential effects from the NorthMet Project Proposed Action on groundwater and surface water quality including whether a water quality evaluation criterion is likely to be exceeded. Surface water and groundwater evaluation locations are points or lines on the landscape at which GoldSim generates model results that are compared to applicable water quality evaluation criteria. These were identified during the preparation of the FEIS to provide decisions-makers and the public with a discrete point from which impacts can be understood and evaluated. The evaluation criteria are a basic and essential component of this water resources impact assessment and were geographically located for the purpose of environmental review.

For each constituent at each evaluation location, GoldSim produces 500 predictions (or realizations) of concentrations and orders them to generate a cumulative frequency distribution. The 90^{th} percentile value of the distribution is referred to as the P90 concentration. The 50^{th} percentile is the P50 concentration and the 10^{th} percentile is the P10 concentration. The P90 annual maximum for a mine year is the highest P90 value over the 12 monthly timesteps that comprise that year. The maximum P90 concentration for the simulation is the highest P90 value for all of the mine years (200 years at the Mine Site and 500 years at the Plant Site). For non-hardness based evaluation criteria, the modeling results are screened for further analysis by comparing the maximum P90 concentration against the criterion value. If the maximum P90 concentration is less than the evaluation criterion, it is concluded that the constituent would not cause an impact of concern at the evaluation location over the entire simulated time period and no further assessment occurs. If the maximum P90 concentration is greater than the evaluation criterion, it is retained for further evaluation. While the P50 concentration is considered the best-estimate, the maximum P90 concentrations provides assurance that the FEIS is not underestimating potential water quality impacts from the NorthMet Project Proposed Action.

To further illustrate how the probabilistic modeling results are used in the FEIS, consider the example of where the predicted maximum P90 concentration of a solute is exactly equal to the evaluation criterion. In this case there is a minimum 90 percent probability that the actual concentration would be below the criterion over the entire model simulation. This threshold, however, does not imply and is not equivalent to saying that water quality criteria would be exceeded 10 percent of the time.

As an example of the screening process, consider cobalt at Partridge River station SW-004a. Cobalt is a useful screening example, because it is expected to be released from Mine Site contaminant sources at predicted concentrations significantly higher than background concentrations already occurring in natural groundwater and surface water. Figure 5.2.2-19 is a plot of predicted P10, P50, and P90 annual maximum cobalt concentrations at SW-004a. In this FEIS, a constituent is concluded to not have a severe impact if its P90 concentrations are less than its associated water quality evaluation criterion. As shown on Figure 5.2.2-19, the P90 plot of annual maximum cobalt concentrations for all years is about 3 µg/L, which is lower than the water quality evaluation criterion of 5 mg/L, so cobalt would be predicted to not have a significant impact at this evaluation location. A closer inspection of the GoldSim output indicates that the maximum P90 cobalt concentration of all mine years (2,400 timesteps) is 3.11 µg/L as shown on the plot. The screening process would conclude that cobalt at SW-004a would not be retained for further evaluation.

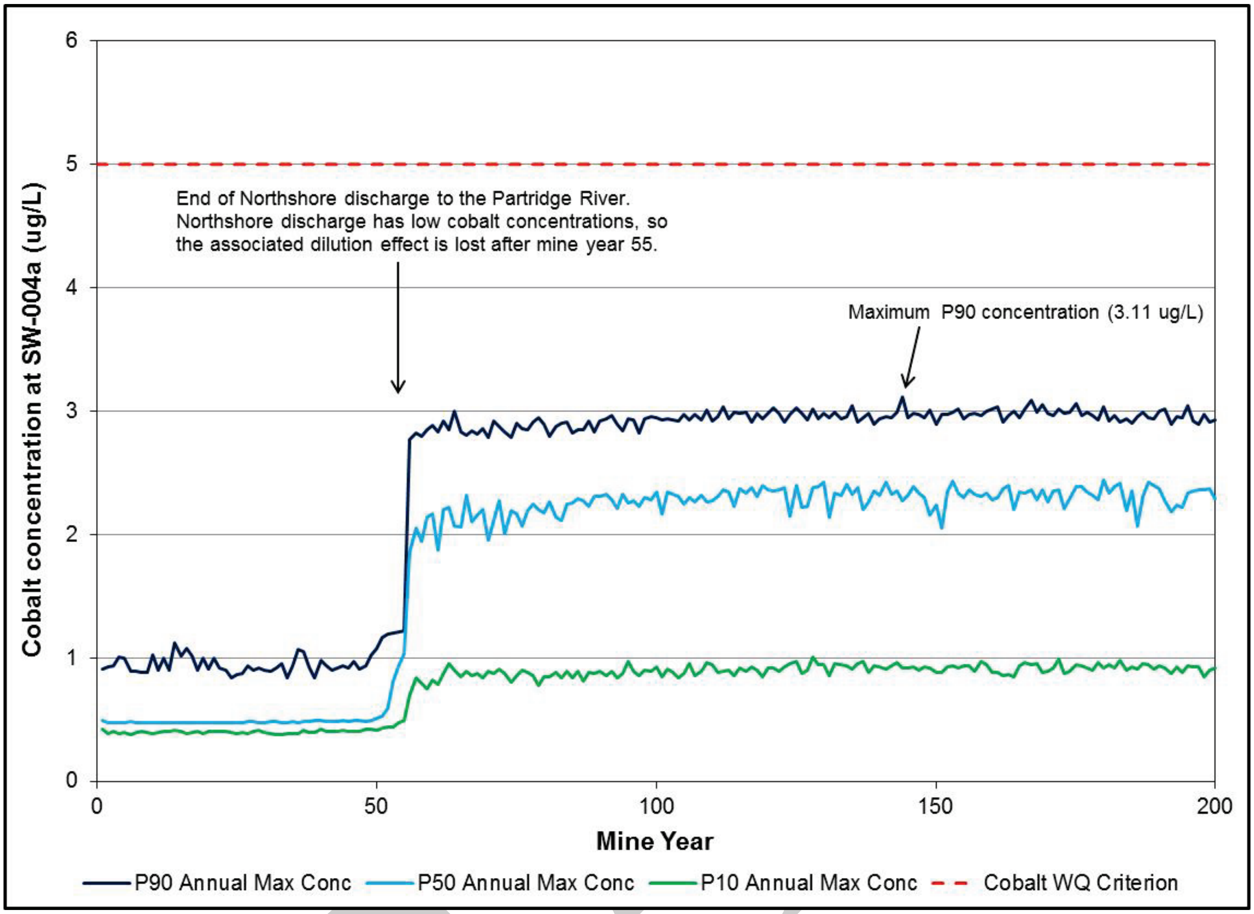


Figure 5.2.2-19 GoldSim-predicted Annual Maximum Cobalt Concentrations at SW-004a

The P90 threshold was adopted in another mining NEPA document where probabilistic modeling was used (Idaho Cobalt Project [USFS 2009b]). Regarding the selection of the maximum P90 threshold for initial screening, the Co-lead Agencies retain the flexibility to consider other modeling analyses and screening approaches for evaluating the significance of a particular modeled impact.

For the purposes of screening review, the first year of model data were excluded when calculating maximum P10, P50, and P90 values. Solute concentrations between model cells can take several timesteps to stabilize from the input initial conditions, and the predicted concentrations for these initial timesteps may be unreliable and not representative of the expected conditions. To avoid including these numerical artifacts in the screening analysis, the first twelve timesteps of the model data (mine year 1) were not used to generate the maximum P90 concentrations used for screening.

The use of the P90 criterion for determining whether or not evaluation criteria are being met is not equivalent to how water quality-based effluent limits (WQBELs) would be developed for NPDES permitting. Appropriate WQBELs would be derived based on water quality standards and implemented in the permit. Discharges would be evaluated during the NPDES permitting stage and WQBELs applied according to 40 CFR 122.44(d).

Surface water chemical constituents with hardness-based evaluation criteria include cadmium, chromium III, copper, lead, nickel, and zinc. The screening of these constituents requires special considerations because hardness, and the associated evaluation criterion, could change from monthly timestep to timestep during a model realization and also for the same timestep between different realizations. It was therefore not possible to develop a single evaluation criterion to which the GoldSim-predicted solute concentrations could be compared. The approach to screening was therefore based on evaluating the frequency of occurrence of an exceedance for each timestep that computed a solute concentration and hardness value, the latter dictating the solute evaluation criterion for that timestep only. At the end of the GoldSim simulation, each timestep would have 500 solute concentrations to compare to 500 evaluation criteria (one pair for comparison for each realization). The total number of exceedances for the timestep was divided by 500 and converted to a percent to determine the exceedance probability for that time step. For each model year, the exceedance probability for the 12 associated (monthly) timesteps was averaged and that was taken as the annual average exceedance probability for that mine year.

As an example, Figure 5.2.2-20, shows a plot of the annual average exceedance probability for lead at Plant Site evaluation location TC-1 (red line). Also shown (in blue) is a line representing the probability of the NorthMet Project Proposed Action exceeding a criterion while the CEC scenario does not exceed. If the highest value on this second curve is less than 5 percent, it was concluded that the constituent at that location would not require further discussion and it was not considered further in the FEIS. If the maximum value was greater than 5 percent, the constituent at that location was retained for further evaluation. This includes an additional narrative that evaluates the characteristics of the exceedances including the differences between NorthMet Project Proposed Action and CEC scenario concentrations, the conservativeness of model assumptions leading to the prediction of exceedances, and possible mitigation measures that can be considered to reduce the frequency of exceedances. If the constituent is not retained for further evaluation, then it is not discussed further in this FEIS and the quantification of impacts provided in tables was determined to be sufficient for purposes of environmental review.

For the example shown on Figure 5.2.2-20, the maximum annual probability is 3.9 percent, so the constituent and location (in this case, lead at TC-1) would not be evaluated further. Note that for the example shown, the annual probabilities of the NorthMet Project Proposed Action exceeding when CEC does not (blue line) is visually very similar to the NorthMet Project Proposed Action exceedance probabilities (red line) for each mine year meaning that, in this case, the small probability of exceedances (less than 5 percent) is attributable to the NorthMet Project Proposed Action and not to background, therefore further discussion is not provided.

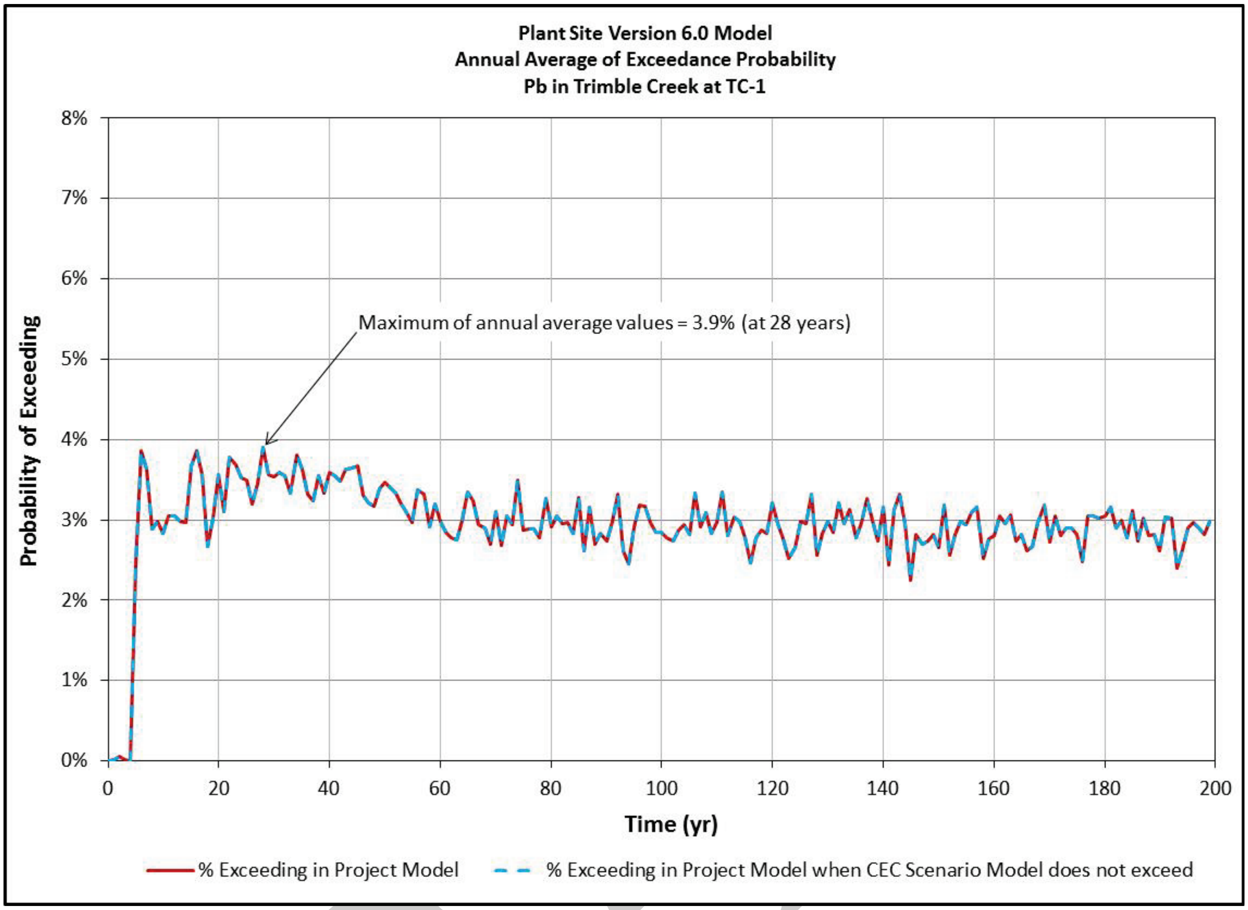


Figure 5.2.2-20 Example of Exceedance Probability Plot for a Constituent with a Hardness-Based Evaluation Criterion

Hardness-dependent evaluation criteria are affected month by month by the modeled concentration of hardness. Therefore, the FEIS uses the frequency of exceedance approach described in Section 5.2.2.2.3 for screening of surface water constituents with hardness-based criteria.

A 5 percent screening threshold was selected because in the judgment of the Co-Lead Agencies, it is sufficiently conservative for purposes of identifying cases where additional discussion is necessary to understand potential environmental effects. The 5 percent threshold is equivalent to the NorthMet Project Proposed Action exceeding a criterion at a given evaluation location when CEC scenario does not one month out of every twenty.

If the frequency of exceedance is greater than 5 percent, the constituent is retained for further evaluation in the FEIS. This includes an additional narrative that evaluates the characteristics of the exceedances including the differences between NorthMet Project Proposed Action and CEC scenario concentrations, the conservativeness of model assumptions leading to the prediction of exceedances, and possible mitigation measures that can be considered to reduce the frequency of exceedances. If the constituent is not retained for further evaluation, then it is not discussed further in this FEIS and the quantification of impacts provided in tables was determined to be sufficient for purposes of environmental review.

CEC Scenario

The overall analysis of NorthMet Project Proposed Action effects on water quality also takes into consideration the extent to which predicted water quality for the NorthMet Project Proposed Action compares with modeled existing conditions. There are some processes, however, that most water quality models, including the one used for the FEIS, do not fully capture, which limits the ability to simply compare the predicted effects of the NorthMet Project Proposed Action from water quality models with existing water quality for some constituents. These include sulfate reduction between the LTVSMC Tailings Basin and the Embarrass River and site-specific redox reactions (see Section 4.2.2.3.2 for more discussion of sulfate reduction in the Embarrass River Watershed). For this reason, a CEC scenario was modeled within GoldSim.

The CEC scenario draws from the same existing condition hydrologic and water quality dataset in GoldSim that was used for modeling the NorthMet Project Proposed Action, but does not introduce any NorthMet mine features or activities. Otherwise, both scenarios were modeled the same way, using 500 Monte Carlo simulations for the same model durations and the results were displayed in the same probabilistic manner.

This CEC scenario model was intended to represent conditions in the absence of the NorthMet Project Proposed Action and also in the absence of future activities that may improve water quality under the Consent Decree between the MCPA and Cliffs Erie. The one exception is ending Northshore discharge to the Partridge River in mine year 55, which is included in both the NorthMet Project Proposed Action and CEC scenarios for the assessment of cumulative effects. Modeling both scenarios in the same way allows for a direct comparison of predicted water quality model results and facilitates an assessment of the extent to which implementation of the NorthMet Project Proposed Action would result in changes in existing water quality.

Note, however, that this modeled CEC scenario is not the same as the No Action Alternative, the impacts of which are described in Section 5.2.2.4. The CEC scenario assumes one change in baseline conditions The only modeled source of constituent loading to the groundwater or surface water that does not represent background sources is the Peter Mitchell Pit discharge to the Partridge River, which is assumed to stop in approximately 2070 because it is expected to occur. Other than this change the CEC scenario model does not include future expected additional mitigation such as water quality mitigation at the existing LTVSMC Tailings Basin, because these measures have not yet been determined Nor does it try to account for climate change. The No Action Alternative, on the other hand, is not static and anticipates for other predictable changes in the NorthMet Project Proposed Action area, such as other planned projects, required mitigation, and climate change.

<u>Comparison of NorthMet Project Proposed Action with the CEC Scenario</u>

The analysis of the model results that follows (see Section 5.2.2.3) compares predicted solute concentrations for both the NorthMet Project Proposed Action and CEC scenario to applicable groundwater and surface water evaluation criteria. These comparisons are made at each of the Mine Site and Plant Site groundwater and surface water evaluation locations (a combined total of eight groundwater and 18 surface water evaluation locations) using the GoldSim P90 probabilistic results.

5.2.2.3 NorthMet Project Proposed Action

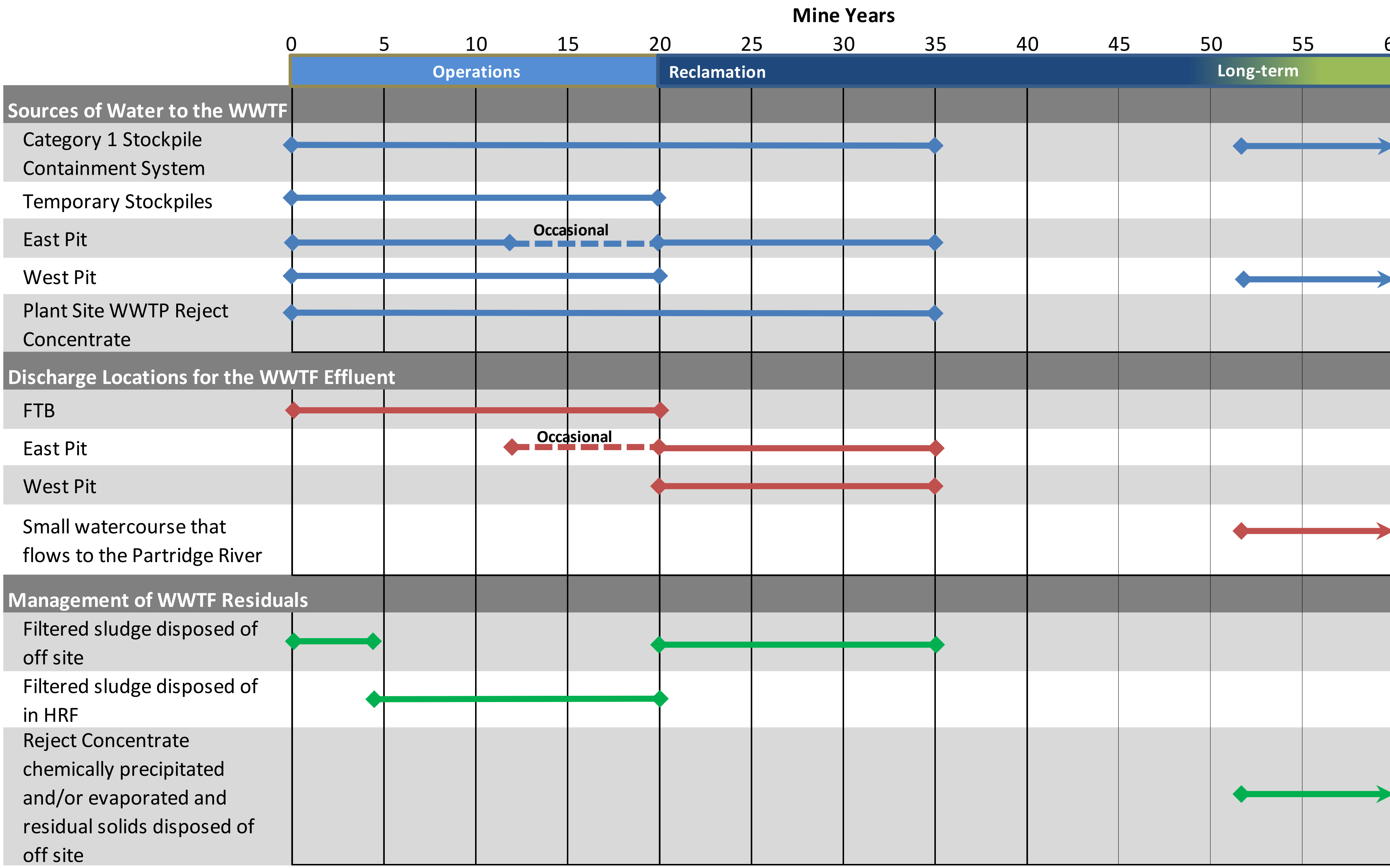
This section discusses the potential environmental consequences of the NorthMet Project Proposed Action on groundwater and surface water levels and quality at both the Mine Site and Plant Site (Tailings Basin) and the Transportation and Utility Corridor. Figure 5.2.2-21 and 5.2.2-22 illustrate Plant Site and Mine Site water management timelines.

5.2.2.3.1 NorthMet Project Proposed Action Water Budget Overview

This section briefly describes the water budget under the NorthMet Project Proposed Action at the Mine Site and Plant Site. Under the NorthMet Project Proposed Action, the following water sources would have to be managed:

- Stormwater runoff on mine facilities (e.g., waste rock stockpiles, mine pits, Tailings Basin);
- Seepage from mine facilities into groundwater and surface water;
- Pit lakes and saturated pit backfill, which include groundwater entering the mine pits;
- Process plant makeup water withdrawn from Colby Lake;
- Stream augmentation water from the Plant Site's WWTP;
- Discharge of excess water from the WWTF and WWTP;
- Transport and use of excess Mine Site water for process makeup at the Plant Site; and
- Transport and use of excess Plant Site Water to accelerate re-flooding of the West Pit at the Mine Site.

An overall water process flow diagram, shown on Figures 5.2.2-10 and 5.2.2.12, illustrates the principle NorthMet Project Proposed Action components and their relationship to surface water and groundwater resources.



Note: Actual start and end years are variable due to uncertainties and variability in the water and chemical balances. Dates shown are approximate and represent average estimates.

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This document is a working document. This document may change over time as a result of new information, further deliberation, or other factors not yet known to the Co-lead Agencies.

Figure 5.2.2-21
Mine Site Water Management Timeline
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

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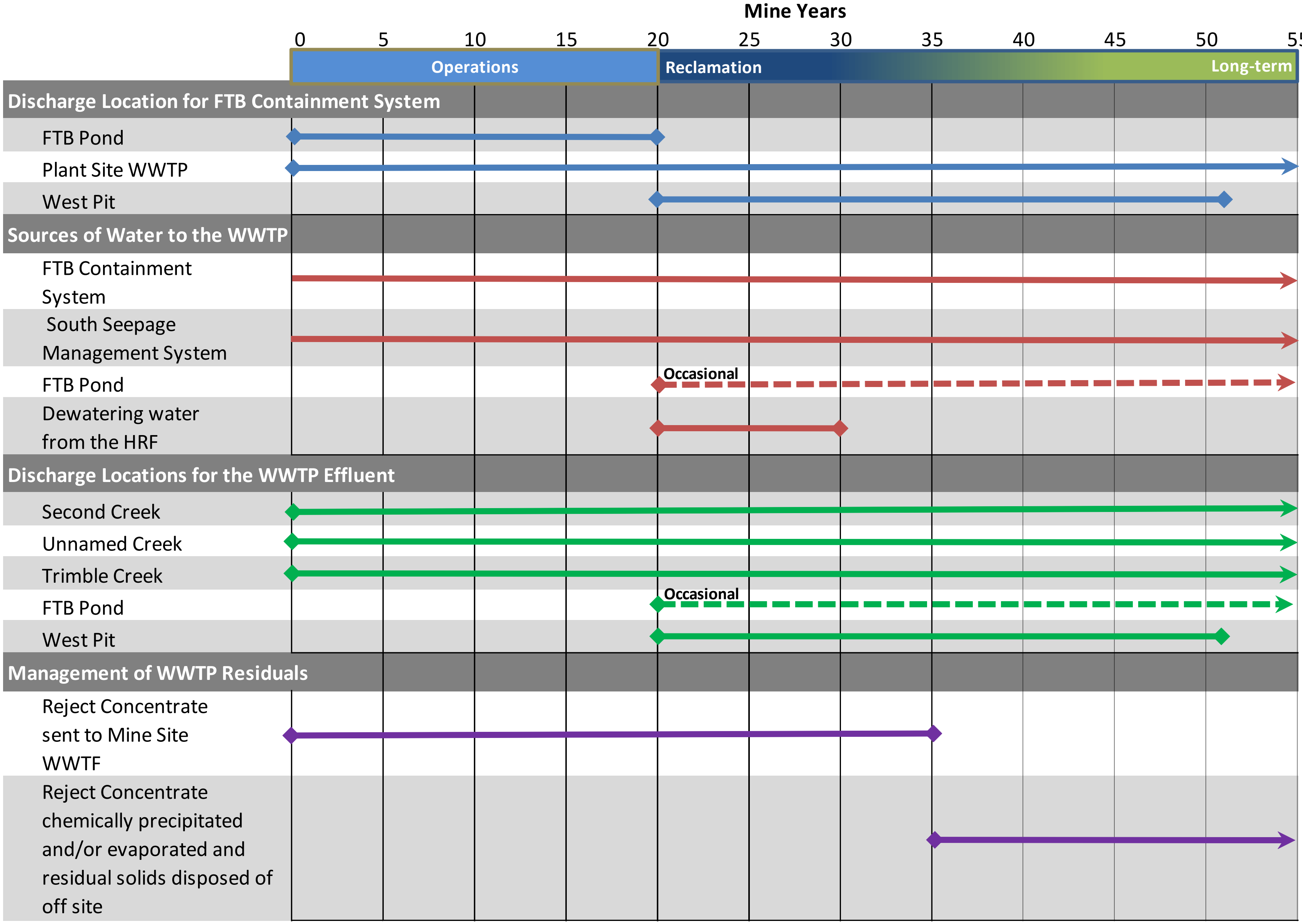

Note: Actual start and end years are variable due to uncertainties and variability in the water and chemical balances. Dates shown are approximate.

This document is a working document. This document may change over time as a result of new information, further deliberation, or other factors not yet known to the Co-lead Agencies.

Figure 5.2.2-22
Plant Site Water Management Timeline with Mechanical Treatment
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

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Operations (Year 0 to 20)

Mine Site

During operations, the West Pit (years 0-20), Central Pit (years 12-16) and East Pit (years 0-11) would be dewatered due to pit inflows from groundwater. A process water pipeline would carry this water to the WWTF West Equalization Basin. Temporary liners, underdrains and ditches associated with the Category 2/3 Stockpile, Category 4 Stockpile, Ore Surge Pile, would capture surface runoff and groundwater seepage and convey this contact water to lined ponds. Process water pipelines would carry this water to the WWTF West Equalization Basin. The Category 1 Stockpile containment system, Rail Transfer Hopper pond liners and Haul Road pond liner would capture contact water which would be directed to the WWTF East Equalization Basin.

Initial construction activity involving wetland dewatering (effluent management) would be addressed by construction stormwater management during permitting. Surface runoff from the Overburden Storage and Laydown Area would drain to a process water pond. Pond water quality and operational demands would determine if it is piped to the Central Pumping Station, to the Tailings Basin or to the East Pit during filling.

Interior ditches, exclusion dikes (including perimeter and rim pit dikes) would be used to manage non-contact stormwater and prevent contact with mine wastes. Five sedimentation ponds would be used to reduce total suspended solids and allow for controlled discharge off site. Runoff from the covered Category 1 Stockpile would be managed as stormwater and discharged of site via a sedimentation pond. The geomembrane cover construction would begin at mine year 14 and be complete by mine year 21.

Groundwater seepage through lined and unlined mine features would begin migrating toward the Partridge River.

A chemical precipitation WWTF would treat process water from the West and East equalization ponds. Effluent would flow to the clay-lined Central Pumping Station Pond where it would be blended with Overburden Storage and Laydown Area runoff. The Central Pumping Station would then pump the treated water to the Tailings Basin or to the East Pit during filling (after mine year 11). No water would be discharged off site.

Filtered sludge from the chemical precipitation process would be sent off site for disposal or stored at the Hydrometallurgical Residue Facility. The reject concentrate stream from the Plant Site WWTP would be transported to the WWTF via rail tank cars where it would be added to the West Equalization Basin.

Beginning in year 11, after East Pit mining would be completed, the pit would be backfilled with Category 2/3 and 4 waste rock from the temporary waste rock stockpiles and from ongoing operations. The East Pit backfill would re-saturate with groundwater, in-pit runoff, direct precipitation, and treated process water from the WWTF, to limit the oxidation of the sulfide minerals in the pit walls and backfilled waste rock, and reduce the amount of metals leaching to the pit water. Water would be maintained within 5 ft of the backfill surface (PolyMet 2015d). During periods of high precipitation or during spring snowmelt, partial dewatering of the East Pit (to the WWTF and ultimately to the Tailings Basin) may be required to allow placement of the waste rock.

Once backfilling of the East Pit is complete, the backfill would continue to saturate and the pore water would be sent to the WWTF for treatment and returned to the pit to improve the pore water quality. When the backfill water level rises above the top of bedrock (approximately mine year 20), it would release into the East Pit – Category 2/3 Surficial Flowpath. The affected groundwater in this flowpath would migrate slowly towards the Partridge River.

The pipeline between the WWTF and the East Pit would be left in place during and after backfill re-saturation to manage the water elevation in the East Pit.

Plant Site

During operations, the primary source of process water at the Plant Site would be the Tailings Basin ponds, which would contain return water from the beneficiation plant, treated water from the Mine Site WWTF and Plant Site WWTP, and water collected from the Tailings Basin containment system. Colby Lake water would also be withdrawn. Direct precipitation and stormwater runoff from the process areas at the Plant Site would also be directed to the Tailings Basin pond. Tailings Basin pond water would be sent to the WWTP for treatment and discharged to surface water for operational needs as necessary. The purpose of the WWTP would be to treat water for discharge to the environment when the NorthMet Project Proposed Action has excess water that could not be stored in the Tailings Basin pond. The WWTP would include an RO unit or equivalent technology that would meet water quality targets. Containment systems would be installed across the western, northwestern, northern, and eastern sides of the Tailings Basin to collect water leaving the Tailings Basin as surface and surficial groundwater flow. During operations, this water would be returned to the Tailings Basin pond for re-use. A small portion of groundwater would bypass the containment system and enter into groundwater flowpath. Groundwater would then emerge in surface waters north, northwest and west of the Tailings Basin. On the southern side of the Tailings Basin, an existing seepage containment system would be upgraded by PolyMet to achieve 100 percent capture of tailings surface and groundwater seepage that otherwise would flow into Second Creek, a tributary of the Partridge River. Improvements to capture efficiency of the existing dam may include lining the upstream dam face with bentonite and injecting grout into the dam. A second dam could be constructed approximately 500 ft downstream of the existing dam where the geography is more constricted. This potential second dam may be earthen with a clay or concrete cutoff wall extending to bedrock.

The Tailings Basin containment systems would reduce flows to tributaries that extend from the Tailings Basin. Flow would be increased through augmentation. A portion of the water collected by the containment system and water from the Tailings Basin pond would be sent to the WWTP, treated, and discharged to Unnamed Creek, Trimble Creek, and Second Creek in order to maintain downstream hydrology and wetland function. Mud Lake Creek would be augmented via a drainage swale on the eastern side of the Tailings Basin. Augmentation would restore flow to ± 20 percent of existing or uncaptured flows to maintain existing hydrology, geomorphology, aquatic communities, connectivity, water quality, and biology (Chisholm 2006).

Tailings Basin pond elevation would be controlled by pumping any excess pond water to the WWTP. An emergency overflow channel would be constructed as a backup means of controlling pond elevation, but discharge from the emergency overflow would not be expected. The emergency overflow is provided for protection of the dams in the rare event that freeboard within the Tailings Basin is not sufficient to contain all stormwater. Such instances have the potential to occur in the event of a probable maximum precipitation rainfall event or some fraction thereof. Probable maximum precipitation rainfall events are rare and such an event has a low likelihood of being experienced during the life of the basin.

Colby Lake water would be pumped to the Hydrometallurgical Plant and to the WWTP. Wet hydrometallurgical residue would be pumped to the Hydrometallurgical Reside Facility. Leakage from the Hydrometallurgical Residue Facility would be collected by the leakage collection component of the double-liner system and returned to the Hydrometallurgical Residue Facility flotation pond and from there it would be returned to the Hydrometallurgical Plant.

Reject concentrate from the WWTP RO system would be sent to the Mine Site WWTF for treatment by chemical precipitation.

Reclamation (Starting Year 21)

Mine Site

The backfilled East Pit would continue to saturate and the pore water would be sent to the WWTF for treatment and returned to the pit to improve the pore water quality. A wetland would be established at the surface of the pit and water levels would be maintained by a gravity overflow structure to the West Pit.

West Pit reclamation would commence when mining activity ceases. Primary dewatering systems would no longer be operated, and the West Pit would begin to flood naturally with groundwater, precipitation, and surface runoff from the tributary watershed. Flooding would be accelerated by delivery of treated water from both the Mine Site WWTF and the Plant Site WWTP. Seepage through the Category 1 Stockpile containment system would also contribute water to the West Pit. With the addition of water pumped from the Plant Site, West Pit flooding is projected to be completed before the end of mine year 55. When the West Pit water level rises above the top of bedrock, there would be a release of pit lake water into the West Pit Surficial Flowpath. The affected groundwater in this flowpath would migrate slowly south towards the Partridge River.

Temporary stockpiles and unnecessary haul roads would be removed along with their associated process water ponds. The WWTF would also receive low flow rates from the Category 1 Stockpile surface and groundwater seepage containment system.

Reject concentrate from the Plant Site WWTP RO system would be treated at the Mine Site WWTF and the resulting filtered sludge would be taken off site for disposal.

Plant Site

Plant Site reclamation would include building and structure demolition and equipment removal, Tailings Basin reclamation, and Hydrometallurgical Residue Facility reclamation.

During Tailings Basin reclamation, the pond bottom and beaches would be covered with a bentonite layer to reduce the downward percolation from the pond, which would reduce the amount of water collected by the Tailings Basin containment system.. Most of the side slopes and top (non-ponded) surfaces of the Tailings Basin would be amended with bentonite to reduce meteoric infiltration and oxygen diffusion into the tailings, with the intent of reducing sulfide oxidation and associated release of soluble sulfate and metals. Tailings Basin cell 2W would be re-vegetated to reduce meteoric infiltration (PolyMet 2015d).

Water management would include maintenance of the pond and wetland within the reclaimed Tailings Basin, stormwater management, and continued operation of the WWTP and the containment systems. A wetland would be constructed on the pond perimeter.

After bentonite amendment of tailings surfaces, establishment of the wetland, and continued water treatment, the tailings pond water quality would improve over time. The pond and wetland would continue to lose water via seepage, but at a reduced rate as compared to operations. The reject concentrate stream from the WWTP would be sent to a distillation crystallizer to generate a solid residual that would be transported offsite for disposal.

Containment systems would continue to operate, although seepage rates would be progressively reduced. The collected seepage would be pumped to the WWTP. During this period, the WWTP effluent would be used for both West Pit flooding and stream augmentation (PolyMet 2015a).

The WWTP and the containment system would be periodically inspected to ensure continuing integrity. Monitoring of piezometers or other similar devices would continue for the purpose of assessing the continued effectiveness of the containment system and to inform appropriate mitigation and/or permitting of any potential release of seepage that may bypass the containment system. The NPDES/SDS permit covering the facility would prohibit a point source water discharge from the containment system that adds pollutants to waters of the U.S.

Reclamation of the Hydrometallurgical Residue Facility would include removal of ponded water from the cell surface, removal of pore water from the residue, construction of the cell cover system, and establishment of vegetation and stormwater runoff controls. Once the Hydrometallurgical Residue Facility is reclaimed, the volume of water draining from the facility would decline and nearly cease if the cover system were effective. The facility would only require periodic pumping of any remaining drainage to the WWTP and inspection of the reclaimed cell to verify integrity of the reclamation systems.

Closure and Post-Closure Maintenance (after Reclamation is Complete)

Mine Site

During this phase, the WWTF would be converted to a Reverse Osmosis (RO) system with a distillation crystallizer to eliminate the liquid reject stream. The moist waste solids from this system would be disposed of offsite. Pilot-testing has indicated that treated effluent from this system would have sulfate concentrations less than 9 mg/L and meet water quality discharge standards for all other regulated solutes (Barr 2013f). Effluent from the WWTF RO system would be discharged to the West Pit Overflow Creek shown on Figure 5.2.2-23.

Water levels in the East Pit would generally be controlled by passive wetland overflow to the West Pit. Depending on seasonal weather conditions, there could be occasional pumped flows from the wetland to the WWTF or of treated effluent from the WWTF to the wetland to further control the water levels (PolyMet 2015d). In any event, saturated backfill in the East Pit would continue to release groundwater to the East Pit – Category 2/3 Surficial Flowpath.

After refill, the West Pit water level would be controlled by pumping to the WWTF to prevent surface water overflow from the pit lake. However, release of pit lake water to the West Pit

Surficial Flowpath would continue. The WWTF would also receive low flow rates from the Category 1 Stockpile groundwater containment that would then be discharged to the West Pit Overflow Creek shown on Figure 5.2.2-23.

Perimeter dikes that would be no longer needed to provide access or separation from the areas outside the Mine Site would be removed. The dike located north of the East Pit would remain in place to minimize mixing of the Partridge River flows with the East Pit water and prevent gully development on the northern side of the pit in the segments not protected by ditches (see Figure 5.2.2-23). In addition, the dike located north of the Category 1 Stockpile would remain in place to allow access to groundwater monitoring locations. The Category 1 Stockpile would be inspected on a regular basis and portions of the geomembrane liner and soil cover would be replaced if necessary.

Surface runoff would be routed away from the mine pits using a combination of existing and new ditches (see Figure 5.2.2-23). Some portions of the pit rim dikes may be left in place, if needed to prevent an uncontrolled flow to or from the pits and potential erosion of the pits walls. A more detailed evaluation of this requirement would be conducted prior to mine closure.

Stormwater pond outlet control structures would remain in place as necessary to manage water resource effects. The outlet control structure on the stormwater pond located immediately north of the East Pit and the Category 1 Stockpile would remain in place to minimize the mixing of the Partridge River flows with the East Pit water and prevent gully development on the northern side of the pit. The outlet control structures on the two stormwater ponds next to Dunka Road would remain in place to direct water under the road and the railroad to a tributary to the Partridge River along natural drainage paths. As a requirement of the NPDES/SDS stormwater permit and/or Reclamation Plan for the facility, discharges from these outlet control structures would be monitored as necessary to ensure that stormwater runoff to the Partridge River would meet water quality discharge limits. For modeling purposes, it is assumed that the water quality of this stormwater runoff is the same as the non-contact water for other portions of the watershed.

The WWTF would continue to operate during closure and long-term maintenance, treating excess water from the West Pit and discharging the effluent to the West Pit Overflow Creek. The typical discharge rate from the WWTF is predicted to be about 300 gpm. The water balance model predicts periodic temporary higher treatment/discharge rates (up to about 600 gpm) to create additional freeboard prior to spring snowmelt. By pumping pit lake water to the WWTF, the pit water level would be managed to always provide sufficient freeboard to absorb extreme precipitation events without overflowing.

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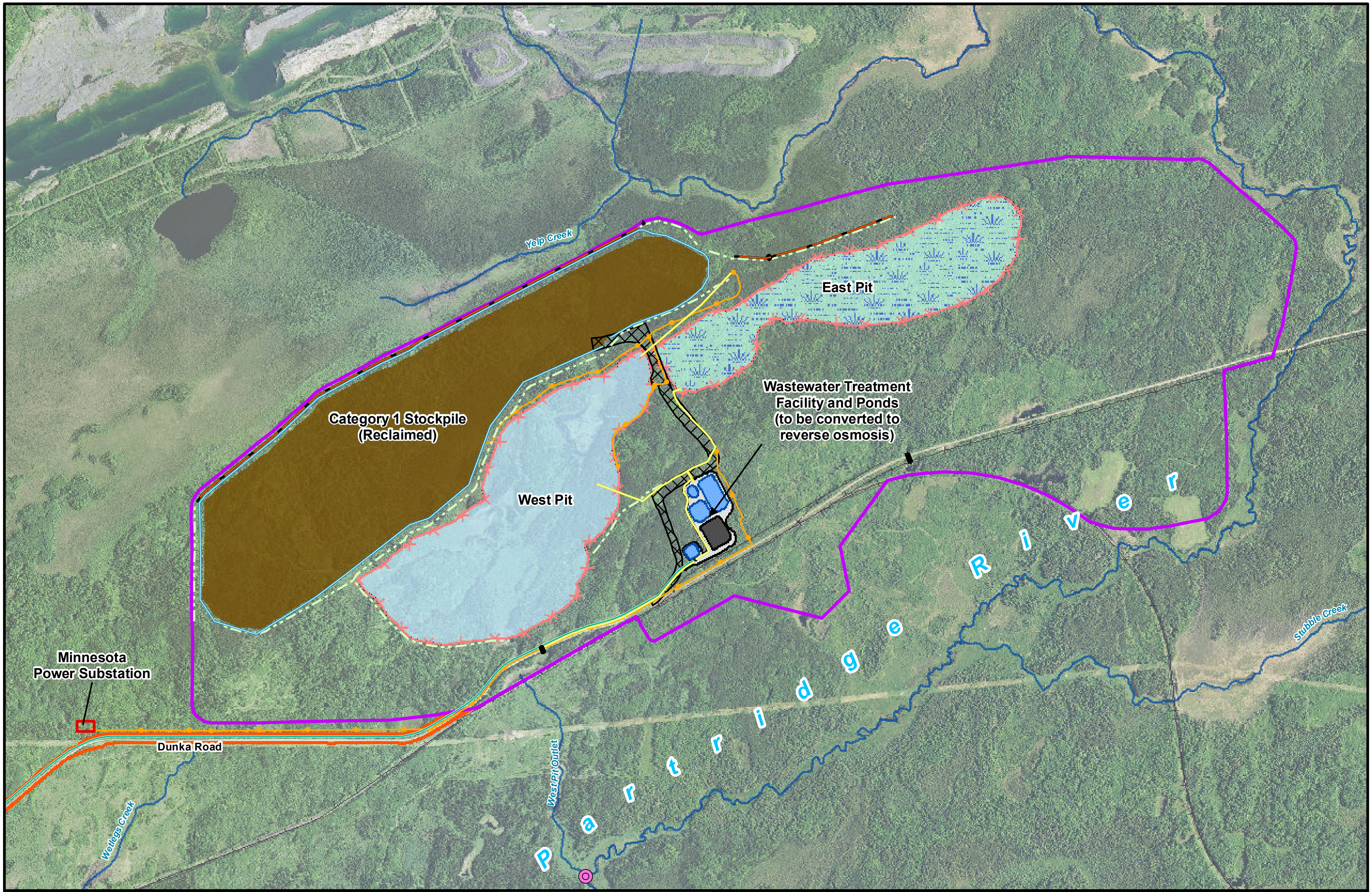

Mine Site
Pit with Backfill and Surface Wetland
Pit Lake
Covered in Previous Years
Haul Road
Transportation and Utility Corridor
Approximate location of WWTF Discharge to Partridge River
Groundwater Containment System
Transmission Line
Stormwater Collection Ditch
Perimeter Dike
Process Water Pipes
Treated Water Pipeline
Fence
Culvert
Stream/River

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St. Paul District

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Figure 5.2.2-23
Mine Site Plan - Long-term Closure
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

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Plant Site

At the beginning of closure, the WWTP RO system would be modified for multistage operation and use of the distillation crystallization unit to eliminate the liquid reject stream. The moist waste solids from this system would be disposed of off-site. Pilot-testing has indicated that treated effluent from this system would meet water quality discharge standards for all regulated constituents.

During closure and long-term maintenance, the WWTP would continue to treat water collected by the Tailings Basin containment systems. The treated effluent would be used for flow augmentation to Unnamed Creek, Trimble Creek, and Second Creek. (PolyMet 2015a). Tailings seepage bypassing the containment system (approximately 20 gpm) would continue to enter the northern, northwestern, and western surficial flowpaths, and migrate slowly toward the Embarrass River.

Closure and Post-Closure Maintenance Objectives

The ultimate water resource closure objective is to transition from the mechanical treatment provided by the WWTF and WWTP to non-mechanical treatment. Transition to the non-mechanical treatment systems would begin after the performance of the non-mechanical treatment methods have been proven. At the Mine Site, non-mechanical treatment systems would be considered for long-term treatment of water from the Category 1 Stockpile surface and groundwater seepage containment system and West Pit overflow. At the Plant Site, non-mechanical treatment would be considered for tailings seepage collected by the Tailings Basin containment systems. Descriptions of possible non-mechanical systems are presented in PolyMet 2015d. See section 5.2.2.3.5 for more information on the transition to non-mechanical systems.

Long-term monitoring of the Hydrometallurgical Residue Facility would continue. Water collected by the leak detection system (if any water) would be sent to the WWTP (for treatment. Monitoring would continue and mitigation measures would be undertaken if there was any indication of potential solute releases to groundwater or surface water.

Surface water and groundwater would be monitored as required by relevant permits. The closure and long-term maintenance activities would continue until monitoring indicated that the site water quality had met the stipulated permit conditions for discontinuing these activities.

5.2.2.3.2 Partridge River Watershed

This section discusses the potential environmental consequences of the NorthMet Project Proposed Action on groundwater and surface water hydrology and quality within the Partridge River Watershed, which includes all of the Mine Site, Transportation and Utility Corridor, processing plant and a small portion of the Tailings Basin that contributes flow via a surface seep to the headwaters of Second Creek, which is a tributary to the Partridge River.

<u>Effects on Groundwater Hydrology</u>

This section discusses the effects of the NorthMet Project Proposed Action on groundwater hydrology, specifically groundwater levels at the Mine Site. The NorthMet Project Proposed Action would not result in any measurable effects on groundwater levels along the

Transportation and Utility Corridor (other than as a result of the West Pit dewatering, which is discussed as part of the Mine Site) or at the processing plant.

The NorthMet Project Proposed Action would affect groundwater levels at the Mine Site during operations by dewatering the active mine pits and pumping water to the Plant Site (years 0 to 11) or to the East Pit and Tailings Basin (years 11 to 20). During years 20 to 52, water from the Plant Site would be pumped to the West Pit to accelerate flooding and help return groundwater levels to near pre-mining conditions.

Inflow to Mine Pits

The expected rate of groundwater inflow to the East Pit and West Pit during operations was estimated from MODFLOW modeling, similar to that performed for the DEIS. The model was updated in several ways, including the following:

- MODFLOW model was recalibrated using target groundwater baseflows of 0.41 cfs at SW-002, 0.51 cfs at SW-003, and 0.92 cfs at SW-004 to reflect revisions from the XP-SWMM model;
- Groundwater elevations at monitoring wells MW-1 through MW-18 were included as targets in the updated calibration;
- A new calibration constraint was for surficial aquifer heads not to be significantly higher than ground surface; and
- The model was calibrated using higher values of hydraulic conductivity for Virginia Formation.

These updated estimates of groundwater inflow rates to the pits were used to develop the overall water balance for the probabilistic model. Table 5.2.2-19 shows the MODFLOW-predicted inflows to the pit (years 1 to 20) as well as outflows during closure, once the pits have flooded (PolyMet 2015m).

Table 5.2.2-19 Groundwater Inflows at the Mine Pits Based on MODFLOW Results

Year	West Pit Inflow (gpm)	Central Pit Inflow (gpm)	East Pit Inflow (gpm)
1	0	0	220
2	60	0	190
3	40	0	210
4	30	0	250
5	30	0	450
6	50	0	430
7	40	0	420
8	40	0	460
9	30	0	690
10	30	0	710
11	80	30	760
12	50	20	760
13	50	10	700
14	40	10	710
15	40	10	710
16	40	10	570
17	40	10	380
18	40	10	270
19	40	10	170
20	40	10	40

	West Pit[1]		Combined East Central Pit[2]	
Closure and Long-term Maintenance	Inflow (gpm)	Outflow (gpm)	Inflow (gpm)	Outflow (gpm)
	30–40	10–20	30–40	20–50

Source: PolyMet 2015m.

[1] Open pit lake with water-surface elevation ranging from 1,576 to 1,585 ft amsl.
[2] Combine pits backfilled and re-saturated with water-level elevation ranging from 1,592 to 1,595 ft amsl.

Extent of Groundwater Drawdown

Understanding the extent of groundwater drawdown, especially in the surficial material surrounding the NorthMet Project Proposed Action mine pits, is important in order to assess the potential effects on nearby surface water features such as wetlands. However, the complex geology with the presence of bedrock, surficial deposits, and wetland soils at the Mine Site makes it difficult to accurately quantify drawdown at any specific location. Site characterization data and MODFLOW calibration results indicate that the bulk hydraulic conductivity of bedrock is much lower than the bulk hydraulic conductivity of surficial materials. As a consequence, the bedrock tends to be saturated and overlain by a thin surficial aquifer that controls the local groundwater flow system. In a dewatering situation, the lower-permeability bedrock tends to remain saturated because it is subject to downward leakage from the overlying higher-permeability surficial aquifer (as long as the surficial aquifer contains groundwater). Unsaturated conditions in bedrock may occur very close to the pit wall, but not at moderate or large distances from the pit. Blasting during the mining operation is controlled to maintain pit wall integrity for safety considerations. Fractures and impacts to hydraulic conductivity due to blasting would not be expected to extend more than a few tens of feet from the pit walls. Water table drawdown in the surficial aquifer near the mine pits would be limited because it would be subject to meteoric recharge and has a saturated thickness on the order of only 14 ft.

Monitoring well response to pit dewatering at the Canisteo Pit, located approximately 65 miles west of the NorthMet Project Proposed Action area in similar surficial geology, indicated significant aquifer heterogeneity. Modeling of aquifer response at the Canisteo site using MODFLOW resulted in differences between simulated and measured water levels ranging from +28 ft to -4 ft (Jones 2002). The model clearly could not accurately estimate water level changes of a few feet or less as would be desirable for assessing potential effects on nearby surface water features such as wetlands. Therefore, it was concluded that it was not reasonable to attempt to quantify drawdown at the Mine Site using the MODFLOW model.

In lieu of using MODFLOW to estimate pit drawdown at the Mine Site, an analog approach was developed using available well data from the Canisteo Pit, which is the only mine pit within the Mesabi Iron Range that has an associated water balance study with well data that could be used to assess potential drawdown effects. Sixteen Canisteo wells were used for the analog evaluation. An additional shallow well near Kinney, Minnesota, adjacent to Minntac's West Pit, and one deep bedrock well, also near Kinney, were also used for the evaluation. A comparison of the hydrogeologic conditions at the Canisteo Mine Pit, the Kinney area wells, and the Mine Site concluded that the geologic and hydrogeologic settings of the Mine Site are relatively similar to the Canisteo and Minntac sites (Barr 2011i).

The Canisteo Pit is not as deep as the proposed NorthMet mine pits. However, the surficial deposits at the Canisteo site ranges from 50 to 100 ft thick, while the surficial deposits at the Mine Site average only about 14 ft thick. Also, the underlying bedrock at the Canisteo site is composed exclusively of the Biwabik Iron Formation, which generally has a higher hydraulic conductivity than the Duluth Complex, Virginia Formation, and Giants Range Granite that underlie surficial deposits at the Mine Site. Despite the difference in pit depths, it is interpreted that there is potential for greater drawdown at the Canisteo site compared to the Mine Site. Overall, the Canisteo data are believed to provide a reasonably conservative estimate of the maximum extent of surficial aquifer drawdown that would result from the proposed PolyMet mine pits.

Water level data collected from monitoring wells over several years were used to characterize the aquifer's response to the changing Canisteo Pit water level, and response to the approaching, dewatered Minntac West Pit (ERM and MDNR 2011).

The following were conclusions of the analog study:

- Three wells within 700 ft of the Canisteo Pit showed a strong response to the rising pit water;
- Six wells within 900 to 2,625 ft of the Canisteo Pit showed a measurable, but weak, response to the rising pit water;
- Seven wells within 660 to 3,500 ft of the Canisteo Pit showed no response to the rising water;
- The deep bedrock well near Kinney showed an apparent, progressive water level drop when the dewatered Minntac West Pit approached within about 1,000 ft of the well; and
- The shallow well near Kinney did not show any measurable water level drop from June 2000 through March 2003 (when data collection stopped for safety reasons), during which time the dewatered Minntac West Pit had advanced to within 900 ft of the well.

Observations from the above discussed analog site show no clear, systematic relationship between the proximity of wells to mine pits and effects on groundwater levels.

Considering the analog site evaluation conclusions, the following guidelines for potentially measurable drawdown can be used at the Mine Site:

- 0 to 1,000 ft from the pit rim: groundwater drawdown from pit dewatering may occur and may be measurable;
- 1,000 to 1,700 ft from the pit rim: groundwater drawdown from pit dewatering may occur, but may be difficult to distinguish from natural variations in background water levels;
- 1,700 to 3,200-plus ft from the pit rim: groundwater drawdown from pit dewatering may occur, but would likely only occur under certain hydrogeologic conditions, and may not be discernible from natural variability; and
- Beyond 3,200 ft from the pit: no drawdown effects would be expected.

These guidelines are intended to help define zones of potential groundwater drawdown that could be used to estimate potential indirect effects on nearby surface water features and wetlands (see Section 5.2.3 for further discussion of this analog approach). They could also be used to design a monitoring program to quantify actual effects, which could trigger appropriate mitigation measures if warranted. Contingency mitigation options are discussed in the Water Management Plan for the Mine Site (PolyMet 2015m). These guidelines have been expanded considerably since the original analog study (see Section 5.2.3).

There are few surface waterbodies within the 0 to 1,000 ft or the 1,000 to 1,700 ft zones, where groundwater drawdown may occur and would potentially be distinguishable from natural variations that could be affected by pit drawdown. The West Pit Outlet Creek is located within these zones and would be affected by the WWTF discharge and other NorthMet Project Proposed Action activities, as well. Yelp Creek and the headwaters of the Partridge River are located to the north of the mine pits, but beyond the 0 to 1,000 ft zone. The proposed Category 1 Stockpile surface and groundwater seepage containment system, with its low-permeability cut-off wall keyed into bedrock, would minimize effects of pit drawdown on these waterbodies.

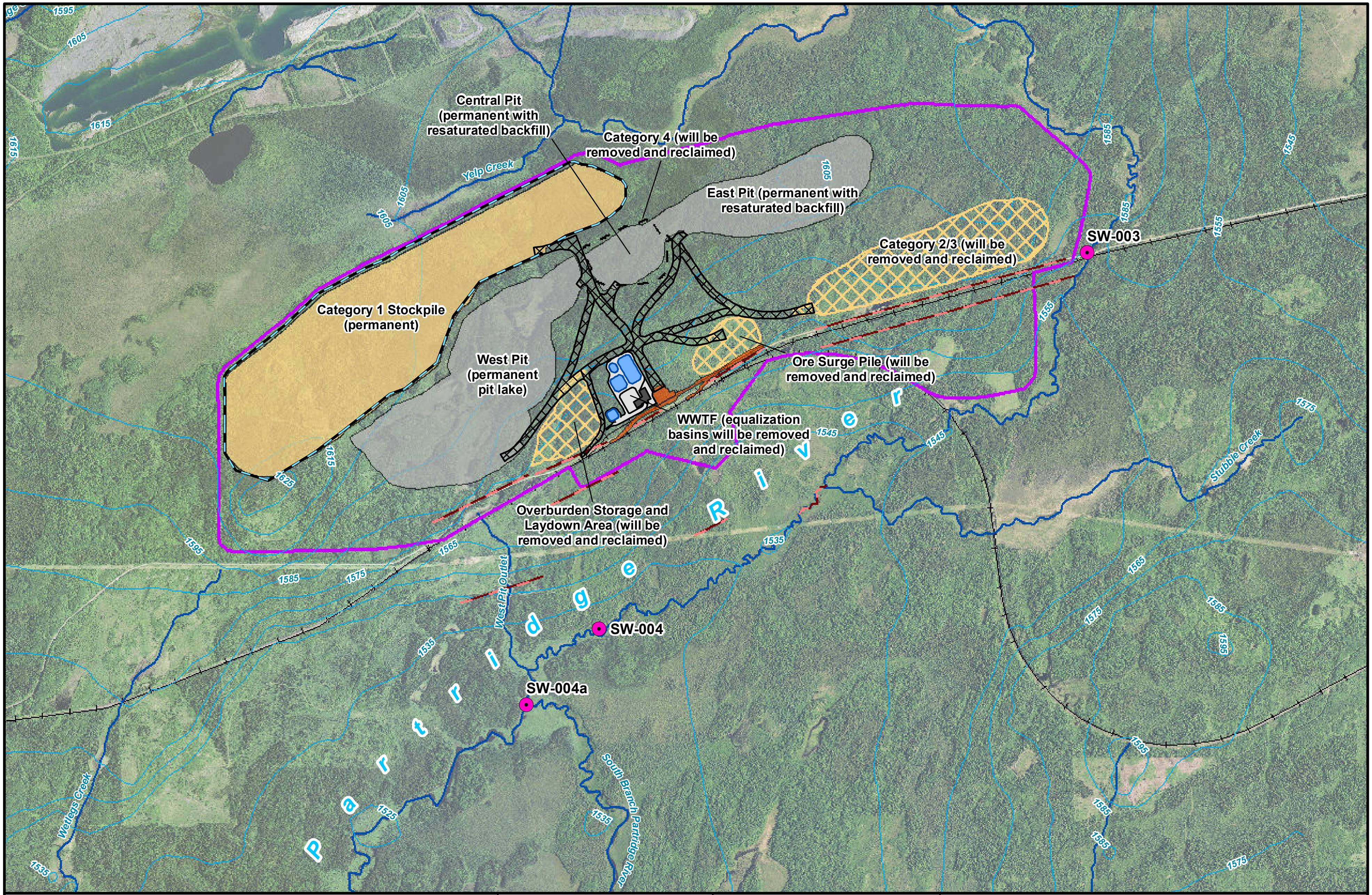
Note that these guidelines would apply during mine operations and reclamation, but groundwater drawdown associated with the mine pits should decline and essentially cease as the pits flood. The actual steady-state water level in the East Pit would be established by an outlet structure (invert at elevation 1,592 ft amsl) that would route surface overflows into the West Pit. The water level in the West Pit would be controlled by operation of the WWTF. Long-term change in on-site surficial aquifer groundwater levels (i.e., permanent drawdown) would be due to the fixing of head boundaries to lower surface water levels controlled by pumped discharge by the WWTF relative to existing conditions. There would be a permanent drawdown of a maximum of about 20 ft immediately surrounding the West Pit lake, resulting from a closure groundwater elevation of 1,579 ft versus existing groundwater elevation of approximately 1,600 ft, and about 10 ft immediately surrounding the East Pit, resulting from a closure groundwater elevation of 1,592 ft versus existing groundwater elevation of approximately 1,600 ft.

Effects on Groundwater Quality in the Surficial Aquifer

The NorthMet Project Proposed Action could affect groundwater quality at the Mine Site by leaching metals, sulfate, and other solutes from exposed waste rock, overburden, ore, WWTF ponds and unsubmerged part of pit walls. Water affected by those contaminants could enter groundwater system and migrate from mine facilities to the Partridge River.

Potential Sources of Groundwater Impacts and Proposed Engineered Controls

The potential sources of groundwater impacts from the NorthMet Project Proposed Action within the Partridge River Watershed include the waste rock stockpiles, the Overburden Storage and Laydown Area, the Ore Surge Pile, the WWTF, and the mine pits (see Figure 5.2.2-24). Each of these sources is briefly described below and key features are summarized in Table 5.2.2-20. Note that the Category 2/3 Stockpile, the Overburden Storage and Laydown Area, and the Ore Surge Pile, which are potential contaminant sources to groundwater, would only exist during mine operations and would cease to exist after approximately mine year 20. Another potential contaminant source, the WWTF equalization basins, would be removed at about mine year 55. Most seepage from the permanent Category 1 Stockpile would be captured. Uncaptured seepage would migrate to the West and East Pits, although a very small part of it would enter bedrock. The mine pits would remain permanently and potentially serve as long-term sources of contamination. The Category 4 Stockpile would exist until about year 11 and any seepage from this stockpile would migrate as surface water or groundwater to the East Pit where it would be collected as part of the pit dewatering system and pumped to the WWTF for treatment. After year 11, material in the Category 4 Stockpile would backfill the combined East Central Pit.



Groundwater Evaluation Locations
Surficial Aquifer Head Contour (m) at Closure
Groundwater Containment System
Surface Water Modeling/Monitoring Location
Stream/River
Mine Site
Haul Road
Mine Pit
Permanent Stockpile
Removed and Reclaimed Stockpile
Removed Stockpile

US Army Corps of Engineers
St. Paul District

This document is a working document. This document may change over time as a result of new information, further deliberation, or other factors not yet known to the Co-lead Agencies.

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Figure 5.2.2-24
Mine Site Potential Contaminant Source Areas
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

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Table 5.2.2-20 Mine Site Solute Source Areas used in GoldSim

Source Area	Active Source Period (mine years)	Engineered Features	Chemical Mechanisms
Category 1 Stockpile	0+	Geomembrane cover; perimeter surface and groundwater seepage containment system. Permanent mine feature.	Most solutes released from Category 1 Stockpile material at concentration caps. Seepage collected by containment system would be sent to the WWTF or the West Pit. Seepage not collected by containment system would migrate as groundwater to West and East Pits. A very small part of it would enter bedrock.
Category 2/3 Stockpile	0–20	Geomembrane underliner with seepage collection. Solid material would be sent to East Pit as backfill. Would be removed during reclamation.	Oxidation of Category 2/3 Stockpile material. Seepage collected above liner sent to WWTF. Seepage through liner would enter the underlying groundwater system.
Category 4 Stockpile	0–20	Geomembrane underliner with seepage collection. Solid material sent to East Pit as backfill. Would be removed during reclamation.	Oxidation of Category 4 Stockpile material. Seepage would migrate as groundwater to the East Pit.
West Pit	Pit lake: 20+ Flow to groundwater flowpaths: 48+[1]	Dewatered during mining, followed by flooding. Water level would reach top of bedrock at year 48. Maximum flooding would occur at about year 52, after which water level would be controlled by pumping to the WWTF.	Oxidation of wall rock prior to flooding. Would receive affected water from East Pit. Receives treated (or blended) water from Plant Site WWTP during flooding period (20-52 years). Would receive treated water from Mine Site WWTF. Beginning in year 48, the West Pit water level would rise above the top of bedrock and begin to release pit lake water into the West Pit surficial groundwater flowpath.
East Pit	Flow to groundwater flowpath: 20+[1] Flow to West Pit: 21+[1]	Would merge with the Central Pit. Dewatered during mining. All Category 2, 3, and 4 waste rock, and some Category 1 waste rock, would be used as backfill. Water level in saturated backfill would reach top of bedrock at year 20. Maximum refill would occur at year 21, after which water level in saturated backfill would be controlled by overflow through a wetland to the West Pit.	Oxidation of wall rock prior to backfill saturation. Solute release from unsaturated and saturated backfill. Beginning in year 20, the water level in the East Pit saturated backfill would rise above the top of bedrock and begin release of pit water into the East Pit Cat 2/3 Surficial (groundwater) Flowpath. The East Pit would reach maximum refill at about year 21.
Overburden Storage and Laydown Area	0–20	Unlined facility, but with collection system for surface runoff. Would be removed during reclamation.	Leaching of overburden materials. Seepage would enter underlying groundwater system.

Source Area	Active Source Period (mine years)	Engineered Features	Chemical Mechanisms
WWTF Basins	0–33	Precipitation/filtration treatment plant using equalization basins with leak detection system and geomembrane underliners. Would be removed during reclamation when water treatment plant converted to RO at year 33.	Receives water from West Pit (including East Pit overflow), Category 1 Stockpile, Category 2/3 Stockpile, Overburden Storage and Laydown Area, and Ore Surge Pile. Would receive reject concentrate from Plant Site WWTP. Seepage collected from leak detection system (if any) would be sent to WWTF. Seepage through underliner would enter the underlying groundwater system.
Ore Surge Pile	0–21	Geomembrane underliner with seepage detection. Would be removed during reclamation.	Oxidation of ore. Seepage collected from leak detection system (if any) would be sent to WWTF. Seepage through underliner would enter the underlying groundwater system.

Source: PolyMet 2015d.

[1] Based on deterministic GoldSim run with P50 inputs.

All of these potential contaminant sources would be located at the Mine Site. The only potential contaminant sources along the Transportation and Utility Corridor or at the processing plant (both within the Partridge River Watershed) would be from spills, as there would be no surface stockpiles of waste rock, ore, or other potential solute sources in these areas. As mentioned previously, the South seep from the Tailings Basin at the headwaters of Second Creek is currently, and would continue to be, collected and pumped back to the Tailings Basin pond. PolyMet has committed to future upgrades to achieve 100 percent capture by this system if the NorthMet Project Proposed Action is approved.

No effects on groundwater quality along the Transportation and Utility Corridor are anticipated during construction, operations, or closure as part of the NorthMet Project Proposed Action.

Waste Rock Stockpiles

The NorthMet Project Proposed Action would generate about 308 million tons of waste rock over the 20 years of mine operations. This waste rock would be managed according to its geochemical properties. Four categories of waste rock were defined generally based on its sulfur content as summarized in Table 5.2.2-21.

Table 5.2.2-21 Summary of Waste Rock Stockpile Properties

Waste Rock Categorization	Sulfur Content (% S)[1]	Approximate % of Waste Rock Total Mass[4]	Max Footprint (acres)	Stockpile Duration	Bottom Liner System	Cover System
Category 1	%S ≤ 0.12	70%	508/526[(5)]	Permanent	No liner system; a surface and groundwater seepage containment system would collect water for pumping to the WWTF.	3-ft engineered cover with a 40-mil geomembrane barrier.
Category 2	0.12 < %S ≤ 0.31	24%	180[(3)]	Temporary	12-inch compacted (1 x 10^{-5} cm/s) subgrade overlaid by 80-mil LLDPE geomembrane, covered by a 24-inch overliner drainage layer.	Stockpile would be completely removed and reclaimed.
Category 3	0.31 < %S ≤ 0.6	3%	180[(3)]	Temporary	12-inch compacted (1 x 10^{-5} cm/s) subgrade overlaid by 80-mil LLDPE geomembrane, covered by a 24-inch overliner drainage layer.	Stockpile would be completely removed and reclaimed.
Category 4[(2)]	> 0.6 %S Duluth Complex 0.4 ≤ %S ≤ 5.0 Virginia Formation	3%	57	Temporary	12-inch compacted (1 x 10^{-6} cm/s) subgrade overlaid by 80-mil LLDPE geomembrane, covered by a 24-inch overliner drainage layer.	Stockpile would be completely removed and reclaimed.

Source: PolyMet 2015a.

[1] In general, the higher the rock's sulfur content, the higher its potential for generating acid rock drainage or leaching heavy metals.
[2] Includes all Virginia formation rock.
[3] Max footprint is total for Category 2/3 waste rock.
[4] Approximately 29% of waste rock that ultimately fills the East Pit (mostly Category 2 and 3) would be sent to the pit without prior stockpiling.
[5] The Category 1 waste rock stockpile has a maximum footprint of 508 acres while active. It would reach this size by mine year 6. The stockpile would be re-graded as part of reclamation with a final footprint of 526 acres in mine year 2.

As Table 5.2.2-21 above indicates, the Category 1 Stockpile would be permanent. It would not have a liner, but would be surrounded by a surface and groundwater seepage containment system consisting of a cutoff wall (i.e., low-permeability hydraulic barrier) and a sub-surface drain that would collect 90 to 94 percent of the seepage from the stockpile during mine operations and 94 percent after the mine's closure. This stockpile would be progressively reclaimed with an engineered geomembrane cover system constructed from year 14 through 21. A maximum of 8 percent of seepage is estimated to bypass the containment system, during mine operations. However, most of such uncaptured seepage would migrate with groundwater to the West Pit, where it would be collected and pumped to the WWTF for treatment. Only about 2 percent of the overall seepage during the mine operation period would bypass both the containment system and the West Pit and East Pit.

During reclamation and closure, the estimated bottom seepage from the Category 1 Stockpile would be about 3 gpm. About 94 percent of that seepage would be captured by the containment system and none of the seepage would bypass West Pit and East Pit.

The Category 2/3 and 4 stockpiles would be constructed with an underliner system including a compacted subgrade, an underdrain, an impermeable geomembrane liner, an overliner drainage layer, and a leachate collection system. Drainage from these stockpiles would be collected on the liner and routed to a lined sump for pumping to the WWTF for treatment. The GoldSim modeling assumes, however, that some leachate seeps through tears/flaws in the Category 2/3 Stockpile geomembrane liner, reaches the groundwater table, and follows what is referred to as the Category 2/3 Stockpile and East Pit Flowpath, ultimately discharging to the Partridge River. Some leachate from the Category 4 Stockpile is also assumed to seep through the liner system, but given its location adjacent to the East Pit, it is assumed that any uncollected seepage would follow the hydraulic gradient to the East Pit, where it would be collected as part of the pit dewatering system and pumped to the WWTF for treatment. Once mining of the East Pit is completed (approximately year 11), the Category 2/3 and Category 4 waste rock would be backfilled into the East Pit, the liner system would be removed, and the footprints of these stockpiles revegetated per an approved reclamation plan. Once mining ceases in the East Pit, waste rock would be directly deposited in the East Pit.

Overburden and Overburden Storage and Laydown Area

The NorthMet Project Proposed Action would strip overburden as needed for mine development, thereby minimizing the amount of exposed bedrock at any one time. About 32 percent of the overburden would be stripped in the first 2 years of the mine life, with the balance being removed by the end of year 11. Overburden present at the Mine Site is categorized into three types: unsaturated overburden, saturated overburden, and peat (organic soils). Each type of overburden would be managed in accordance with its characteristics.

Saturated overburden is material that has been below the normal water table and not exposed regularly to oxygen, so it is still potentially reactive if exposed to oxygen. Some of this material would be used for construction purposes, but only for applications where it would be placed below the water table or where any water contacting it would be collected and appropriately treated. Saturated overburden not used for construction purposes would be commingled with waste rock and placed in the temporary Category 2/3 or 4 stockpiles with a geomembrane liner.

Unsaturated overburden is above the normal water table, and waste characterization studies indicate that it has been exposed to oxygen for a sufficiently long period of time that it is now non-reactive. This material would be used for construction purposes. To the extent that unsaturated overburden exceeded immediate construction needs, it would be temporarily stored in the unlined Overburden Storage and Laydown Area. Peat would also be used for reclamation purposes, as appropriate, and any excess would be temporarily stored along with the unsaturated overburden in the unlined Overburden Storage and Laydown Area for future use during reclamation.

Surface runoff from the Overburden Storage and Laydown Area is considered "process water," and would be captured in an unlined pond (Pond PW-OSLA) and monitored for quality. If the Overburden Storage and Laydown Area water were of acceptable quality, it would be pumped to the Central Pumping Station and discharged to the East Pit or the Tailings Basin, where the destination would be based on variable project demand over time. If water in Pond PW-OSLA required treatment, it would be pumped to the WWTF for treatment prior to delivery to the Central Pumping Station.

Since the Overburden Storage and Laydown Area would be unlined, the GoldSim model assumes meteoric water would seep into the groundwater below the Overburden Storage and Laydown Area and follow the Overburden Storage and Laydown Area Flowpath ultimately discharging to the Partridge River. During operations, the estimated bottom seepage from the Overburden Storage and Laydown Area would be about 14 gpm. The water quality of this seepage was estimated based on the results of the Meteoric Water Mobility Procedures test for peat and unsaturated overburden (PolyMet 2015q).

Ore Surge Pile

An Ore Surge Pile would be constructed near the Rail Transfer Hopper to allow for temporary storage of ore and a steady flow and uniform grade of ore to the processing plant. Ore would pass into and out of this pile during operations to meet plant needs for efficient processing. The Ore Surge Pile would have a geosynthetic underliner system identical in design to that for the Category 4 Stockpile. Drainage from the Ore Surge Pile would be collected on the liner and routed to a lined sump for pumping to the WWTF for treatment. The Ore Surge Pile, including the liner system, would be removed at the completion of mining activities (at mine year 20) and reclaimed.

The GoldSim modeling assumes that a small volume of leachate would seep through flaws in the geomembrane liner, reach the groundwater table, and migrate along the Ore Surge Pile Flowpath, ultimately discharging to the Partridge River.

East Pit

During mining, the East Pit would be dewatered. In approximately year 10, mining of the East Pit would be completed and backfilling would begin with stockpiled Category 2/3 and 4 waste rock, and fresh waste rock (all categories) from the West Pit. During backfilling, natural groundwater inflow to the pit would saturate the backfill. The pore water in the initially saturated backfill would have relatively high solute concentrations (see Figure 5.2.2-25 for a representative example based on sulfate), but once submerged, oxygen transport would be limited and there would be a systematic decrease in oxidation and associated dissolution of sulfide minerals.

Additional concentration reduction would be accomplished by pumping the East Pit backfill pore water through the WWTP and re-injecting the treated effluent back into the backfill.

Once the saturated water level in the backfill reaches the top of bedrock along the pit rim (approximate elevation of 1,577 ft at year 20), some backfill pore water would begin to flow from the pit into the surficial aquifer. The quality of the aquifer inflow would reflect the quality of the pit lake water, which would gradually improve over time due to reclamation activities at the Mine Site. This groundwater inflow would migrate south through the East Pit Category 2/3 Surficial Flowpath and ultimately release to the Partridge River. Since both the Category 2/3 Stockpile and the East Pit would share the same flowpath, the flowpath would experience two concentration peaks, the first representing the arrival of solutes from the Category 2/3 Stockpile, which would reach the Partridge River around year 35 and would peak around year 55, and the second from the arrival of aquifer inflow from the East Pit, which would reach the Partridge River around year 100 and peak around year 150. For cobalt, Figure 5.2.2-26 shows the dual peak that would occur in the East Pit Cat 2/3 Surficial Flowpath at the Partridge River and compares this response with peaks that would occur in the other surficial flowpaths.

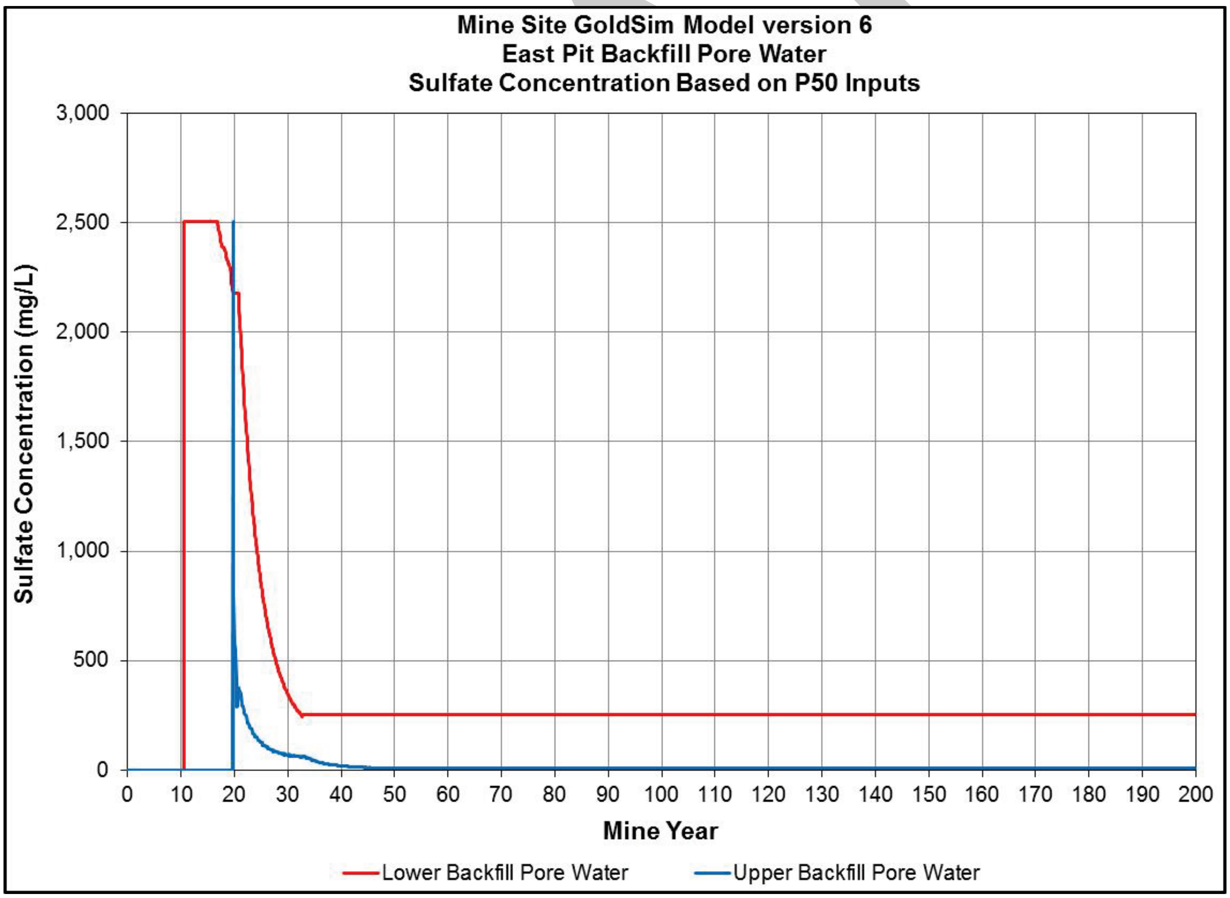


Figure 5.2.2-25 Sulfate Concentrations in East Pit Backfill Based on GoldSim Deterministic Run with P50 Inputs

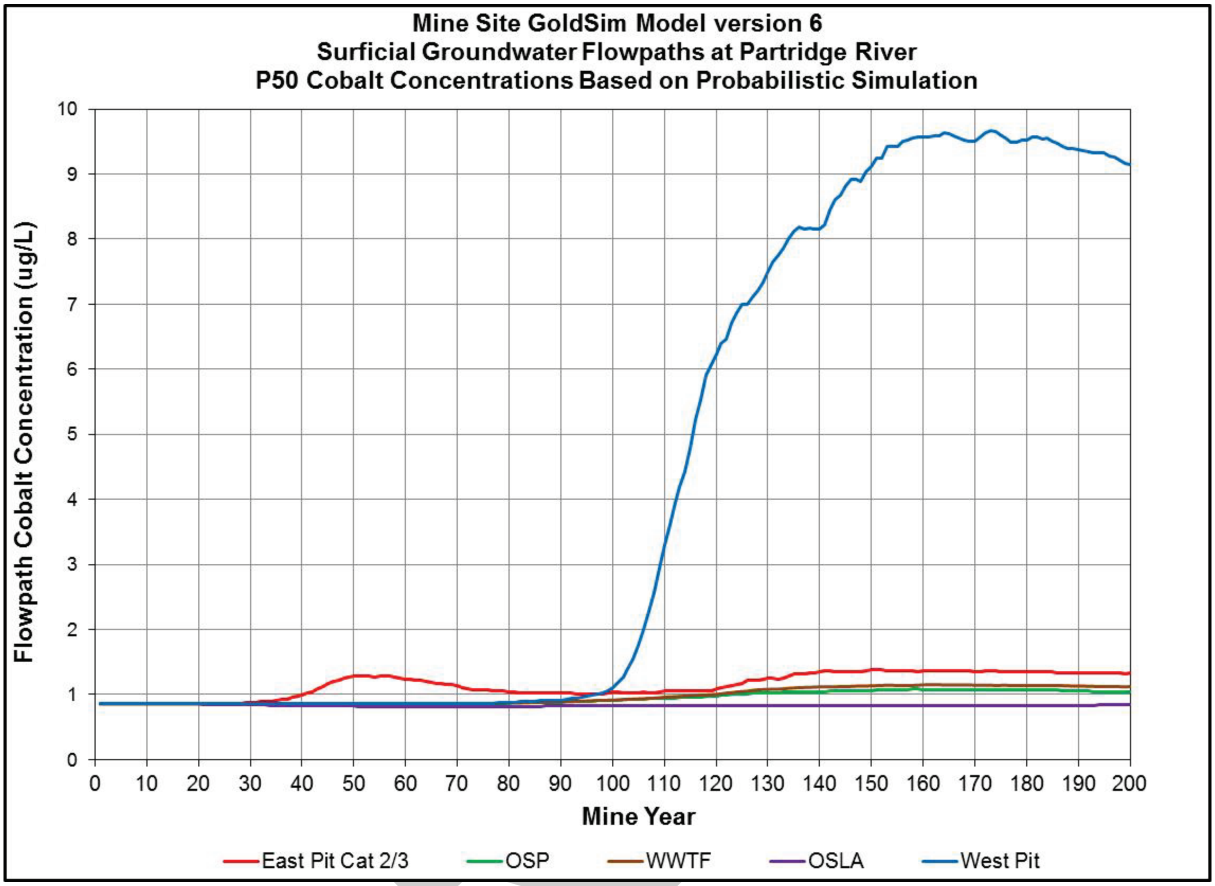


Figure 5.2.2-26 P50 Cobalt Concentrations in Surficial Groundwater Flowpaths at the Partridge River Based on GoldSim Probabilistic Simulation

West Pit

Flooding of the West Pit would begin after the completion of mining in year 21. The water in the West Pit is expected to contain dissolved oxygen with initial concentrations as high as 15 mg/L. This oxygen would be initially reactive with the pit wall rock, but the reactivity would decrease over time as the material exposed to water oxidizes. Groundwater flow in bedrock would be towards the pit, so the only mechanism for oxygen to reach unoxidized rock beyond the pit wall would be diffusion, and this would limit the rate of wall rock chemical reactions.

Once the water in the flooded pit reaches the top of bedrock along the pit rim (approximate elevation 1,550 ft at year 48), some of the pit lake water would begin to flow into the surficial aquifer. The quality of this aquifer inflow would reflect the quality of the pit lake water, which is predicted by GoldSim to improve over time due to: 1) dilution from rainfall and surface runoff into the pit and 2) submergence of pit walls with an association decrease in the oxidation of sulfide minerals. The groundwater inflow would migrate south along West Pit Surficial Flowpath and ultimately release to the Partridge River. The initial arrival of West Pit solutes at the Partridge River would occur at about year 105, and peak concentrations in groundwater discharging to the river would occur at about year 160.

Wastewater Treatment Facility

The WWTF would treat influent water from a variety of sources (e.g., pit dewatering, stockpile leachate collection, contact surface water, Plant Site RO concentrate). The only potential source of groundwater contamination at the WWTF would be leakage from the two equalization basins and from the Central Pumping Station. The equalization basin would have a geomembrane liner system and would be designed to have a minimum of 3 ft of freeboard, in accordance with the MPCA guidance (Meyer et al. 2009). Leakage from these basins through the liner system is calculated differently than for the waste rock stockpile liner systems because these ponds would have standing water above the underliner. Therefore, the hydraulic pressure on the liners would be greater, and, in turn, more water would be expected to leak on a per-acre basis (i.e., approximately 5 gallons per acre per day) (PolyMet 2015m). The total volume of leakage from the equalization basins, however, would be less than from the stockpiles, as the footprint of the equalization basins would be smaller. This leakage would reach the groundwater table and follow the WWTF Flowpath ultimately to the Partridge River.

Groundwater Transport and Evaluation Locations

Solutes from each source area described above would be transported by groundwater along its associated flowpath (see Figure 5.2.2-7). Each of these flowpaths has a groundwater evaluation location where the GoldSim model predicts groundwater quality (see Figure 5-2.2-7). At each evaluation location, the predicted water quality for the NorthMet Project Proposed Action is compared with both the evaluation criteria and the predicted water quality for the CEC Scenario. See Table 5.2.2-22 for a summary of solute fate and transport.

The time at which contaminants leached from the Mine Site would begin to affect water quality at the downgradient evaluation locations depends on the following four variables:

- The time (i.e., year) when the source facility was constructed or began leaching contaminants;
- The rate at which contaminants move in groundwater (assumed to equal the groundwater flow rate for all constituents except the four attenuated contaminants (arsenic, antimony, copper, and nickel), which are assumed to migrate more slowly than the groundwater);
- The distance between the source and the evaluation location; and
- Mechanical dispersion, which tends to spread out the solute plume.

Cobalt was generally used to illustrate groundwater transport at the Mine Site because the model did not account for attenuation and it would enter the surficial flowpaths at concentrations higher than baseline groundwater. As a consequence, the movement of solute fronts associated with this solute is readily discernible on concentration-versus-time and concentration-versus-distance plots for the modeled flowpaths. Transport of other non-attenuated solutes should be similar to cobalt, but the changes in concentrations are not as visually noticeable as it is for cobalt.

The estimated migration times for contaminant plumes to reach the evaluation locations are presented in Table 5.2.2-22.

Table 5.2.2-22 P50 Solute Migration Times for Mine Site Groundwater Flowpaths Based on GoldSim Probabilistic Simulation

	Solute Source Times		Solute Migration Times to Groundwater Evaluation Location[1]		Solute Migration Times to Partridge River[1]	
Surficial Groundwater Flowpath	**Start Mine Year**	**Stop Mine Year**	**Initial Concentration Increase Mine Year**	**Peak Concentration[5] Mine Year**	**Initial Concentration Increase Mine Year**	**Peak Concentration[5] Mine Year**
Category 2/3 Stockpile	0	20	15	30	35	55
East Pit	20[(4)]	Continuous	95	135	125	150
Ore Surge Pile [6]	0	21	90	155	90	155
WWTF	0	33	80	130	85	160
Overburden Storage and Laydown Area	0	20	8[(2)]	20[(3)]	30[(2)]	60[(3)]
West Pit	48[(4)]	Continuous	85	135	105	160

Source: PolyMet 2014v.

[1] For all constituents except arsenic, copper, nickel, and antimony, which are modeled with adsorption coefficients that greatly increase solute migration times.
[2] Concentration decrease for most constituents.
[3] Minimum concentration for most constituents.
[4] Time when pit water level would rise above the top of bedrock and begin to release pit water into the adjacent surficial (groundwater) flowpath.
[5] All modeled peak concentrations are below evaluation criteria.
[6] River location used for groundwater evaluation location.

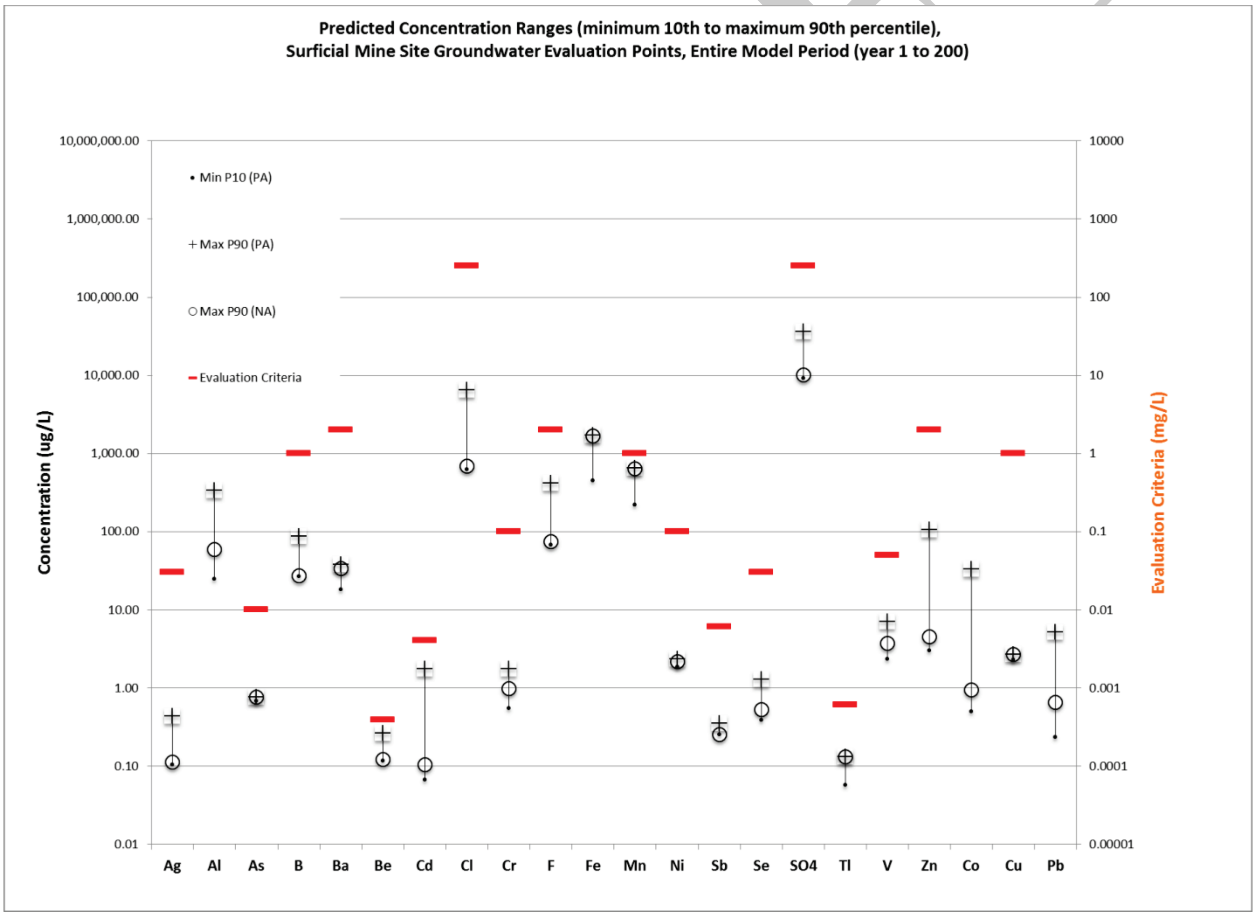
Table 5.2.2-22 indicates that all of the contaminant plumes would reach the Partridge River within the 200-year modeled duration.

Surficial Groundwater Quality at the Evaluation Locations

Model results were reviewed for all 29 solutes at the evaluation location within each of the five surficial flowpaths. A screening process was used to identify any constituents and locations that warranted a more robust examination because some modeled concentrations were above or equal to water quality evaluation criteria. The screening process involved comparing the single-highest monthly P90 water quality prediction from among the 2,388 months covered by the simulation (i.e., 12 months times 199 years, with the first year of simulation excluded for screening review due to potential numerical artifacts in the model results) for each constituent at each of the five evaluation locations. These NorthMet Project Proposed Action modeled values were compared with both the CEC scenario modeled values and the evaluation criteria discussed previously.

The screening of maximum P90 groundwater concentrations of all modeled solutes indicated that none of the solutes at any of the five flowpaths were predicted to ever exceed the evaluation criteria. These results are shown in Table 5.2.2-23, which lists the maximum P90 values for each modeled constituent. These results are illustrated, along with the maximum P90 concentrations for the CEC scenario and the range in NorthMet Project Proposed Action model concentrations (lowest P10 to the highest P90 value over 200-year simulation and across all groundwater model-reporting points), in Figure 5.2.2-27. The proportional increase in the concentrations of each solute (i.e., the ratio of the maximum P90 value under the NorthMet Project Proposed Action scenario to the maximum P90 value under the CEC scenario) are listed in Table 5.2.2-23 and illustrated graphically in Figure 5.2.2-28. Note that if the values are the same, the relative change ratio would be 1; values greater than 1 indicate the ratio at which the NorthMet Project Proposed Action would result in an increase in solute concentrations relative to the CEC Scenario model results.

When groundwater affected by mining reaches the Partridge River, the concentration of groundwater that exits from the flowpath into the river would be a mixture of water that entered the upgradient end of the flowpath, meteoric recharge along the flowpath, and background groundwater into which the contaminant front disperses. For most constituents both the meteoric and background groundwater concentrations are lower than the source concentration. This means there would be a reduction in concentration of these constituents by the time the original source water arrived at the Partridge River (PolyMet 2015m).



Note: Groundwater evaluation criteria plotted are listed in Table 5.2.2-2.

Figure 5.2.2-27 Predicted Maximum P90 Concentrations of Each Solute versus Evaluation Criteria, Mine Site Surficial Groundwater Evaluation Locations

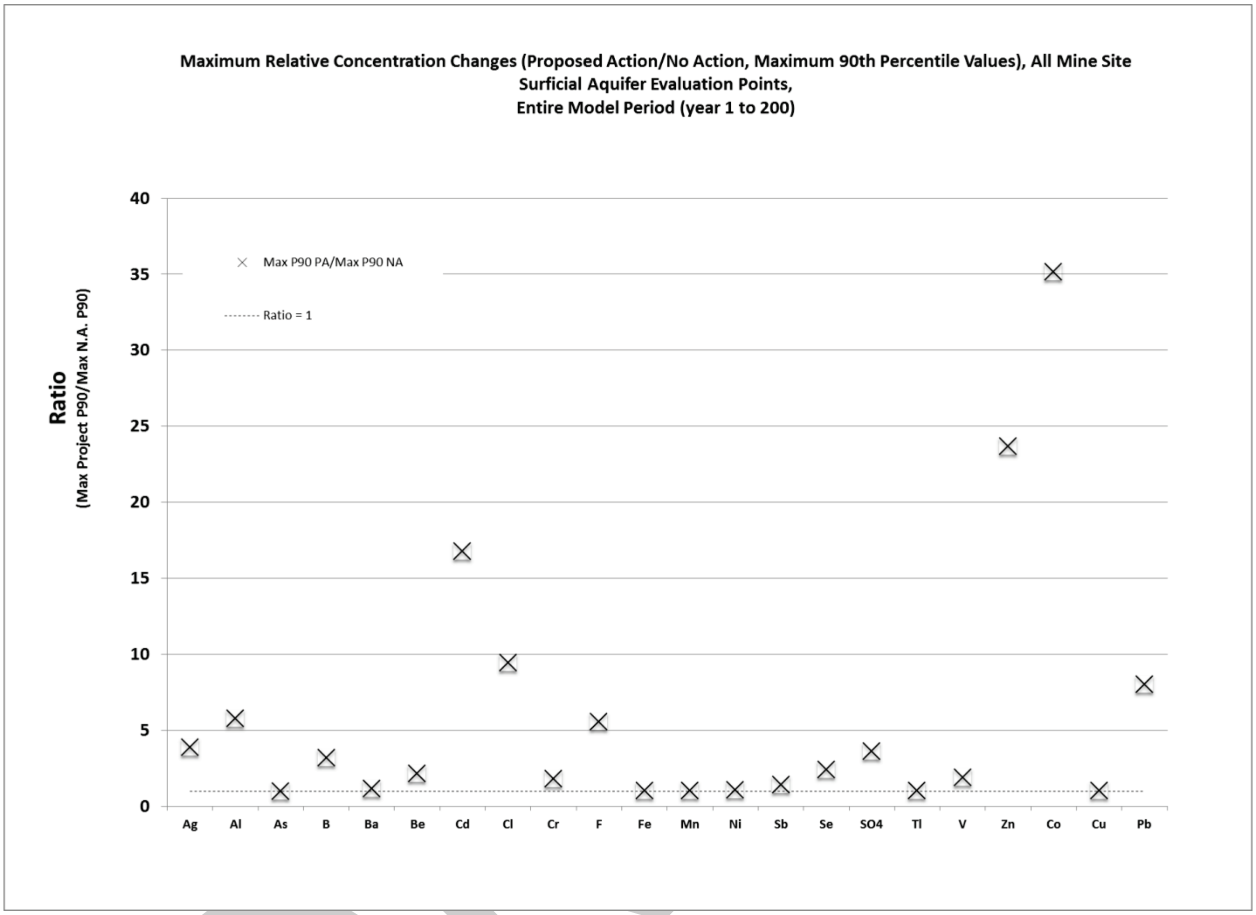


Figure 5.2.2-28 Relative Maximum P90 Concentration Differences (Proposed Action vs CEC), Over the 200-year Simulation Period at a Mine Site All Surficial Aquifer Evaluation Locations

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Table 5.2.2-23 Mine Site Groundwater – Maximum P90 Solute Concentration Over Entire 200-Year Simulation at Each Evaluation Location Based on the GoldSim Probabilistic Model

	FEIS Groundwater Evaluation Criterion			East Pit Category 2/3 Surficial Flowpath at Property Boundary		Overburden Storage and Laydown Area Surficial Flowpath at Old Property Boundary		Ore Surge Pile Surficial Flowpath at Partridge River		WWTF Surficial Flowpath at Property Boundary		West Pit Surficial Flowpath at Property Boundary	
Parameter	**Concen-tration**	**Units**	**Reference Table**	**NorthMet Project Proposed Action**	**CEC Scenario**	**NorthMet Project Proposed Action**	**CEC Scenario**	**NorthMet Project Proposed Action**	**CEC Scenario**	**NorthMet Project Proposed Action**	**CEC Scenario**	**NorthMet Project Proposed Action**	**CEC Scenario**
General													
Alkalinity	--	mg/L	5.2.2-2	67.5	67.5	67.5	67.5	67.5	67.5	67.5	67.5	67.5	67.5
Calcium	--	mg/L	5.2.2-2	18.1	16.1	16.1	16.1	16.1	16.1	16.1	16.1	29.0	16.1
Chloride	250	mg/L	5.2.2-2	3.5	0.69	3.7	0.69	0.69	0.69	0.69	0.69	6.5	0.69
Fluoride	2	mg/L	5.2.2-2	0.13	0.08	0.42	0.08	0.08	0.08	0.08	0.08	0.17	0.08
Hardness	--	mg/L	5.2.2-2	77.6	69.9	69.9	69.9	70.0	69.9	70.2	69.9	120	69.9
Sulfate	250	mg/L	5.2.2-2	18.6	10.1	36.2	10.1	10.2	10.1	10.5	10.1	34.0	10.1
Magnesium	--	mg/L	5.2.2-2	7.9	7.3	7.3	7.3	7.3	7.3	7.3	7.3	11.7	7.3
Potassium	--	mg/L	5.2.2-2	4.7	1.7	2.6	1.7	1.7	1.7	1.8	1.7	6.4	1.7
Sodium	--	mg/L	5.2.2-2	16.2	5.6	16.1	5.6	5.6	5.6	5.6	5.6	23.9	5.6
TDS[1]	500	mg/L	5.2.2-2	109	82.0	122.8	82.0	82.2	82.0	82.6	82.0	152	82.0
Metals													
Aluminum	--	µg/L	5.2.2-2	339	58.9	139	58.9	70.1	58.9	79.0	58.9	58.9	58.9
Antimony	6	µg/L	5.2.2-2	0.35	0.25	0.29	0.25	0.25	0.25	0.25	0.25	0.27	0.25
Arsenic	10	µg/L	5.2.2-2	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76
Barium	2,000	µg/L	5.2.2-2	34.8	33.4	33.4	33.4	33.4	33.4	33.4	33.4	38.1	33.4
Beryllium[2]	0.39	µg/L	5.2.2-1[(2)]	0.15	0.12	0.16	0.12	0.12	0.12	0.12	0.12	0.27	0.12
Boron	1,000	µg/L	5.2.2-2	30.6	27.5	87.3	27.5	27.5	27.5	27.5	27.5	65.7	27.5
Cadmium	4	µg/L	5.2.2-2	0.28	0.10	0.10	0.10	0.11	0.10	0.11	0.10	1.7	0.10
Chromium III	100	µg/L	5.2.2-2	1.1	0.98	0.98	0.98	0.98	0.98	0.98	0.98	1.8	0.98
Cobalt	--	µg/L	5.2.2-2	10.5	0.94	0.94	0.94	1.7	0.94	1.8	0.94	33.1	0.94
Copper	1,000	µg/L	5.2.2-2	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7
Iron	--	µg/L	5.2.2-2	1,721	1,673	1,673	1,673	1,676	1,673	1,681	1,673	1,673	1,673
Lead	--	µg/L	5.2.2-2	0.86	0.65	0.65	0.65	0.65	0.65	0.66	0.65	5.2	0.65
Manganese[2]	1,002	µg/L	5.2.2-1[(2)]	645	635	635	635	636	635	636	635	635	635
Nickel	100	µg/L	5.2.2-2	2.3	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2
Selenium	30	µg/L	5.2.2-2	0.72	0.53	0.61	0.53	0.53	0.53	0.54	0.53	1.3	0.53
Silver	30	µg/L	5.2.2-2	0.14	0.11	0.44	0.11	0.11	0.11	0.11	0.11	0.16	0.11
Thallium[2]	0.6	µg/L	5.2.2-2	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13
Vanadium	50	µg/L	5.2.2-2	4.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	7.0	3.7
Zinc	2,000	µg/L	5.2.2-2	19.2	4.5	4.5	4.5	4.8	4.5	5.2	4.5	106	4.5

Source: PolyMet 2014v.

[1] Groundwater evaluation criteria.
[2] Surficial groundwater.

Table 5.2.2-24 Relative Difference in Maximum P90 Concentrations (NorthMet Project Proposed Action/CEC Scenario) for Mine Site Surficial Flowpath

Parameter	Units	East Pit-Category 2/3 Flowpath at the Property Boundary[1]	East Pit-Category 2/3 Flowpath at the Partridge River	Overburden Storage and Laydown Area Flowpath at the Property Boundary[1]	Overburden Storage and Laydown Area Flowpath at the Partridge River	Ore Surge Pile Flowpath at the Partridge River[1]	WWTF Flowpath at the Property Boundary[1]	WWTF Flowpath at the Partridge River	West Pit (Surficial) Flowpath at the Property Boundary[1]	West Pit (Surficial) Flowpath at the Partridge River
General										
Alkalinity	Unitless	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Calcium	Unitless	1.1	1.1	1.0	1.0	1.0	1.0	1.0	1.8	1.5
Chloride	Unitless	5.1	3.6	5.3	2.4	1.0	1.0	1.0	9.4	6.9
Fluoride	Unitless	1.7	1.4	5.6	2.4	1.0	1.0	1.0	2.2	1.9
Hardness	Unitless	1.1	1.1	1.0	1.0	1.0	1.0	1.0	1.7	1.5
Sulfate	Unitless	1.8	1.5	3.6	1.8	1.0	1.0	1.0	3.4	2.7
Magnesium	Unitless	1.1	1.0	1.0	1.0	1.0	1.0	1.0	1.6	1.4
Potassium	Unitless	2.7	2.0	1.5	1.1	1.0	1.0	1.0	3.7	2.8
Sodium	Unitless	2.9	2.1	2.9	1.6	1.0	1.0	1.0	4.3	3.3
TDS	Unitless	1.3	1.2	1.5	1.1	1.0	1.0	1.0	1.85	1.5
Metals										
Aluminum	Unitless	5.8	2.9	2.4	1.4	1.2	1.3	1.3	1.0	1.0
Antimony	Unitless	1.4	1.0	1.1	1.0	1.0	1.0	1.0	1.0	1.0
Arsenic	Unitless	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Barium	Unitless	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.1	1.1
Beryllium	Unitless	1.3	1.2	1.3	1.1	1.0	1.0	1.0	2.2	1.8
Boron	Unitless	1.1	1.1	3.2	1.7	1.0	1.0	1.0	2.4	2.0
Cadmium	Unitless	2.7	2.0	1.0	1.0	1.0	1.1	1.1	16.8	12.2
Chromium III	Unitless	1.1	1.1	1.0	1.0	1.0	1.0	1.0	1.8	1.5
Cobalt	Unitless	11.2	4.6	1.0	1.0	1.8	1.9	1.7	35.2	24.3
Copper	Unitless	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Iron	Unitless	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lead	Unitless	1.3	1.2	1.0	1.0	1.0	1.0	1.0	8.0	5.8
Manganese	Unitless	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Nickel	Unitless	1.1	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Selenium	Unitless	1.3	1.2	1.1	1.0	1.0	1.0	1.0	2.4	2.0
Silver	Unitless	1.2	1.1	3.9	1.9	1.0	1.0	1.0	1.4	1.3
Thallium	Unitless	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Vanadium	Unitless	1.2	1.1	1.0	1.0	1.0	1.0	1.0	1.9	1.6
Zinc	Unitless	4.3	3.0	1.0	1.0	1.1	1.2	1.1	23.7	17.0

Source: PolyMet 2014v.

[1] Evaluation location.

Effects on Bedrock Groundwater Quality

At the Mine Site, the only mine-related solute sources to bedrock groundwater are flooded backfill in the East Pit, ponded water in the West Pit, and seepage from the Category 1 Stockpile. These waters are carried by two flowpaths to the south to the Partridge River. The East Pit bedrock evaluation location is the property boundary and the West Pit evaluation location is the old property boundary or current Mine Site project boundary.

Predicted water quality in the bedrock was reviewed, but the solute load from these sources did not reach the evaluation locations at the end of the 200-year model simulation because the estimated travel time for groundwater between the mine pits and the bedrock evaluation locations would be much longer (greater than 1,000 years). The effect of the NorthMet Project Proposed Action on bedrock groundwater is considered negligible at the bedrock evaluation locations.

Saline Groundwater

Saline groundwater is known to occur in bedrock across the Canadian Shield (Fritz and Frape 1987; Morton and Ameel 1985). In general, the potential for encountering saline water increases with depth, such that briny groundwater (defined as TDS greater than 35,000 mg/L) may be nearly ubiquitous in bedrock at depths greater than approximately 3,000 ft throughout the Lake Superior Basin in northeastern Minnesota (Morton and Ameel 1985), including the Duluth Complex (Rouleau et al. 2003; Bottomley 1996). Brackish to saline groundwater is encountered sporadically in deep (greater than 1,000 ft) bedrock wells in northeastern Minnesota and on the Keweenaw Peninsula and in shallow (less than 300 ft) bedrock wells near Lake Superior (Morton and Ameel 1985). Elevated salinity at depth does not appear to be caused by the bedrock itself, as studies have found no particular relationship with rock type (Morton and Ameel 1985). One study concluded that these "brines" were likely formed by the evaporation of seawater during Devonian time about 359 to 419 million years ago (Bottomley 1996).

The concern for water quality is whether excavation of the East Pit and West Pit could penetrate zones of saline or briny groundwater or otherwise draw these waters to the surface, thereby increasing the salinity of the pit water.

The closest wells to the NorthMet Project Proposed Action area that are known to have encountered saline groundwater are located 3.2 miles to the northeast of the East Pit at the former AMAX test shaft at depths of approximately 1,200 to 1,400 ft bgs (elevation 200 to 400 ft amsl) (Barr 2012m). The maximum depths of the East Pit and West Pit, however, are approximately 630 and 700 ft bgs (elevation 800 to 900 ft amsl) or a minimum of 400 ft above the elevation where saline water was observed.

Bedrock groundwater sampling from the Mine Site also suggests that the pit excavations would not encounter saline groundwater. Sampling from two exploratory boreholes, a water supply well, and nine groundwater monitoring wells drilled at the Mine Site found a maximum chloride concentration of 15.7 mg/L (this excludes a value of 93.1 mg/L from the initial sampling of Observation Well-3, where the maximum value detected in subsequent monitoring was 0.81 mg/L) (Barr 2012m).

Despite the absence of brine in current wells, the excavation and dewatering of the mine pits would likely draw water up from deeper bedrock below the pits, which could contain elevated chloride concentrations. Bedrock conductivity, however, is much lower than the surficial aquifer, and hydraulic analyses indicate that groundwater inflow to the West Pit would be dominated by water from the surficial aquifer, which is predicted to comprise 64 percent of groundwater inflow at end of mining and increase to 98 percent of inflow after the pit is fully flooded (PolyMet 2015m, Table 1-22b).

Regionally, the Federal Hardrock Mineral Prospecting Permits Project ROD recognizes this as a potential risk from exploration drilling (USFS 2012b), noting the possibility that "exploratory drilling could cause pockets of brackish (i.e., salty) groundwater to reach freshwater supplying drinking water wells." This ROD concluded, in consultation with the MDH, that "this scenario is considered unlikely," but "that the risk is not zero" (USFS 2012b).

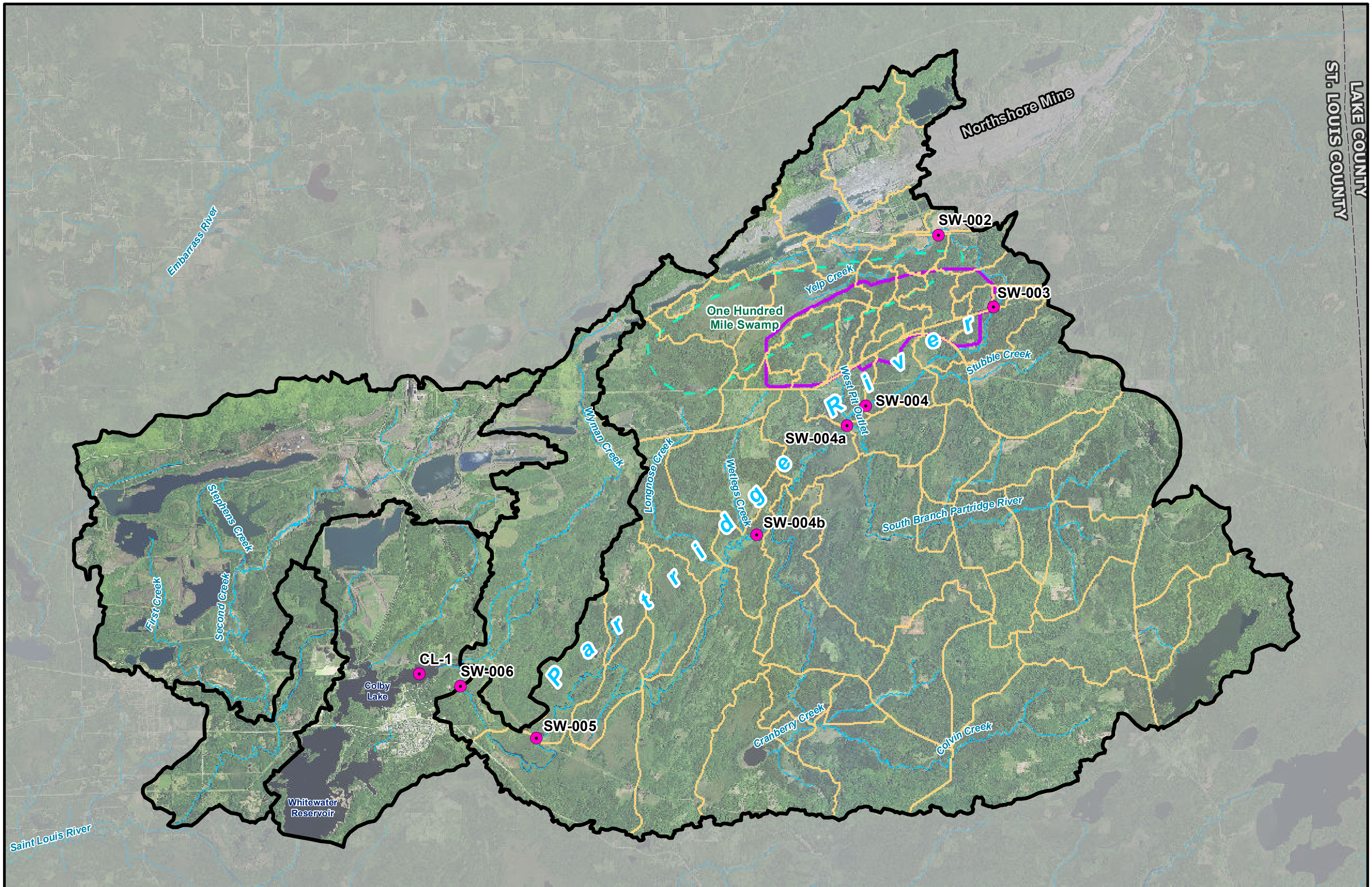
Given that bedrock groundwater monitoring from 12 wells with depths up to 600 ft bgs at the Mine Site did not reveal any elevated chloride concentrations, that the nearest known occurrence of saline water is 3.2 miles from the Mine Site, and that the proposed pit floors would be at least 400 ft above the elevation where saline water is known to occur, the risk of encountering saline water is considered low. If encountered, saline bedrock groundwater inflow to the pits would be diluted by other water sources (surficial aquifer, and precipitation). In addition, any groundwater inflow to the pit during operations would be collected as part of pit dewatering and pumped to the WWTF for treatment. Finally, the chances of a perpetual elevated saline condition is considered small because the pits would flood in closure, producing hydraulic head that would inhibit groundwater upwelling.

Effects on Surface Water Hydrology in the Partridge River Watershed

This section describes the effects of the NorthMet Project Proposed Action on the surface water hydrology of the Partridge River and its tributaries (see Figure 5.2.2-29). The NorthMet Project Proposed Action could affect flows in the Partridge River and its tributaries by changing drainage areas (e.g., alteration or reduction in watershed area), reducing groundwater baseflow contributions during the dewatering and flooding of the East Pit and West Pit, and withdrawing water from Colby Lake occasionally for use as makeup water at the processing plant during operations .

Changes in Drainage Area

The NorthMet Project Proposed Action would result in changes to drainage areas in some locations that would, in turn, affect streamflows. These changes would primarily include the capture and retention of contact water at the Mine Site and during reclamation the use of this water to flood the West pit. During mine operations and reclamation, surface water runoff from much of the Mine Site would be retained within the site until the West Pit floods. This would reduce the drainage area that currently provides surface water runoff to the Partridge River. Table 5.2.2-25 shows the total watershed area and percent watershed area reduction at each surface water evaluation location for selected time periods.



Model Evaluation Locations
Partridge River Watersheds
Upper Partridge River Subwatersheds
One Hundred Mile Swamp
Mine Site
Stream/River

US Army Corps of Engineers
St. Paul District

This document is a working document. This document may change over time as a result of new information, further deliberation, or other factors not yet known to the Co-lead Agencies.

0 0.5 1 2 3 Miles

Figure 5.2.2-29
Partridge River Subwatersheds and Surface Water Evaluation Locations
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

2384

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Table 5.2.2-25 Total Watershed Area (acres) and Percent Watershed Area Reduction for the Partridge River Resulting from the NorthMet Project Proposed Action

Location/ Year	SW-001[(1)]	SW-002	SW-003	SW-004	SW-004a	SW-004b	SW-005	SW-006	Colby Lake
Existing Conditions	670	4,508	5,550	10,566	30,557	45,665	59,065	62,056	74,636
Operations Mine Year 11	670 0%	4,264 5.4%	5,301 4.5%	9.907 6.2%	29,041 5.0%	44,149 3.3%	57,549 2.6%	60.540 2.4%	73,120 2.0%
End of Operations Mine Year 20	670 0%	4,484 0.5%	5,521 0.5%	10,126 0.4%	29,504 3.4%	44,612 2.3%	58,012 1.8%	61,003 1.7%	73,583 1.4%
Closure and Post-closure Maintenance	670 0%	4,462 1.0%	5,504 0.8%	10,397 1.6%	29,903 2.1%	45,011 1.4%	58,411 1.1%	61,402 1.1%	73,982 0.9%

Source: PolyMet 2015m, Attachment C.

[1] Station SW-001 is upstream from the NorthMet Project Proposed Action area, and is thus unaffected by the NorthMet Project Proposed Action. Data from this station are used in the hydrologic modeling, but this FEIS does not estimate water quality at this station.

The maximum watershed area reduction for any modeled location along the Partridge River would be 6.2 percent at SW-004, during year 11 of operations. A maximum long-term watershed area reduction of 2.1 percent would occur at SW-004a. Mine year 11 is presented as it is the predicted time of maximum change in watershed area. It represents the time when the combined East Central Pit has reached maximum areal extent (and has not been backfilled), and when the West Pit is open and approaching maximum areal extent.

The reduced drainage areas were taken into consideration in the XP-SWMM modeling and are presented in the Mine Site Data Package (PolyMet 2015m) with key values presented in Table 5.2.2-26 of this FEIS.

XP-SWMM Modeling Results for the Partridge River

The flow parameters and water resources evaluation criteria, established in Section 5.2.2.1.2, were used to evaluate the effects on surface water hydrology in the Partridge River Watershed. The XP-SWMM model was run for the NorthMet Project Proposed Action and the CEC scenarios for selected years during operations, and reclamation and closure, to determine the changes to each parameter at each stream location. Given the relatively small watershed area changes (watershed area reductions would approximate flow reductions), only selected modeling results are presented here to demonstrate the range of potential hydrologic effects. Effects on Colby Lake were not evaluated with the XP-SWMM model; however, water-level changes to Colby Lake and Whitewater Reservoir are addressed in a subsequent section of the FEIS. Table 5.2.2-26 summarizes the XP-SWMM results for selected flow parameters and stream locations. Modeled annual daily mean flow is also shown as a percentage of existing conditions in Figure 5.2.2-30.

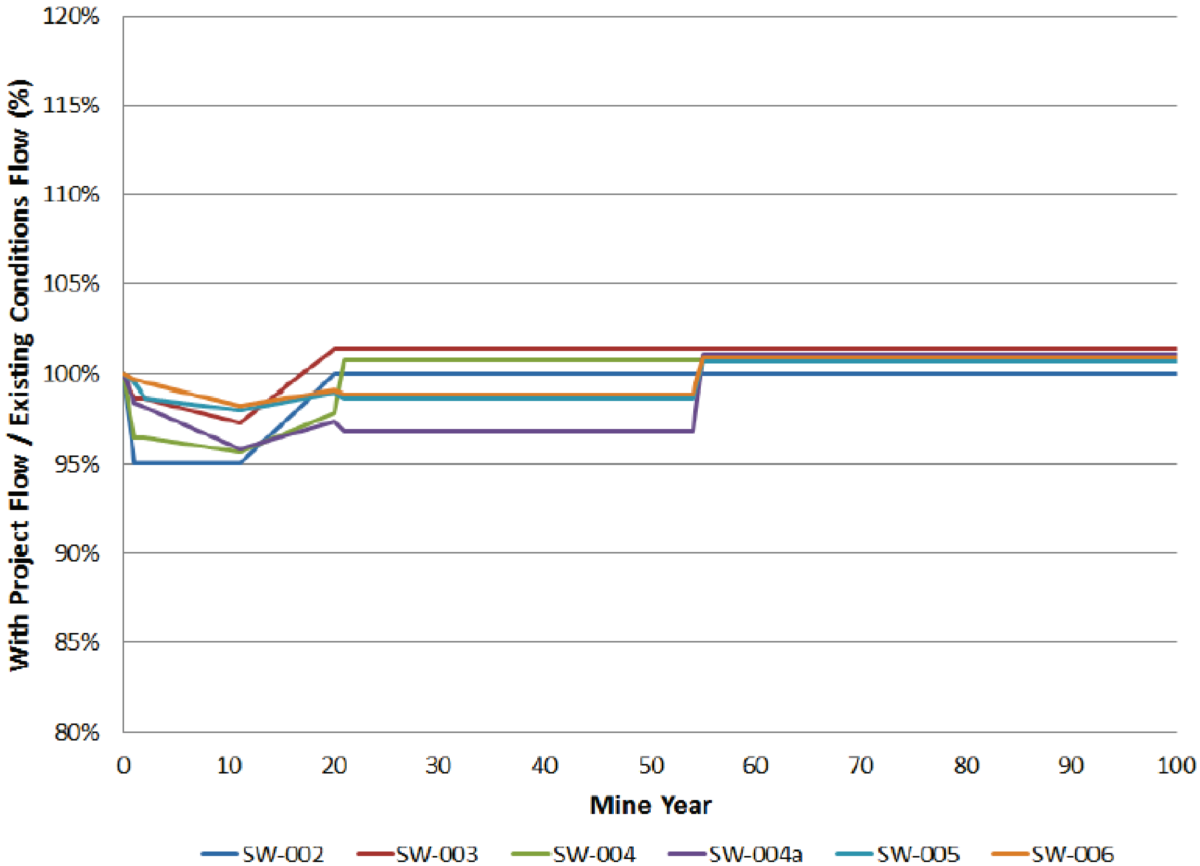
2414 -Page Intentionally Left Blank-

Table 5.2.2-26 Modeled Percent Change in Selected Streamflow Parameters at Selected Locations in the Partridge River

Location/Flow Parameter	SW-002				SW-004				SW-004a				SW-006			
	Year 11 Change in Flow	Mine Year 11 Percent Change	Long-Term Closure Change in Flow	Long-Term Closure Percent Change	Year 11 Change in Flow	Mine Year 11 Percent Change	Long-Term Closure Change in Flow	Long-Term Closure Percent Change	Year 11 Change in Flow	Mine Year 11 Percent Change	Long-Term Closure Change in Flow	Long-Term Closure Percent Change	Year 11 Change in Flow	Mine Year 11 Percent Change	Long-Term Closure Change in Flow	Long-Term Closure Percent Change
Annual Daily Mean (cfs)	-0.30	-4.9%	0.00	NC	-0.60	-4.3%	0.10	NC	-1.67	-4.4%	0.39	1.0%	-1.33	-1.7%	0.68	NC
February Mean (cfs)	-0.06	-5.7%	-0.01	NC	-0.10	-4.2%	0.02	NC	-0.30	-4.6%	0.43	6.5%	-0.24	-1.8%	0.50	3.7%
Average Annual 3-day Min (cfs)	-0.02	-5.1%	0.00	NC	-0.06	-7.1%	-0.03	-3.6%	-0.16	-7.8%	0.78	38.0%	-0.16	-3.4%	0.71	15.3%
Average Annual 30-day Min (cfs)	-0.03	-7.3%	-0.01	-2.4%	-0.07	-7.6%	-0.03	-3.3%	-0.14	-5.7%	0.54	22.1%	-0.14	-2.7%	0.49	9.3%
Mean Duration of Low Pulses (days)	0.02	NC	0.02	NC	0.83	3.2%	0.00	NC	0.07	NC	-0.24	NC	-2.20	-5.9%	-2.57	-6.9%
April Mean (cfs)	-1.62	-5.3%	-0.16	NC	-3.37	-4.7%	0.17	NC	-9.02	-4.5%	-1.70	NC	-8.25	-2.0%	-0.84	NC
Average Annual 3-day Max (cfs)	-3.33	-4.7%	0.20	NC	-4.21	-2.8%	3.91	2.6%	-14.75	-3.5%	-1.03	NC	-15.99	-2.1%	-1.21	NC
Mean Duration of High Pulses (days)	-0.09	-1.8%	-0.09	-1.8%	-0.07	-2.4%	-0.03	-3.3%	-0.25	-3.0%	-0.17	-2.0%	0.00	NC	-0.16	-1.3%

Source: PolyMet 2015m, Attachment J.
NC: Indicates modeled change less than 1 percent.

2420 -Page Intentionally Left Blank-



Source: Barr 2015i

Figure 5.2.2-30 Project Impact on Partridge River Annual Daily Mean Flow, shown as Modeled Flows Over Time as a Percent of Existing Conditions

It is apparent from Table 5.2.2-26 that almost all effects on streamflow during the year of maximum watershed reduction (mine year 11) would be in the form of streamflow reductions. The largest modeled effect, about an 8 percent reduction, would occur during low-flow conditions. After the West Pit is filled with water, discharge from the WWTF to the West Pit Outlet Creek would more than compensate for the reduced low flows at some locations. The maximum modeled effect is at location SW-004a, just downstream of where the WWTF discharge would enter the Partridge River. Here, the annual minimum 3-day flow and average annual 30-day low flow would increase by about 38 and 22 percent, respectively. The actual flow increases would be on the order of 0.78 and 0.54 cfs, respectively. The NorthMet Project Proposed Action would have little effect on high flows, as shown for the mean April flows and the annual maximum 3-day flows.

Modeling predicts that annual daily mean flow would change by 5 percent or less during operations and reclamation, and return to within approximately 1 percent of existing flow conditions in closure and long-term maintenance, as shown in Figure 5.2.2-30.

Changes in hydrology can affect stream geomorphology. PolyMet conducted a Level I Geomorphic Survey of the Partridge River from its headwaters to Colby Lake (Barr 2005) to determine the stability of the river under existing conditions, evaluate its sensitivity to hydrologic change, and indicate how restoration may be approached if a portion of the stream becomes unstable. The Geomorphic Survey found the Upper Partridge River to be stable, with no evidence of erosion except in its headwaters (see Figure 4.2.2-7). Its steep reaches are well-armored and the flatter reaches tend to have well-vegetated shorelines. As indicated in Table 5.2.2-26, the NorthMet Project Proposed Action would reduce flow in the Upper Partridge River during mine operations by1.8 to 7.8 percent depending on evaluation location and flow parameter, with less of an effect (2.0 to 5.3 percent) on higher flows. Flows would return to nearly pre-NorthMet Project Proposed Action conditions during closure, except at surface water stations downstream of WWTF discharge points where river flows would be higher.

No erosion or significant geomorphic changes are expected in the Upper Partridge River due to the NorthMet Proposed Action for the following reasons:

- The Geomorphic Survey of the Upper Partridge River found it to be stable;
- The NorthMet Project Proposed Action would not directly disturb the river banks;
- High flows (e.g., bank-full flows), which are important in shaping geomorphic processes, would only be reduced by a maximum of five percent during operations which is within the range of natural variability; and
- Most streamflows would return to near pre-NorthMet Project Proposed Action conditions after closure.

Effects on the Hydrology of the Partridge River Tributary Streams

The NorthMet Project Proposed Action is not expected to have any measurable effects on surface water hydrology of the tributary streams along the Transportation and Utility Corridor. Flow data collection and monitoring of the Partridge River tributary streams would be conducted for permitting.

Flow in the West Pit Outlet Creek would be modified due to reduction of drainage area, interception of groundwater by the West Pit, and discharge of the WWTF effluent during closure and long-term maintenance. The XP-SWMM model estimates an average annual flow of 1.2 cfs at the approximate location of the future WWTF discharge under existing conditions. The estimated average annual flow at this location in closure and long-term maintenance is increased to 1.4 cfs primarily due to the WWTF discharge (PolyMet 2015m).

A geomorphic survey of the West Pit Outlet Creek between Dunka Road and the Partridge River found no evidence of erosion, downcutting, or channel widening. The survey concluded that because the creek has a well-developed floodplain and substantial and continuous bank vegetation, it would be tolerant to moderate changes in hydrology (Barr 2005).

Effects on Colby Lake and Whitewater Reservoir Water Levels

The effect of the NorthMet Project Proposed Action on water levels in Colby Lake is related to changes in Partridge River inflow and water withdrawals to the Plant Site during operations.

The XP-SWMM modeling for SW-006, just upstream of Colby Lake, shows minor reductions in Partridge River low flows during operations (2.7 percent reduction in the 30-day low flow, which is equivalent to about 0.14 cfs). On an annual average basis, inflow to Colby Lake would be reduced about 1.7 percent during operations (in mine year 11) and have virtually no change during closure (see Table 5.2.2-26 for SW-006) (PolyMet 2015m).

NorthMet Project Proposed Action makeup water demand from Colby Lake during operations would vary between 260 and 1,760 gpm (0.6 and 3.9 cfs) with an average annual demand of 760 gpm (1.7cfs). After operations complete, makeup water from Colby Lake would no longer be withdrawn (PolyMet 2015a).

Combining the flow reduction at SW-006 with the rate of process makeup water removed from Colby Lake provides an estimate of the total reduction in flow to Colby Lake. The maximum predicted reduction to average annual flow due to the NorthMet Project Proposed Action at SW-006 is 1.7 percent, occurring during mine year 11, which corresponds to an average annual flow reduction of 600 gpm (1.3 cfs) (Table 5.2.2-26). The average and maximum Colby Lake annual withdrawal rates during operations are 760 gpm (1.7 cfs) and 1,750gpm (3.9 cfs). Therefore, the estimated annual average reduction in flow to Colby Lake is 1,360 gpm (3.0 cfs) with a maximum withdrawal rate of 2,350 gpm (5.2 cfs). The NorthMet Project Proposed Action DEIS (MDNR and USACE 2009) evaluated two potential Colby Lake withdrawal rates, 3,500 gpm and 5,000 gpm. The model assumed transfer of water from Whitewater Reservoir in order to maintain water levels above the critical outflow elevation of 1,439 ft at all times in Colby Lake, which is required under MDNR Water Appropriation Permit 1949-0135.

The evaluation criterion for Colby Lake and Whitewater Reservoir is an assessment of the annual mean, maximum, and minimum lake level changes from existing conditions. At a 3,500 gpm withdrawal rate and average flow conditions, the average Colby Lake drawdown over the modeled period was 0.01 ft, with an average annual water level fluctuation of about 3.6 ft, compared to 3.9 ft for zero withdrawal. Whitewater Reservoir would also be affected by water withdrawals, as it is used to help maintain water levels in Colby Lake. Under this 3,500 gpm withdrawal and average flow conditions scenario, drawdown on Whitewater Reservoir was predicted to be about 0.4 ft with a maximum annual fluctuation of about 4.2 ft, compared to about 2.9 ft for zero withdrawal (PolyMet 2015m). Environmental consequences of the drawdown on wetlands and aquatic resources are discussed in Sections 5.2.3 and 5.2.6, respectively.

It is reasonable to assume that the effects of PolyMet’s proposed withdrawal of less than 3,500 gpm would be no worse on Colby Lake and Whitewater Reservoir water levels than this modeled 3,500 gpm withdrawal. These anticipated effects on water levels are well within the range experienced during the former LTVSMC taconite mining operations.

Effects on the Hydrology of the Lower Partridge River

Existing flow conditions in the Lower Partridge River can be estimated by examining the flow record (i.e., 1942 to 1982) at USGS gaging station 04016000, which was located approximately 1.5 miles downstream of Colby Lake. Historic hydrologic alterations to Partridge River watershed area caused by former LTVSMC operations are likely present in the USGS flow data, while alterations from the present Mesabi Nugget operations are not considered. Notwithstanding these effects, the historic flow records can be used to provide a reasonable estimate of NorthMet Project Proposed Action effects on the Lower Partridge River.

The record shows average monthly flows varying from about 17 cfs during February to about 333 cfs during May, with an average annual flow of about 112 cfs. As described above, the maximum effect of the NorthMet Project Proposed Action on streamflow into Colby Lake would be a net reduction in flow of about 3.0 to 4.2 cfs during operations, which would represent about a 2.7 to 3.8 percent decrease in the average annual flow at the gage site. This withdrawal cannot simply be subtracted from each month to estimate effects on low or high flows because of required transfer of water from Whitewater Reservoir when Colby Lake drops to elevation 1,439.0. Given this requirement to supplement low flows by transferring water from the reservoir, it is expected that effects on low flows at the gage station would be negligible. Effects on high flows would be less than on average flows, and would proportionately diminish as the flow increases. Note that high flows downstream of Colby Lake would also be substantially reduced because of water transfers to the reservoir during high runoff periods, which reflects existing operating procedures. Therefore, the NorthMet Project Proposed Action is expected to have negligible effects on flow in the Lower Partridge River. Note that during closure, once the West Pit floods, the hydrology of the Partridge River is expected to return to relatively normal conditions with no net change in average annual flow at SW-006 (Table 5.2.2-26).

Effects on the Hydrology of Second Creek

Second Creek is the only Lower Partridge River tributary stream that could be notably affected by the NorthMet Project Proposed Action. The current estimated average seepage rate is about 230 gpm (Table 5.2.2-42). Historically, seepage from the southern side of the Tailings Basin entered the headwaters of Second Creek. In July 2011, a seepage collection system was installed, which returned most of the south-side seepage to the Tailings Basin pond. Under the NorthMet Project Proposed Action, the seepage collection system would be upgraded to ensure essentially 100 percent capture of the southern side surface seepage. If seepage were observed to bypass the existing dam, a second dam could be constructed approximately 500 ft downstream of the existing system, in an area where the Second Creek headwaters valley is more constricted and any remaining subsurface seepage would have come to the surface. This potential second dam could be constructed as an earthen dam with a clay or concrete cutoff wall (extending to bedrock if necessary) in order to achieve 100 percent capture of the surface seepage. As part of its streamflow augmentation plan (PolyMet 2015j), PolyMet would discharge WWTP effluent to the headwaters of Second Creek at a rate equal to a minimum of 80 percent of the uncaptured south-side seepage rate, or at least 184 gpm, to compensate for interception of the south-side seepage. The effects of the NorthMet Project Proposed Action on Second Creek streamflow would be minimal.

<u>Effects on Surface Water Quality</u>

The NorthMet Project Proposed Action would affect the water quality of the Partridge River and its tributaries that drain the Mine Site, Transportation and Utility Corridor, and the processing plant area. PolyMet proposes to treat and re-use water, resulting in no direct surface water discharges to the Partridge River until the West Pit completely refills by approximately year 52. The West Pit would not be allowed to overflow until its water quality meets water quality based effluent limits. During operations, reclamation, and closure and post-closure maintenance there would be continuous augmentation at the Plant Site to Second Creek, which is a tributary of the Partridge River. Several other potential pathways for surface water quality effects include domestic wastewater, non-contact stormwater runoff, and seepage from waste rock stockpiles.

PolyMet proposes to manage domestic wastewater by providing portable facilities serviced by a supplier at the Mine Site. These portable facilities would be designed to adequately manage the domestic wastewater requirements of the NorthMet Project Proposed Action, so this potential contaminant source is not discussed further.

The other predicted effects of the NorthMet Project Proposed Action on surface water quality in the Upper Partridge River, Colby Lake, and the Lower Partridge River are discussed below.

Effects on the Upper Partridge River

Water quality in the Upper Partridge River (upstream of Colby Lake) is already affected by discharges from the Northshore Mine. As mentioned above, PolyMet does not propose any surface water discharges to the Upper Partridge River until the West Pit floods around year 52. However, non-contact stormwater runoff, unrecoverable groundwater seepage from the five groundwater flowpaths (i.e., from the waste rock stockpiles, pits, Ore Surge Pile, WWTF, and Overburden Storage and Laydown Area), and the WWTF discharge would all serve as contaminant sources to the Upper Partridge River. Each of these sources is discussed below and then the predicted overall effect of these sources on water quality in the Upper Partridge River is evaluated.

Non-contact Stormwater Runoff

PolyMet proposes to collect non-contact stormwater runoff from undisturbed and reclaimed vegetated areas within the Mine Site and route it to the Partridge River via existing drainage patterns to the extent possible. Stormwater quality is not expected to differ significantly from existing conditions because it would not contact any reactive rock, but there would be the potential for increased suspended solids. PolyMet would provide sedimentation ponds at the outlet locations to manage suspended solids prior to discharge to surface waterbodies (see Figures 3.2-5, 3.2-6, 3.2-7, and 3.2-8). These sedimentation ponds should be adequate to manage suspended solids, but monitoring of the discharge is recommended as part of any NPDES/SDS permit (see Section 4.1.3.5 for a discussion of recommended monitoring measures).

Unrecovered Groundwater Seepage from Liner Leakage and Pit Seepage

The WWTF equalization basins, Ore Surge Pile, Category 2/3 Stockpile, and Category 4 Stockpile would all have compacted soil and geomembrane liners. Percolating water above the liner would be collected and pumped to the WWTF for treatment.

Some water is predicted to leak through the liners as a result of tears or defects in the geomembrane liners and this effect is included in the GoldSim model. The quantity of water leaking through the liners is determined by the liner design and effectiveness. The Hydrologic Evaluation of Landfill Performance model was used to help estimate liner leakage, including the use of uncertainty analysis for three key input variables (i.e., liner slope, subgrade permeability, and frequency of liner defects) (PolyMet 2015m).

The proposed liner systems would be installed in accordance with the proposed design using rigorous quality control measures consistent with industry standards. Current construction practices and improvements in electrical leak detection surveys should be able to achieve the proposed design criteria (i.e., defects/acre, overliner slope, and subgrade permeability). Concerns regarding geomembrane liners primarily relate to the potential for differential settlement to cause tears and for it to degrade over time. These concerns are tempered by the fact that all of the proposed liner systems would be temporary. The Ore Surge Pile and Category 2/3 and 4 stockpiles would be removed, including the liners, by year 21. The WWTF equalization basins would remain in use while the East Pit is being treated in reclamation and closure and post-closure maintenance until approximately year 33.

Because the Category 4 waste rock stockpile would be surrounded by mine pits and its footprint later becomes the Central Pit, any liner leakage from the stockpile would not enter a groundwater flowpath, and would instead be assumed to enter the East Pit and contribute to the flow that must be dewatered from the pit during operations.

During reclamation and closure and post-closure maintenance, small volumes of water are predicted to flow from the pits into the downgradient surficial groundwater. These untreated pit releases would include East Pit backfill pore water into the East Pit Category 2/3 Surficial Flowpath (beginning year 20) and West Pit lake water into the West Pit Surficial Flowpath (beginning year 48). These releases to surficial groundwater would continue in perpetuity. Groundwater in these flowpaths would flow downgradient and eventually reach the Partridge River.

Liner leakage from the Overburden Storage and Laydown Area, WWTF, Ore Surge Pile, and Category 2/3 Stockpile would also follow groundwater flowpaths that eventually reach the Partridge River, but would only be temporary sources. The leakage/seepage flow rates associated with these solute sources are generally low and are summarized in Table 5.2.2-27. For P50 inputs, depending on the flowpath, the initial concentration change in groundwater discharging to the Partridge River would occur at 8 to 85 years after the start of mining, and peak concentrations would occur in the range of 20 to 155 years (see Table 5.2.2-22). After peak concentrations were achieved, the groundwater concentrations would gradually decrease over many tens to hundreds of years. Note that for the Overburden Storage and Laydown Area flowpath, most solutes would experience a decrease in concentration downgradient of the source.

Table 5.2.2-27 Pit Outflow and Liner/Equalization Basin Leakage into Groundwater Flowpaths (Based on GoldSim Deterministic Run with P50 Inputs)

Contaminant Source	Flow Rate (gpm)	Duration of Source (Mine Years)	Mine Year when Solute Plume First Arrives at Partridge River
East Pit	3.75[1]	20+	100
Category 2/3 Stockpile	0.0193	0–20	35
Ore Surge Pile	0.00116	0–21	90
WWTF Equalization Basins	0.0138	0–33	85
Overburden Storage and Laydown Area	14.0	0–20	30[2]
West Pit	6.09[1]	48+	105

1 Pit water into groundwater flowpath.
2 Concentration decrease.

Category 1 Stockpile Seepage

During operations, the Category 1 Stockpile would be uncovered. Infiltration would percolate to the bottom of the stockpile, where it would be collected by the surface and groundwater seepage containment system. As the stockpile footprint is expanded, the total seepage during operations would increase up to a maximum annual rate of 290 and 440 gpm. Most of this seepage would be collected and sent to the WWTF for treatment. An estimated maximum rate of 20 to 30 gpm would pass below the containment system and be drawn by gravity into the dewatered West Pit.

The Category 1 Stockpile would have a permanent cover consisting of a synthetic cover (geomembrane) overlain by a compacted soil and vegetated growth medium, which would be installed progressively during operations, starting in mine year 14 and planned to be completed by the end of year 21. During reclamation and closure and post-closure maintenance, the total seepage rate from the stockpile is estimated to be about 2.75 gpm. About 2.59 gpm of this seepage would be collected by the surrounding surface and groundwater seepage containment system and sent to the WWTF for treatment. About 0.16 gpm would pass below the containment system and migrate as bedrock groundwater into the West Pit. None of the seepage would flow directly into any of the surficial flowpaths.

Wastewater Treatment Facility Discharges

PolyMet proposes a WWTF at the Mine Site to treat affected water from the sources summarized in Table 5.2.2-28. This table presents P90 (high-end) estimated average Mine Site process water flow rates by source for the indicated design year (which are years 14, 25, and 75 for operations, reclamation, and closure and post-closure maintenance, respectively). Details regarding some of these WWTF influent sources are discussed below. The process water at the Mine Site would be combined into three waste streams for treatment at the WWTF. Construction water would be treated in a construction water stream and would only be needed through approximately year 11. Process water containing relatively high levels of metals and sulfate (drainage from the temporary Category 2/3 Stockpile and Category 4 Stockpile liners and the temporary Ore Surge Pile liner) would be stored in the West Equalization Basin and routed to the chemical precipitation treatment train. Process water containing relatively low concentrations of metals and sulfate (drainage from haul roads, the Rail Transfer Hopper, pit dewatering, and Category 1 Stockpile drainage) would be stored in the East Equalization Basin and routed to the filtration treatment train. The WWTF effluent would be conveyed to the Central Pumping Station pond to be blended with the Overburden Storage and Laydown Area runoff prior to being pumped through the Treated Water Pipeline for use at the Tailings Basin or used to supplement flooding of the East Pit after approximately year 11 (PolyMet 2015r).

Table 5.2.2-28 P90 Mine Site Process Water Flows to the Wastewater Treatment Facility

	90th Percentile Estimated Average Annual Flow (gpm)		
Source	**Operations[2]**	**Reclamation[3]**	**Closure and Post-Closure Maintenance[4]**
East Pit	1,035	1,750[5]	--
Central Pit	55	--	--
West Pit	365	--	400
Haul Roads and Rail Transfer Hopper	65	--	--
Category 1 Stockpile	375	10	10
Category 2/3 Stockpile	145	--	--
Ore Surge Pile	25	--	--
Category 4 Stockpile	0	--	--
WWTP Reject Concentrate	145	175	--
Total[1]	2,065	1,925	405

Source: PolyMet 2015d, Table 2-1.

1 Flows are rounded to the nearest 5 gpm; column values do not sum to 90th percentile total value due to probabilistic modeling (P90 of totals is not equivalent to the total of the P90s).
2 Estimates based on PolyMet 2015m for year 14 (Design Year), 90th Percentile.
3 Estimates based on PolyMet 2015m for year 25, 90th Percentile.
4 Estimates based on PolyMet 2015m for year 75, 90th Percentile.
5 Flow value is total of East Pit and Central Pit.

Actual flow rates would vary both daily and seasonally throughout the 20 years of mine operations. Peak influent flows to the WWTF are anticipated to occur during spring snowmelt. Because influent flow rates to the WWTF would vary significantly over the life of the NorthMet Project Proposed Action and within any given year, the WWTF design includes two equalization basins that would store influent when flows exceed the WWTF's treatment capacity. The WWTF equalization basins are designed for the spring snowmelt, when the Mine Site would be at its maximum area. In the event of an extreme event (e.g., 100-year storm), excess water would remain in the initially dewatered mine pits, which essentially have unlimited storage capacity, with mine operations in the pits temporarily shut down (see PolyMet 2015r). Even during an extreme event, no untreated water would be discharged to a natural water body.

The WWTF process design for operations and reclamation includes chemical precipitation and nano-membrane separation. During mine operations, the treated effluent from the WWTF would be mixed with the runoff collected from the Overburden Storage and Laydown Area in the Central Pumping Station pond, where it would be pumped either to the Tailings Basin pond (for re-use as process water at the Beneficiation Plant) or to help re-saturate the East Pit backfill (after mining would be completed in year 11). The pH in the East Pit backfill would be monitored and adjusted by the addition of alkaline water from the WWTF as backfilling progresses to maintain near-neutral conditions in the backfill pore water. During mine reclamation, the WWTF would primarily be used for treating East Pit backfill surface water and to accelerate flooding of the West Pit.

During mine closure and post-closure reclamation, the WWTF would be used to treat water collected from the Category 1 Stockpile containment system and pumped water from the West Pit. Since the West Pit would now be flooded, the WWTF would begin in closure and post-closure maintenance to discharge effluent to the West Pit Outlet Creek, a natural intermittent stream that flows to the Partridge River just upstream of SW-004a. The treated effluent would need to meet applicable effluent limits. During closure and post-closure maintenance, the existing WWTF nano-membrane system would be converted to an RO system with an evaporator/spray dryer or equivalent unit. Reject concentrate from the primary membrane separation unit would continue to be treated with existing secondary membrane separation and chemical precipitation equipment, or would be evaporated and the residual solids disposed offsite.

Table 5.2.2-29 presents the target WWTF effluent concentrations for the different mine phases. Pilot-testing of a WWTF with RO demonstrated that all of the target closure effluent concentrations could be achieved with the planned WWTF design (Barr 2013f).

Table 5.2.2-29 Wastewater Treatment Facility Preliminary Water Quality Targets

Parameter[1]	Targets			Basis
	Operations	Reclamation	Closure and Post-Closure Maintenance	
Metals/Inorganics (µg/L, except where noted)				
Aluminum	125	125	125	M.R., part 7050.0222 Class 2B (chronic standard)
Antimony	31	31	31	M.R., part 7050.0222 Class 2B (chronic standard)
Arsenic	10	10	4	Federal Standard (pMCLs)
Barium	2,000	2,000	2,000	Minn. Groundwater (HRL, HBV5, or RAA)
Beryllium	4	4	4	Federal Standard (pMCLs)
Boron	500	500	500	M.R., part 7050.0224 Class 4A (chronic standard)
Cadmium[2]	5.1	4.2	2.5	M.R., part 7052.0100 Class 2B (chronic standard)
Chromium III[2]	86	86	86	M.R., part 7052.0100 Class 2B (chronic standard)
Cobalt	5	5	5	M.R., part 7050.0222 Class 2B (chronic standard)
Copper[2]	20	17	9.3	M.R., part 7052.0100 Class 2B (chronic standard)
Iron	300	300	300	Federal Standard (sMCLs)
Lead[2]	10.2	7.7	3.2	M.R., part 7050.0222 Class 2B (chronic standard)
Manganese	50	50	50	Federal Standard (sMCLs)
Nickel[2]	113	94	52	M.R., part 7052.0100 Class 2B (chronic standard)
Selenium	5	5	5	M.R., part 7052.0100 Class 2B (chronic standard)
Silver	1	1	1	M.R., part 7050.0222 Class 2B (chronic standard)
Thallium	0.56	0.56	0.56	M.R., part 7050.0222 Class 2B (chronic standard)
Zinc[2]	260	216	120	M.R., part 7050.0222 Class 2B (chronic standard)
General Parameters (mg/L, except where noted)				
Chloride (mg/L)	230	230	230	M.R., part 7050.0222 Class 2B (chronic standard)
Fluoride (mg/L)	2	2	2	Federal Standard (sMCLs)
Hardness (mg/L)[3]	250	200	100	Hardness PWQT chosen to establish PWQTs for metals with a hardness based standard
Sodium	60% of cations	60% of cations	60% of cations	M.R., part 7050.0224 Class 4A (chronic standard)
Sulfate (mg/L)	250	150	9	Operations: Federal Standard (sMCLs) Long-term closure: M.R., part 7050.0224 Class 4A

Source: PolyMet 2015d; Barr 2013f, Table 3.

M.R. = Minnesota Rules
1 The Process Water Quality Targets parameter list has been updated from RS29T to include only the parameters modeled in GoldSim.
2 Standard based on hardness.
3 *Minnesota Rules,* part 7050.0223 Class 3C standard for hardness is 500 mg/L.

Comparison of Contaminant Sources

The GoldSim model enables the identification of "culpability," or the relative contribution of various contaminant sources to the overall contaminant load at a specific evaluation location. Table 5.2.2-30 presents an illustrative example of the culpability analysis using two representative solutes of interest (copper and sulfate) at evaluation location SW004a during representative years for operations, reclamation, and closure and post-closure maintenance periods. The culpability identifies 12 sources of copper and sulfate at this evaluation location. In addition to the eight NorthMet Project Proposed Action-related sources (i.e., five surficial aquifer flowpaths, two bedrock flowpaths, and the WWTF discharge), three non-NorthMet Project Proposed Action-related sources are identified (i.e., background groundwater, non-contact stormwater runoff, and the Northshore Mine discharge).

Table 5.2.2-30 Culpability Analysis for Copper and Sulfate at SW-004a Based on GoldSim P50 Results

	Copper Load (% of total)			Sulfate Load (% of total)		
Contaminant Source	**Operations Year 12**	**Reclamation Year 25**	**Closure and Post-Closure Maintenance Year 200**	**Operations Year 12**	**Reclamation Year 25**	**Closure and Post-Closure Maintenance Year 200**
Background Groundwater	17.9%	19.1%	16.5%	9.1%	9.5%	13.9%
Non-contact Stormwater	72.1%	70.2%	64.0%	56.6%	55.5%	80.6%
Northshore Mine Discharge	8.8%	9.4%	0.0%	33.7%	34.3%	0.0%
East Pit Category 2/3 Surficial GW Flowpath[1]	0.6%	0.8%	0.7%	0.3%	0.4%	0.7%
East Pit Bedrock GW Flowpath	0.0%	0.002%	0.002%	0.0%	0.005%	0.007%
Ore Surge Pile Surficial GW Flowpath[1]	0.1%	0.2%	0.1%	0.1%	0.1%	0.1%
WWTF Surficial GW Flowpath[1]	0.1%	0.1%	0.1%	0.04%	0.04%	0.1%
Overburden Storage and Laydown Area Surficial GW Flowpath[1]	0.5%	0.3%	0.2%	0.2%	0.1%	0.2%
West Pit Surficial GW Flowpath[1]	0.0%	0.0%	0.3%	0.0%	0.0%	0.5%
West Pit Bedrock GW Flowpath	0.0%	0.0%	0.0%	0.0%	0.0%	0.004%
WWTF discharge	0.0%	0.0%	18.1%	0.0%	0.0%	4.0%

Source: PolyMet 2014v.

GW = Groundwater.
[1] Includes NorthMet Project Proposed Action-related loading and loading associated with meteoric recharge into the flowpath.

As Table 5.2.2-30 indicates, the primary source of contaminant load for both copper and sulfate at SW-004a for operations, reclamation, and closure and post-closure maintenance phases are the non-NorthMet Project Proposed Action-related sources (background groundwater, surface water, and Northshore Mine discharge). In addition, the WWTF discharge represents an important source of copper in closure and post-closure maintenance, and a minor source of sulfate.

Evaluation of Surface Water Quality for the Upper Partridge River

Results of the GoldSim water quality modeling were reviewed for 29 constituents at the seven Partridge River surface water evaluation locations listed in Table 5.2.2-31. Station SW-001, upstream of SW-002, is not an evaluation location because its water chemistry is essentially the same as that of the Northshore Mine discharge. The screening process described previously for constituents without hardness-based evaluation criteria (see Section 5.2.2.2.3) was applied to 23 constituents to identify constituents and locations that warranted a more robust examination. The screening process involved comparing the single-highest monthly P90 water quality prediction (maximum P90 concentration) for the NorthMet Project Proposed Action to the associated evaluation criterion, excluding the first year of simulation as discussed previously. The bold entries in Table 5.2.2-31 identify constituents and locations with maximum P90 values that exceed the associated evaluation criterion and are retained for further evaluation. These include sulfate (SW-005 and SW-006) and aluminum (all evaluation locations).

Table 5.2.2-30 shows that the maximum P90 solute concentrations for the NorthMet Project Proposed Action are similar to the corresponding CEC scenario modeled values for most of the constituents. Some of the NorthMet Project Proposed Action maximum P90 values—such as those for antimony, cadmium, cobalt, copper, nickel, vanadium, and zinc at SW-004a, SW-004b, SW-005, and SW-006, and sulfate and lead at SW-004a and SW-004b—are noticeably higher than the CEC scenario maximum P90 values, but the NorthMet Project Proposed Action values for these constituents all remain well below the applicable evaluation criteria.

While listed in Table 5.2.2-31, six constituents with hardness-based evaluation criteria (cadmium, chromium III, copper, lead, nickel, and zinc) were screened using a different methodology because the associated evaluation criteria could not be described by single values; this methodology was previously discussed in Section 5.2.2.2.3. Using this methodology, Table 5.2.2-32 summarizes the initial screening of Mine Site surface water constituents that have hardness-based evaluation criteria. As shown, the probability of the NorthMet Project Proposed Action exceeding the evaluation criterion, when CEC does not, is less than 5 percent for all constituents and locations. As a consequence, all of the Mine Site surface water constituents with hardness-based evaluation criteria are not considered further in this FEIS.

Table 5.2.2-31 Mine Site Surface Water – Maximum P90 Solute Concentration Over Entire 200-Year Simulation with Initial Screening of Constituents without Hardness-Based Evaluation Criteria

			SW-002		SW-003		SW-004		SW-004a		SW-004b		SW-005		SW-006	
Parameter	**Partridge Evaluation Criteria**	**Units**	**NorthMet Project Proposed Action**	**CEC Scenario**	**NorthMet Project Proposed Action**	**CEC Scenario**	**NorthMet Project Proposed Action**	**CEC Scenario**	**NorthMet Project Proposed Action**	**CEC Scenario**	**NorthMet Project Proposed Action**	**CEC Scenario**	**NorthMet Project Proposed Action**	**CEC Scenario**	**NorthMet Project Proposed Action**	**CEC Scenario**
General																
Alkalinity	NA	mg/L	152.7	152.4	150.8	150.7	150.6	150.6	152.4	152.9	150.5	150.8	147.4	147.9	145.8	146.3
Calcium	NA	mg/L	38.0	38.0	37.9	37.8	37.9	37.8	38.0	38.0	37.9	37.9	36.9	36.9	36.7	36.7
Chloride	230	mg/L	16.9	16.9	16.8	16.8	16.8	16.7	16.8	16.9	16.8	16.8	16.4	16.4	16.4	16.4
Fluoride	NA	mg/L	0.21	0.21	0.21	0.20	0.21	0.21	0.21	0.21	0.21	0.21	0.20	0.20	0.20	0.20
Hardness	500	mg/L	135.9	135.8	133.9	132.9	133.3	132.6	134.7	135.2	134.4	134.4	131.7	131.7	131.4	131.4
Magnesium	NA	mg/L	15	15	14.9	14.9	14.6	14.5	14.4	14.5	14.3	14.3	13.9	13.9	13.9	14
Potassium	NA	mg/L	5.01	5.01	4.98	4.97	5.03	4.97	4.98	5.02	4.96	4.98	4.86	4.88	4.83	4.84
Sodium	NA	mg/L	13.2	13.1	13.1	13	13.1	12.9	23.8	13.2	15.9	13.1	13.2	12.8	13.3	13
Sulfate	NA / 10[(1)]	mg/L	27.3	27.3	27.1	27.1	26.4	26.3	24.3	24.2	22.1	22	**18.3**	**18.2**	**17.6**	**17.6**
TDS	700	mg/L	207	207	205	205	204	204	214	204	202	200	192	192	190	191
Metals Total																
Aluminum	125	µg/L	**313.3**	**313.1**	**312.1**	**311.6**	**311.8**	**311.5**	**310.2**	**314.9**	**310.1**	**312.6**	**307.5**	**308.8**	**305.6**	**308.0**
Antimony	31	µg/L	0.25	0.25	0.25	0.25	0.26	0.25	4.15	0.25	2.59	0.25	1.39	0.25	1.13	0.25
Arsenic	53	µg/L	2.59	2.59	2.58	2.58	2.59	2.59	2.69	2.64	2.62	2.62	2.62	2.61	2.61	2.59
Barium	NA	µg/L	31.1	31.2	29.9	30.0	28.3	28.5	34.8	30.5	31.4	29.0	25.8	23.9	24.7	22.8
Beryllium	NA	µg/L	0.12	0.12	0.12	0.12	0.12	0.12	0.25	0.12	0.20	0.12	0.15	0.11	0.14	0.11
Boron	500	µg/L	199.7	199.4	197.8	196.4	197.5	196.7	199.7	201.7	198.2	199.3	195.3	195.5	192.8	193.1
Cadmium	NA[2]	µg/L	0.17	0.17	0.16	0.16	0.16	0.16	0.93	0.17	0.57	0.16	0.34	0.16	0.28	0.16
Chromium III	NA[2]	µg/L	1.44	1.44	1.44	1.44	1.44	1.44	1.74	1.47	1.48	1.48	1.46	1.46	1.44	1.45
Cobalt	5	µg/L	1.29	1.29	1.29	1.29	1.29	1.28	3.11	1.29	2.21	1.29	1.58	1.25	1.44	1.27
Copper	NA[2]	µg/L	3.48	3.48	3.44	3.44	3.42	3.41	5.79	3.48	4.47	3.44	3.40	3.34	3.36	3.32
Iron	NA	µg/L	5,917	5,913	5,858	5,845	5,850	5,843	5,864	5,933	5,824	5,890	5,746	5,765	5,710	5,728
Lead	NA[2]	µg/L	0.94	0.94	0.92	0.92	0.92	0.92	1.85	0.97	1.37	1.03	1.06	1.05	1.05	1.05
Manganese	NA	µg/L	575.2	575.4	548.2	549.0	523.2	522.9	443.6	568.0	452.1	533.7	403.9	442.4	395.0	419.3
Nickel	NA[2]	µg/L	4.35	4.34	4.31	4.29	4.27	4.26	26.7	4.36	16.9	4.31	9.17	4.15	7.77	4.09
Selenium	5	µg/L	1.53	1.53	1.52	1.52	1.51	1.51	1.54	1.54	1.53	1.52	1.49	1.49	1.50	1.49
Silver	1	µg/L	0.11	0.11	0.11	0.11	0.11	0.11	0.16	0.11	0.14	0.11	0.12	0.11	0.12	0.11
Thallium	0.56	µg/L	0.12	0.12	0.12	0.12	0.11	0.11	0.11	0.12	0.11	0.11	0.09	0.09	0.09	0.09
Vanadium	NA	µg/L	3.57	3.57	3.47	3.47	3.38	3.34	6.72	3.51	5.28	3.40	3.87	2.92	3.62	2.82
Zinc	NA[2]	µg/L	25.4	25.4	25.6	25.5	25.5	25.4	48.7	25.4	32.7	25.6	25.9	25.5	27.0	25.9

Source: PolyMet 2015m and PolyMet 2014v

Notes: Bold value indicates exceedance of the evaluation criterion.
[1] Sulfate 10 mg/L wild rice evaluation criterion applies at SW-005 and SW-006
[2] Parameter has a hardness-based evaluation criterion and is screened using a different procedure (see Table 5.2.2-32)

2776 -Page Intentionally Left Blank-

Table 5.2.2-32 Mine Site Surface Water – Screening of Constituents with Hardness-Based Evaluation Criteria[1]

Constituent	SW-003		SW-004		SW-004a	
	Exceedance Probability of PA > CRT (%)	Probability of PA > CRT and CEC ≤ CRT (%)	Exceedance Probability of PA > CRT (%)	Probability of PA > CRT and CEC ≤ CRT (%)	Exceedance Probability of PA > CRT (%)	Probability of PA > CRT and CEC ≤ CRT (%)
Cadmium	0.02	0.00	0.02	0.00	0.02	0.00
Chromium III	0.00	0.00	0.00	0.00	0.00	0.00
Copper	1.68	0.08	0.47	0.03	0.43	0.02
Lead	3.62	0.13	1.67	0.05	1.60	0.03
Nickel	0.23	0.03	0.13	0.02	0.13	0.02
Zinc	1.00	0.07	0.47	0.03	0.47	0.02

Constituent	SW-004b		SW-005		SW-006		Colby Lake	
	Exceedance Probability of PA > CRT (%)	Probability of PA > CRT and CEC ≤ CRT (%)	Exceedance Probability of PA > CRT (%)	Probability of PA > CRT and CEC ≤ CRT (%)	Exceedance Probability of PA > CRT (%)	Probability of PA > CRT and CEC ≤ CRT (%)	Exceedance Probability of PA > CRT (%)	Probability of PA > CRT and CEC ≤ CRT (%)
Cadmium	0.02	0.00	0.02	0.00	0.02	0.00	0.00	0.00
Chromium III	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Copper	1.70	0.03	1.57	0.05	1.55	0.05	3.93	0.22
Lead	3.70	0.10	3.97	0.07	4.02	0.20	3.45	0.05
Nickel	0.23	0.02	0.22	0.02	0.23	0.02	0.12	0.02
Zinc	1.00	0.02	0.97	0.02	0.95	0.02	0.55	0.02

Source: GoldSim output file: "SW_NonDEg_Timeseries_PlantSite.xlsm" (NorthMet GoldSim model, version 6)

PA = NorthMet Project Proposed Action solute concentration; CEC = Continuation of Existing Conditions solute concentration; CRT = Hardness-based evaluation criterion
(bold) Indicates constituent with {PA > CRT ***and*** CEC ≤ CRT} probability greater than 5%; retained for further evaluation.
[1] Maximum of annual average values from Barr exceedance plots (see Attachment J, PS Water Modeling Data Package) or from other GoldSim outputs

Table 5.2.2-33 below compares the maximum P50 and P90 for NorthMet Project Proposed Action and the CEC Scenario modeled concentrations for selected representative solutes of interest during mine operations, reclamation, and closure and post-closure maintenance at SW-004a, which is the evaluation location where the NorthMet Project Proposed Action would have its greatest effects on water quality for most constituents. As these data show, the water quality is predicted to be essentially the same for the CEC scenario and the NorthMet Project Proposed Action modeled values for operations and reclamation. This result is not unexpected, as most of the groundwater contaminant source loads would not reach the Partridge River at the end of the reclamation period, and WWTF effluent discharge to the Partridge River would not begin until about year 48. By year 200 in closure and post-closure maintenance, which reflects when effects would have peaked and would be decreasing, the WWTF would be discharging and all groundwater contaminant source loads would have reached the Partridge River (except negligible contributions from the bedrock flowpaths), the predictions for the NorthMet Project Proposed Action for some constituents (e.g., nickel and zinc) are higher than for the CEC Scenario, but remain below applicable evaluation criteria.

Table 5.2.2-33 Comparison of the Maximum P50 and P90 Values for NorthMet Project Proposed Action and CEC Scenario Concentrations at SW-004a for Selected Key Constituents, by Phase

Parameter	Units	**Maximum** P50 Operations (Years 2-20)		**Maximum** P50 Reclamation (Years 21-55)		**Maximum** P50 **Closure &** Post-Closure Maintenance (Years 56-200)		**Maximum** P90 Operations (Years 2-20)		**Maximum** P90 Reclamation (Years 21-55)		**Maximum** P90 **Closure &** Post-Closure Maintenance (Years 56- 200)	
		PA	**CEC**	**PA**	**CEC**	**P[A]**	**CEC**	**PA[1]**	**CEC[2]**	**P[A]**	**CEC**	**P[A]**	**CEC**
Sulfate	mg/L	21.9	21.7	21.8	21.7	15.8	16.4	24.2	24.1	24.3	24.2	20.1	21.6
Aluminum	µg/L	113.6	113.7	111.1	111.2	115.8	118.3	276.1	276.3	295.6	295.6	310.2	314.9
Arsenic	µg/L	1.1	1.1	1.4	1.1	2.0	1.0	2.6	2.6	2.4	2.4	2.7	2.6
Copper	µg/L	1.5	1.5	2.5	1.5	4.7	2.2	3.0	3.0	3.2	3.2	5.8	3.5
Lead	µg/L	0.4	0.4	0.7	0.4	1.5	0.5	0.9	0.9	1.0	1.0	1.9	0.9
Nickel	µg/L	1.2	1.3	6.4	1.3	19.8	1.8	3.9	3.9	9.0	3.7	26.7	4.4
Zinc	µg/L	5.7	5.7	14.2	5.7	29.8	5.4	22.4	22.4	22.5	21.9	48.7	25.4

Source: PolyMet 2014v.

[1] NorthMet Project Proposed Action

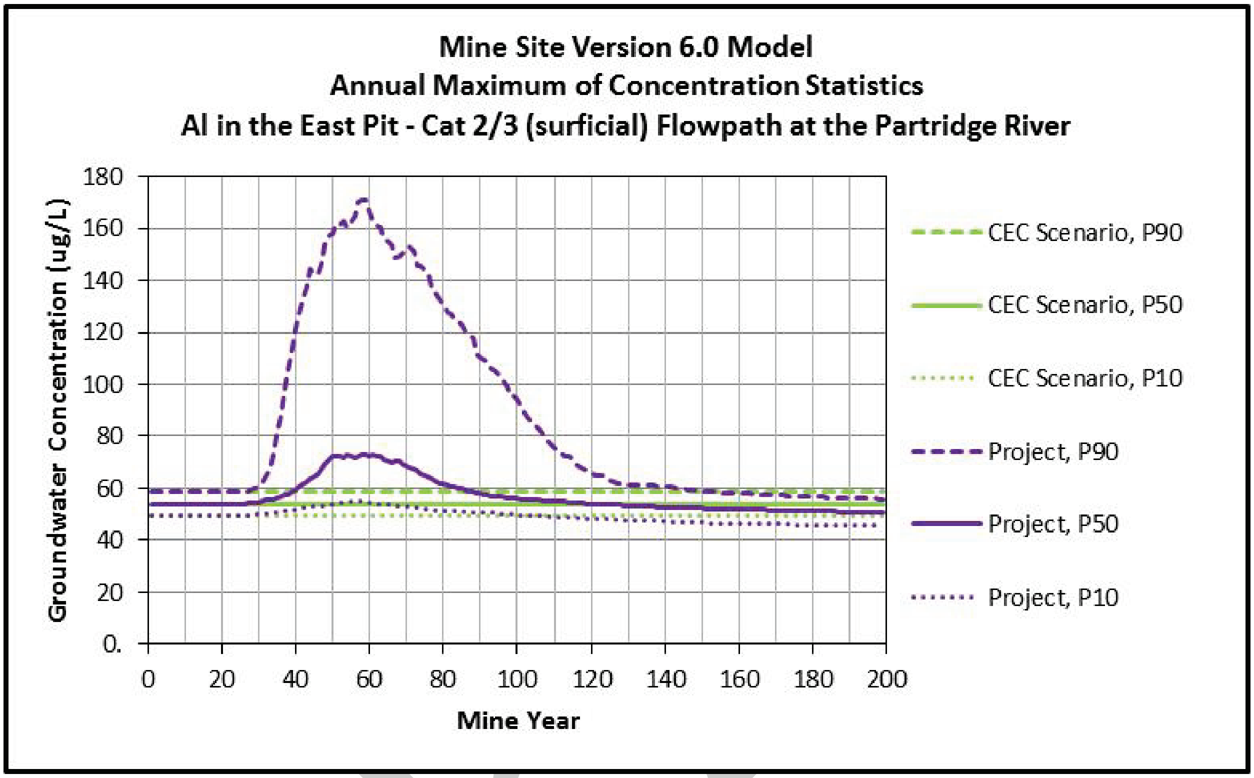
The screening presented in Tables 5.2.2-31 and 5.2.2-32 indicate that sulfate (at SW-005 and SW-006) and aluminum (all evaluation locations) have the potential to cause impacts to Mine Site surface water and require a higher level of evaluation. More detailed analyses for these constituents are provided in subsequent FEIS sections.

Aluminum in the Partridge River

Model results indicate that the maximum P90 concentration of aluminum in the Partridge River for the modeled NorthMet Project Proposed Action would exceed the evaluation criterion (125 µg/L) at all seven evaluation locations along the Upper Partridge River. Aluminum maximum P90 concentrations for NorthMet Project Proposed Action conditions range from 305.6 to 313.3 µg/L at the various evaluation locations (see Table 5.2.2-31).

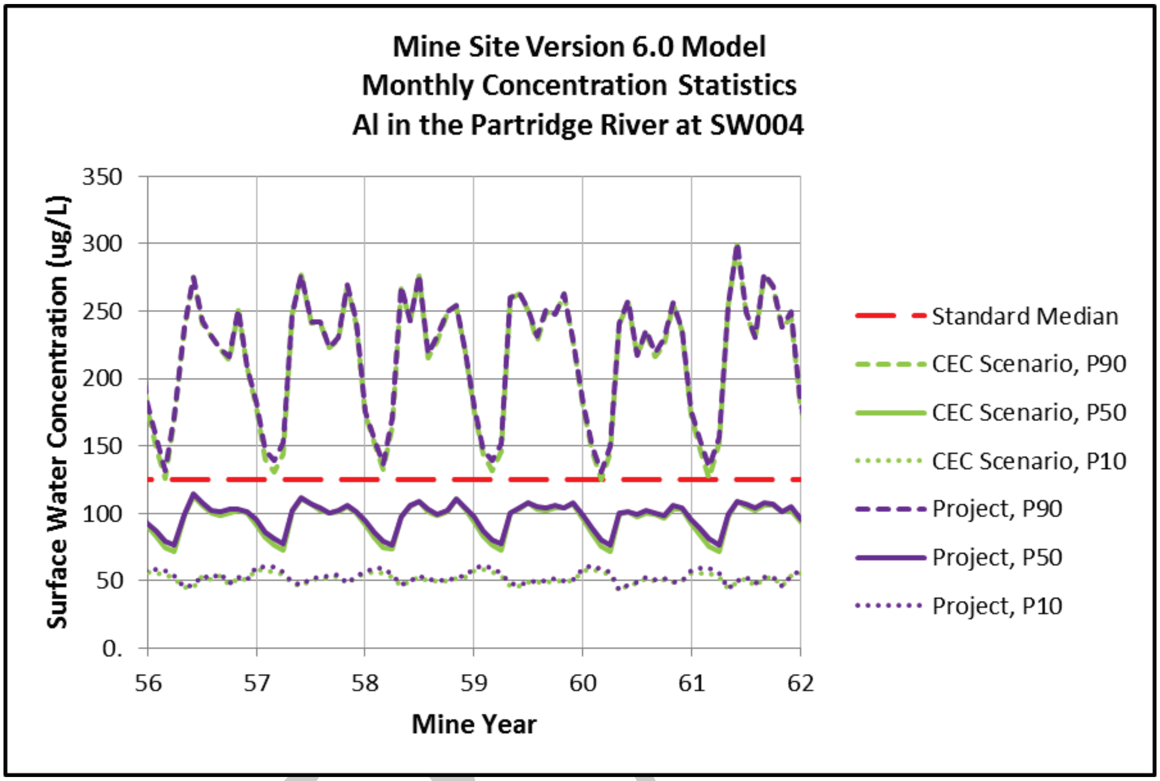
Potential sources of aluminum from the NorthMet Project Proposed Action include the East Pit – Category 2/3 Stockpile, the Ore Surge Pile, the WWTF Equalization Basins, the Overburden Storage and Laydown Area, and the West Pit. For each Mine Site contaminant source, the primary constituent migration pathway would be transport as groundwater in the surficial aquifer and eventual release of affected groundwater to the Partridge River. The groundwater flowpath that provides groundwater release to the Partridge River with P90 aluminum concentrations above the surface water quality evaluation criterion of 125 µg/L is the East Pit – Category 2/3 Stockpile flowpath, which shows a “pulse” in aluminum concentrations that would peak at about 175 µg/L between years 25 and 125 (see Figure 5.2.2-31). As the evaluation criterion is not applicable to groundwater, this pulse in aluminum concentrations would only be a concern if it was measurable upon release to the Partridge River. Figure 5.2.2-32 shows the modeled monthly aluminum concentration for years 56 to 62 at SW-004, the first surface water evaluation location downstream of the East Pit – Category 2/3 Stockpile flowpath contribution, and captures the peak of the pulse shown in Figure 5.2.2-31. As evidenced by the CEC Scenario and the NorthMet Project Proposed Action modeled concentrations being coincident in Figure 5.2.2-32, groundwater flow from the East Pit – Category 2/3 Stockpile is sufficiently diluted upon reaching the Partridge River such that effects from the NorthMet Project Proposed Action are not discernible.

2834



2835
2836 Source: PolyMet 2014v

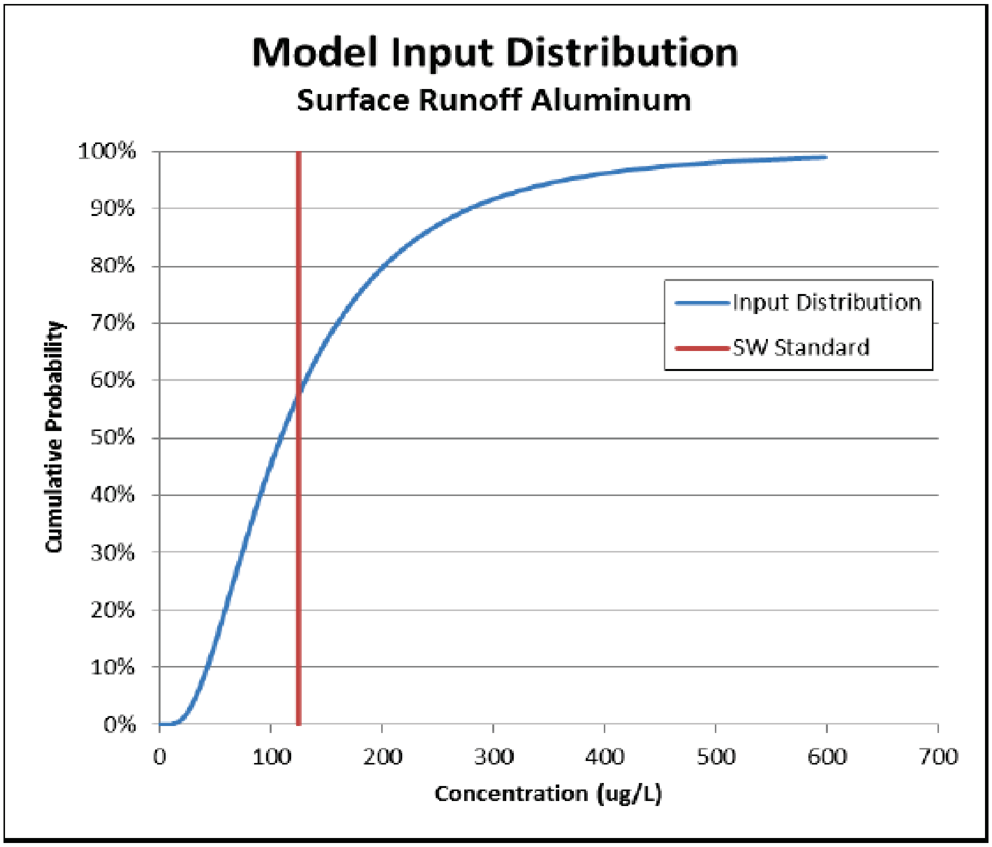
2837 ***Figure 5.2.2-31 Annual Maximum Aluminum Concentrations Along the Groundwater***
2838 ***Flowpath from the East Pit - Category 2/3 Stockpile***



Source: PolyMet 2014v

Figure 5.2.2-32 Monthly Aluminum Concentrations at SW-004

As shown in Table 5.2.2-31 comparing the modeled CEC scenario concentrations in the Upper Partridge River with the modeled NorthMet Project Proposed Action concentrations indicates that although aluminum concentrations in the Upper Partridge River would exceed the evaluation criterion the concentrations are predicted to be about the same as they would be under the CEC scenario. Therefore, it is predicted that the NorthMet Project Proposed Action would not have a measurable adverse effect on aluminum concentrations in the Upper Partridge River. In addition, as indicated in Figure 5.2.2-33, the concentrations of aluminum in background surface runoff (i.e., non-contact water) exceed the evaluation criterion of 125 µg/L approximately 20 percent of the time. This suggests that the modeled aluminum exceedances are attributable to background surface runoff, which is naturally high in aluminum, and not to effects related to the NorthMet Project Proposed Action.



Source: PolyMet 2015m

Figure 5.2.2-33 GoldSim Input – Cumulative Probability Distribution for Aluminum in Surface Runoff

<u>*Sulfate in the Partridge River*</u>

Evaluation locations SW-005 and SW-006 are located in portions of the Partridge River that the MPCA has recommended as being waters used for the production of wild rice, and therefore subject to the 10 mg/L wild rice sulfate evaluation criterion. As shown by bold font in Table 5.2.2-31, the maximum P90 sulfate concentrations at SW-005 and SW-006 for the NorthMet Project Proposed Action are 18.3 and 17.6 mg/L, respectively, which exceed the 10 mg/L criterion. The CEC scenario, however, would also exceed the wild rice evaluation criterion, so the NorthMet Project Proposed Action's compliance with the evaluation criterion requires further evaluation. The analysis below focuses on SW-005 because the NorthMet Project Proposed Action would have greater effects (higher sulfate concentrations) at this location compared to SW-006. Inspection of the GoldSim outputs verifies that predicted sulfate concentrations at SW-006 are always slightly lower than at SW-005 due to dilution effects.

SW-005 shows a dramatic reduction in sulfate concentration after mine year 55 (see Figure 5.2.2-34. Up to this time, the Northshore Mine is modeled as continuously discharging 2.6 cfs of mine water to the Partridge River with a sulfate concentration of 28 mg/L. After mine year 55, there would no longer be a Northshore Mine discharge, but the WWTF would begin to discharging approximately 0.67 cfs to the West Pit Overflow Creek with a sulfate concentration of 9 mg/L. As a consequence, the sulfate chemical load from affected water discharged to the river would decrease after mine year 55, but P90 sulfate concentrations would still exceed the evaluation criterion.

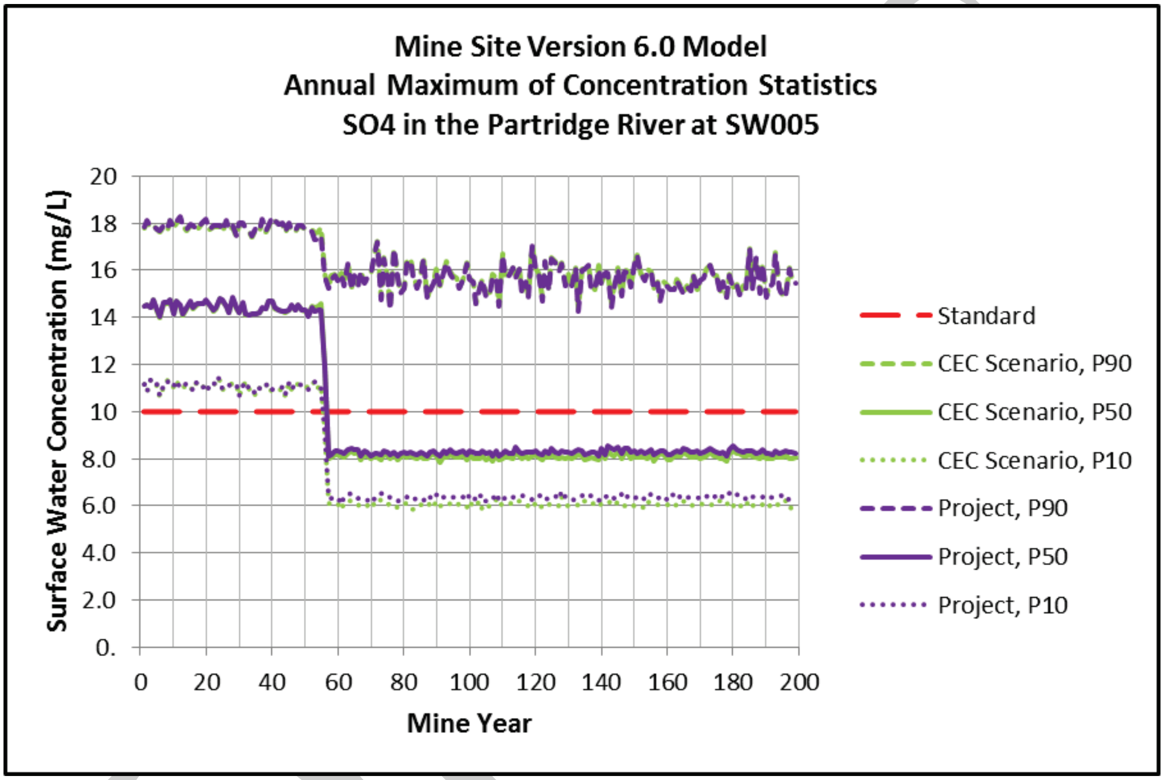


Figure 5.2.2-34 Maximum P90 of Annual Sulfate Concentration at SW-005

Monthly sulfate concentrations in the Partridge River would fluctuate with higher concentrations tending to occur during winter low flows as well as lower concentrations during the spring and summer when increased runoff occurs. For example, Figure 5.2.2-35 shows monthly sulfate concentrations for a representative time period (mine years 30-50) when the Northshore Mine discharges to the Partridge River and the WWTF discharges to the West Pit, but not to the river.. Figure 5.2.2-36 is plot for Mine Years 140-160 when the WWTF discharges to the Partridge River, all groundwater plumes have reached the River, and the Northshore Mine no longer discharges to the River. As can be seen on both figures, sulfate concentrations fluctuate on an annual basis, with highest concentrations during low-flow conditions (typically January and February) when there is less dilution from surface runoff, which typically has low sulfate concentrations.

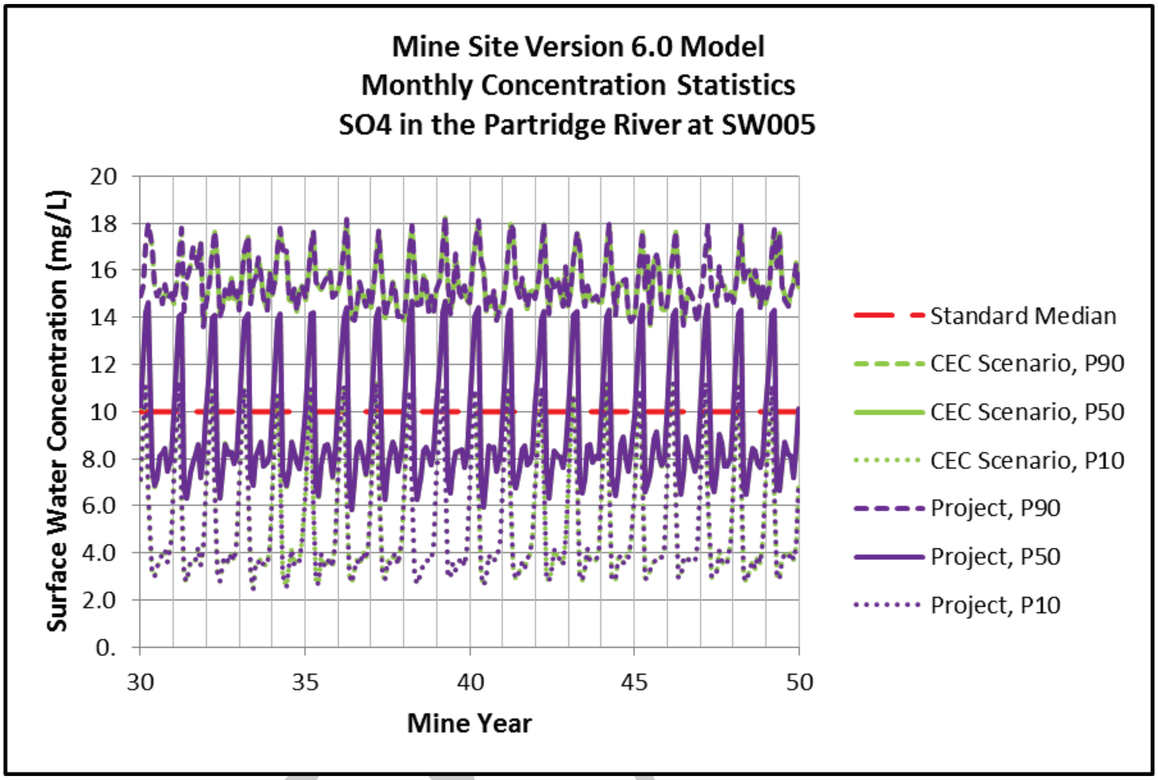


Figure 5.2.2-35 GoldSim-Predicted Sulfate Concentrations at SW-005 for Mine Years 30-50, when Northshore Mine Discharges to the Partridge River and the WWTF Discharges to the West Pit (and not to the River)

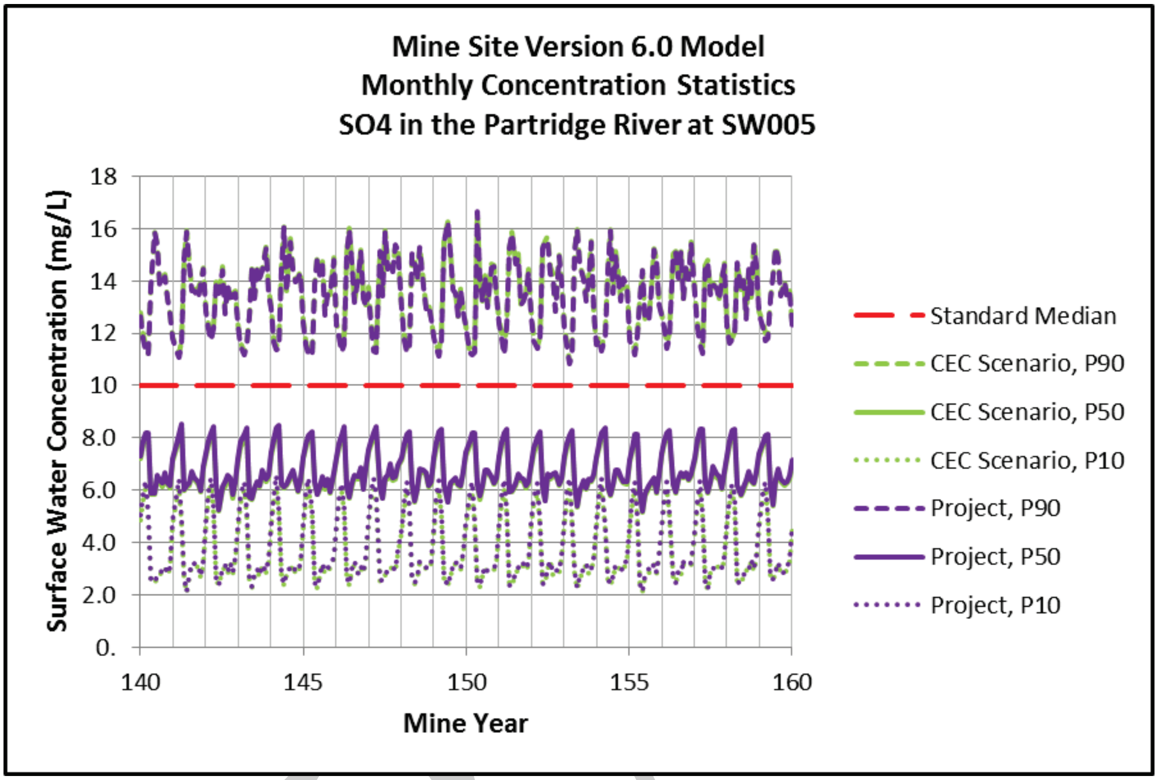


Figure 5.2.2-36 GoldSim-Predicted Sulfate Concentrations at SW-005 for Mine Years 140 -160 when the WWTF Discharges to the Partridge River, Groundwater Plumes have Reached the River, and Northshore No Longer Discharges to the River

To investigate sulfate at SW-005 in more detail, GoldSim results were evaluated on a timestep-by-timestep basis for both P50 concentrations and P90 concentrations, leading to the summary in Table 5.2.2-34. The table indicates the following:

- **Time period 0 to 55 years:** During this period, sulfate concentrations at SW-005 would always exceed the evaluation criterion at the P90 level for both the CEC and NorthMet Project Proposed Action scenarios, but under both scenarios this is attributable to background runoff, background groundwater and the Northshore Mine discharge. The NorthMet Project Proposed Action would have negligible effect on sulfate concentrations in the Partridge River during this period because it would not have any surface discharges during this time and only groundwater from the Overburden Storage and Laydown Area and Category 2/3 Stockpile flowpaths would have reached the Partridge River (initially contributing sulfate load to the river in years 30 and 35, respectively). For all conditions and timesteps, the NorthMet Project Proposed Action would not contribute more than 0.1 mg/L to the sulfate concentration in the Partridge River.
- **Time period 55 to 200 years:** During this period, sulfate concentrations at SW-005 would still always exceed the evaluation criterion at the P90 level for both the CEC and NorthMet Project Proposed Action scenarios, but would be at lower concentrations than during the Year 0 to 55 period because Northshore Mine's discharge would cease. The NorthMet Project Proposed Action's contribution to the sulfate loading increases noticeably because the WWTF begins discharging in Year 55 and the NorthMet Project Proposed Action

groundwater from other flowpaths (in addition to the OSLA and East Pit-Category 2/3 Stockpile flowpaths) begins to reach the Partridge River. The WWTF would discharge at a sulfate effluent target of 9 mg/L so it would not contribute to any exceedances of the evaluation criterion, rather it would provide dilution. The groundwater flowpaths would contribute small volumes, but higher sulfate concentrations to the Partridge River.

Overall, the NorthMet Project Proposed Action would account for approximately 3 percent of the sulfate loadings to the Partridge River at SW-005. The primary sources of sulfate loads would continue to be background runoff and background groundwater. The GoldSim model results indicate that the NorthMet Project Proposed Action would increase exceedances of the evaluation criterion less than 2 percent of the time and the maximum magnitude of this increase would be 0.1 mg/L (Table 5.2.2-34). It should be noted that the GoldSim results show that the evaluation criterion would be met essentially all the time under the NorthMet Project Proposed Action Scenario at the P50 level.

GoldSim results predict that for all situations where a theoretical impact could be attributed to the NorthMet Project Proposed Action, the expected increase in sulfate concentration at SW-005 (and SW-006) would be less than or equal to 0.1 mg/L, and this would be superimposed on typical annual fluctuations of several mg/L. A practical consequence of this result is that the effects of the NorthMet Project Proposed Action would likely not be identifiable by the proposed post-operations field monitoring program.

The small sulfate increases are explained by the small amounts of impacted and untreated water leaving the Mine Site, which only occur as groundwater. For P50 predictions during all phases of the NorthMet Project Proposed Action, the maximum amount of impacted and untreated groundwater leaving the site is 0.031 cfs (14 gpm). The maximum impact to the Partridge River would occur when this affected groundwater is released to the Partridge River during low-flow conditions. At SW-005, the average annual 1-day low flow is estimated to be 6.9 cfs (3,100 gpm) when Northshore is discharging (up to year 55) and 5.0 cfs (2,240 cfs) when only the WWTF discharges to the Partridge River (after year 55). Given the contrast between groundwater and river flows, it is apparent that the mass loading associated with groundwater flow from the Mine Site is far too small to impart a noticeable impact on sulfate concentrations in the Partridge River.

Table 5.2.2-34 GoldSim Predicted Sulfate Concentrations at SW-005

Time Period (myr)	Description	Units	Based on P50 Values	Based on P90 Values
0 – 55 (1)	Percentage of time that PA concentration > 10 mg/L	%	29.0	100.0
	Percentage of time that CEC concentration > 10 mg/L	%	28.9	100.0
	Percent of time that PA concentration > 10 mg/L ***and*** CEC concentration ≤ 10 mg/L	%	0.3	0.0
	Maximum (PA concentration – CEC concentration)	mg/L	0.05	0.09
55 – 200 (2)	Percentage of time that PA concentration > 10 mg/L	%	0.2	100.0
	Percentage of time that CEC concentration > 10 mg/L	%	0.2	100.0
	Percent of time that PA concentration > 10 mg/L ***and*** CEC concentration ≤ 10 mg/L	%	0.0	0.0
	Maximum (PA concentration – CEC concentration)	mg/L	0.27 (3)	0.10

PA = NorthMet Project Proposed Action

1 Northshore discharges 2.6 cfs with sulfate concentration of 28 mg/L; no WWTF discharge.
2 WWTF discharges at average rate of 0.67 cfs with sulfate concentration of 9 mg/L; no Northshore discharge.
3 All PA and CEC concentrations are below the wild rice sulfate evaluation criterion of 10 mg/L.

Given the low probability that sulfate concentrations from the NorthMet Project Proposed Action would be greater than predicted and identifiable from field data, a number of contingency measures could be implemented and adapted as necessary to decrease NorthMet Project Proposed Action effects on the Partridge River. As discussed in Section 5.2.2.3.5, these contingency mitigation measures could include: 1) changes in WWTF effluent sulfate concentration and flow rate, 2) installation of surface and groundwater seepage containment systems, and 3) installation of non-mechanical groundwater treatment systems.

Effects on Surface Water Quality in the Upper Partridge River Tributary Streams

This section discusses the effects on surface water quality in the four Upper Partridge River tributary streams: West Pit Outlet Creek, Wetlegs Creek, Longnose Creek, and Wyman Creek. Surface water quality in these creeks would be affected by ore spillage from the rail cars that would transport ore from the Mine Site to the processing plant during operations. Ore would range in size from 48 inches down to small gravel and dust.

Based on observations at other mining operations using similar side-dump rail cars, it is assumed that spillage is most likely to occur along the first 1,000 meters of rail from the Rail Transfer Hopper (PolyMet 2015q).. The railway does not cross any streams along this stretch. Rainfall contacting the spilled ore would have the potential to release contaminants, but the relatively small volume of material and dilution from other sources are expected to result in surface water quality meeting the evaluation criteria (PolyMet 2015q). During closure, there may be residual effects on surface water quality from the spilled ore, although the small quantity of expected spilled material would become rapidly depleted of sulfide materials compared to the much larger waste rock stockpiles (PolyMet 2015q).

Three potential ways that ore could be released to the environment during transport via rail car include: 1) ore spillage through the hinge gap, 2) ore spillage through the door gap, and 3) dust from the top of the car. To guard against possible adverse effects from spilled ore, PolyMet plans to refurbish the ore cars, tightening or replacing the couplings and linkages to minimize gaps along the hinges and joint areas where spillage could occur (PolyMet 2014a). The quantity of ore that could potentially spill through the door and hinge gaps of a refurbished ore car is estimated to be 0.20 tons per year. This is a 97 percent reduction from the originally calculated value of 6.14 tons per year of unrefurbished cars.

Water quality monitoring is recommended downstream from the rail line on the Partridge River tributary streams to check for any potential deteriorations of water quality over time from ore spillage, and, if detected, adaptive water management measures would be implemented. Dust could be mitigated by spraying water on the loaded ore prior to transport. If significant accumulation of ore spillage occurs, it would be removed.

The West Pit Outlet Creek would also receive effluent from the WWTF during closure, which is estimated at an annual average discharge rate of 0.65 cfs. The WWTF is designed to meet all surface water quality standards with its discharge.

Effects on Surface Water Quality in Colby Lake and Whitewater Reservoir

Screening for Colby Lake constituents with hardness-based criteria is shown in Table 5.2.2-32; as indicated, there are no hardness-based constituents that require further evaluation. Table 5.2.2-35 provides maximum P90 concentrations for Colby Lake along with the initial screening results for constituents that do not have hardness-based evaluation criteria. As indicated by bold entries, aluminum, arsenic, iron, and manganese have maximum P90 concentrations that exceed their associated evaluation criteria, and these are retained for further evaluation.

Table 5.2.2-35 Colby Lake – Maximum P90 Solute Concentration Over Entire 200-Year Simulation with Initial Screening of Constituents without Hardness-Based Evaluation Criteria

Parameter	Colby Lake Evaluation Criteria	Units	CEC Scenario	NorthMet Project Proposed Action	% Change from CEC Scenario
General					
Alkalinity	NA	mg/L	130	129	-0.3%
Calcium	NA	mg/L	35.1	35.1	0%
Chloride	230	mg/L	15.3	15.3	-0.2%
Fluoride	4	mg/L	0.19	0.19	0.2%
Hardness	500	mg/L	133	133	-0.3%
Magnesium	NA	mg/L	14.0	14.0	0%
Potassium	NA	mg/L	4.00	3.97	-0.6%
Sodium	NA	mg/L	12.0	12.0	0.1%
Sulfate	250	mg/L	69.8	69.3	-0.9%
TDS	500	mg/L	150	150	-0.1%
Metals Total					
Aluminum	125	µg/L	**266**	**266**	-0.3%
Antimony	5.5	µg/L	0.26	0.48	85.9%
Arsenic	2	µg/L	**2.44**	**2.46**	0.9%
Barium	2,000	µg/L	16.7	16.9	1.1%
Beryllium	4	µg/L	0.11	0.12	6.7%
Boron	500	µg/L	167	167	-0.2%
Cadmium	NA[1]	µg/L	0.17	0.20	18.5%
Chromium (III)	NA[1]	µg/L	1.28	1.28	-0.1%
Cobalt	2.8	µg/L	1.22	1.26	3.3%

Parameter	Colby Lake Evaluation Criteria	Units	CEC Scenario	NorthMet Project Proposed Action	% Change from CEC Scenario
Copper	NA[1]	µg/L	9.83	9.88	0.5%
Iron	300	µg/L	**5,043**	**5,034**	-0.2%
Lead	NA[1]	µg/L	1.26	1.31	3.4%
Manganese	50	µg/L	**207**	**202**	-2.2%
Nickel	NA[1]	µg/L	4.42	5.43	22.9%
Selenium	5	µg/L	1.29	1.29	0.3%
Silver	1	µg/L	0.11	0.11	0.9%
Thallium	0.28	µg/L	0.07	0.08	0.5%
Vanadium	NA	µg/L	1.83	2.03	11.3%
Zinc	NA[1]	µg/L	26.7	27.6	3.6%

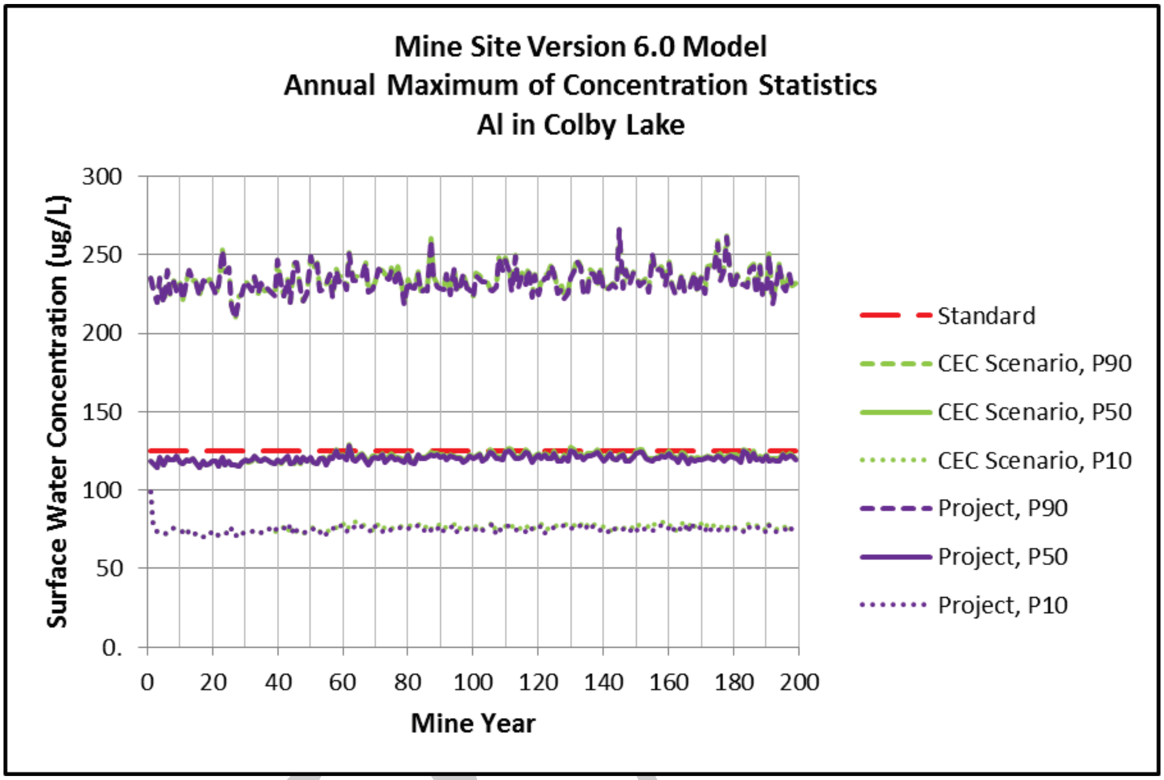
Source: PolyMet 2014v

Note: Bold value indicates exceedance of the evaluation criterion.
[1] Parameter has a hardness-based evaluation criterion and is screened using a different procedure (see Table 5.2.2-32).

Table 5.2.2-35 above also shows the percent change from the CEC scenario model results. The percent change can appear quite large, but the absolute change is quite small, especially when compared with the evaluation criteria. A good example is nickel, which has a maximum P90 value that increases 22.9 percent, but the absolute increase is approximately 1 µg/L, and the NorthMet Project Proposed Action maximum P90 value (5.43 µg/L) is still well below the evaluation criteria (43.3 µg/L). Note that for aluminum, iron, and manganese, the maximum P90 concentration for CEC is lower than the comparable value for the NorthMet Project Proposed Action. For Arsenic, the CEC value is higher, but only by 0.9 percent. The four solutes retained for further analysis are discussed in the following sections.

Aluminum

Model results indicate that the maximum P90 concentration of aluminum (266 µg/L) would exceed the evaluation criteria (125 µg/L) in Colby Lake, just as it is predicted to exceed along most of the Partridge River (see Figure 5.2.2-37).



Source: PolyMet 2014v.

Figure 5.2.2-37 Colby Lake Annual Maximum Aluminum Concentrations

Higher aluminum concentrations would typically occur between April and November, when surface runoff would contribute proportionately more to river flow than groundwater baseflow. Concentrations of aluminum in background surface non-contact water would exceed the water quality standard approximately 20 percent of the time, whereas aluminum in groundwater would almost never exceed the evaluation criteria.

As indicated in Table 5.2.2-35 and Figure 5.2.2-37, the NorthMet Project Proposed Action would not cause Colby Lake aluminum to increase in comparison to the CEC scenario. For P10, P50, and P90 annual maximum curves on Figure 5.2.2-37, the NorthMet Project Proposed Action curves are nearly identical to the CEC curves. In Table 5.2.2-33, the maximum P90 concentration for the Proposed Action (310.2 µg/L) is slightly less than the comparable P90 for CEC (314.9 µg/L). The conclusion is that aluminum would likely exceed the evaluation criterion in Colby Lake, but the NorthMet Project Proposed Action would not cause concentrations to be noticeably higher than what would occur without the NorthMet Project Proposed Action.

Further, aluminum has not been an issue for the City of Hoyt Lakes. For municipal drinking water, the City treats raw water from Colby Lake with high aluminum and produces drinking water that meets applicable regulatory standards. The City is not required to monitor for aluminum, as there is no human health-based drinking water standard for aluminum.

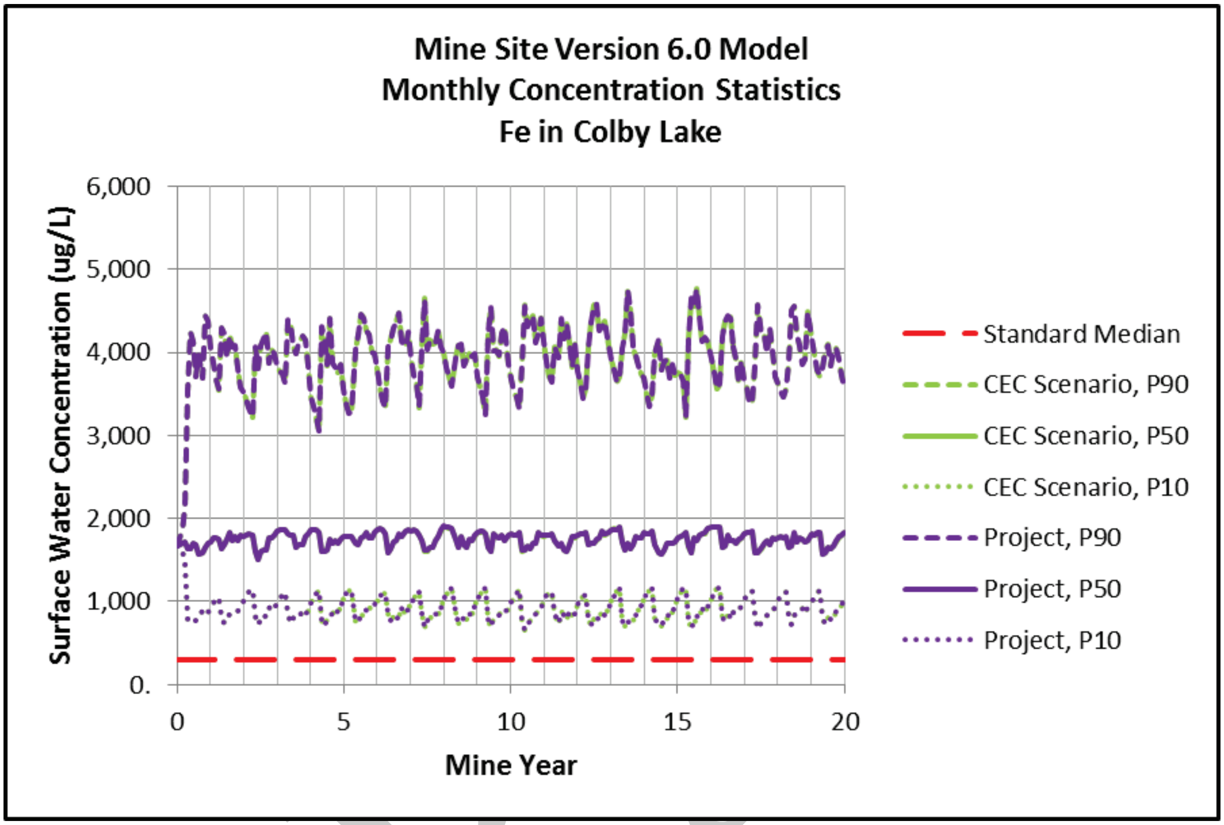
Iron and Manganese

Because Colby Lake is used as a drinking water source by the City of Hoyt Lakes, the USEPA sMCL evaluation criteria apply: 300 µg/L for iron and 50 µg/L for manganese. Measured background iron and manganese concentrations in Colby Lake are high and usually exceed their respective evaluation criteria. Over 90 percent of the background iron samples exceed the iron evaluation criteria and approximately 80 percent of the manganese samples exceed the manganese criteria.

As shown by bold font in the initial screening Table 5.2.2-35 for Colby Lake, the GoldSim-predicted maximum P90 concentrations for iron and manganese exceed the applicable evaluation criterion and therefore require further evaluation. Table 5.2.2-36 shows GoldSim-predicted maximum P50 and maximum P90 concentrations for three NorthMet Project Proposed Action phases; operations, reclamation, as well as closure and long-term maintenance. The following observations are made from this table:

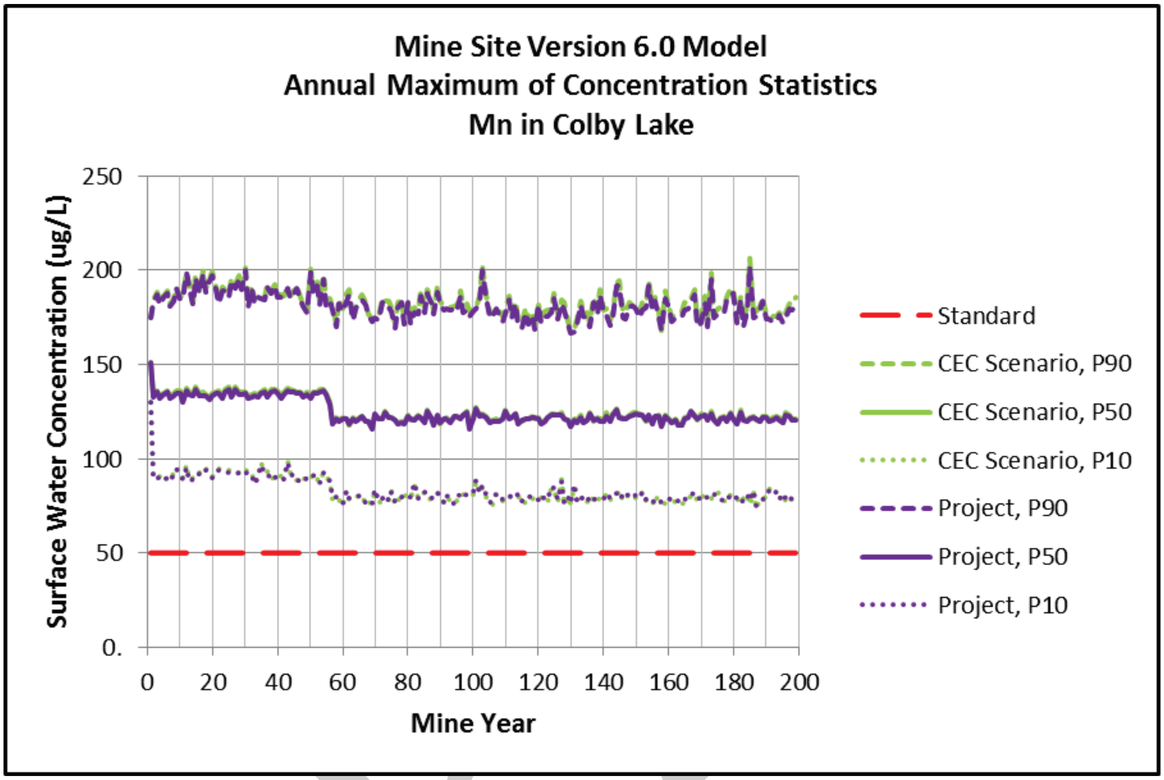
- All maximum P50 and maximum P90 values for iron and manganese exceed the applicable evaluation criterion for both the NorthMet Project Proposed Action and CEC scenarios.
- For manganese, all maximum P50 and maximum P90 values for the NorthMet Project Proposed Action are lower than the comparable CEC scenario. It is therefore concluded that the NorthMet Project Proposed Action would not cause a manganese impact to Colby Lake above and beyond what would occur without the NorthMet Project Proposed Action.
- For iron, the maximum P50 and maximum P90 values for the NorthMet Project Proposed Action are lower than the comparable CEC scenario for the reclamation phase and the closure and long-term maintenance phase, but not for the operations phase. Iron for the operations phase therefore requires further evaluation.

Figure 5.2.2-38 is a plot of GoldSim-predicted monthly P10, P50, and P90 iron concentrations for iron in Colby Lake during the operations phase (0 to 20 years). Inspection of this figure shows that the P10, P50, and P90 lines for the NorthMet Project Proposed Action are either identical or extremely close to the comparable lines for the CEC Scenario. Given this result and the observations made in Table 5.2.2-36, it is concluded that the NorthMet Project Proposed Action would not cause an iron impact to Colby Lake above and beyond what would occur without the NorthMet Project Proposed Action.



Source: PolyMet 2014v

Figure 5.2.2-38 Monthly Iron Concentration in Colby Lake for the Operations Phase (0 to 20 years)



Source: PolyMet 2014v

Figure 5.2.2-39 Colby Lake Annual Maximum Manganese Concentrations

Table 5.2.2-36 GoldSim-Predicted Maximum P50 and Maximum P90 Concentrations of Iron and Manganese in Colby Lake for Different Project Phases

Parameter	**Evaluation** Criterion	**Operations (years 2-20)**		**Reclamation (years 21-55)**		**Post-Closure Maintenance** (years 56-200)	
		PA	**CEC**	**PA**	**CEC**	**PA**	**CEC**
a. Maximum P50 of Annual Concentrations from GoldSim Output							
Iron	300	1,904	1,898	1,952	1,953	1,903	1,932
Manganese	50	136	138	137	138	129	130
b. Maximum P90 of Annual Concentrations from GoldSim Output							
Iron	300	4,771	4,763	4,931	4,932	5,034	5,043
Manganese	50	198	200	200	202	202	207

Arsenic

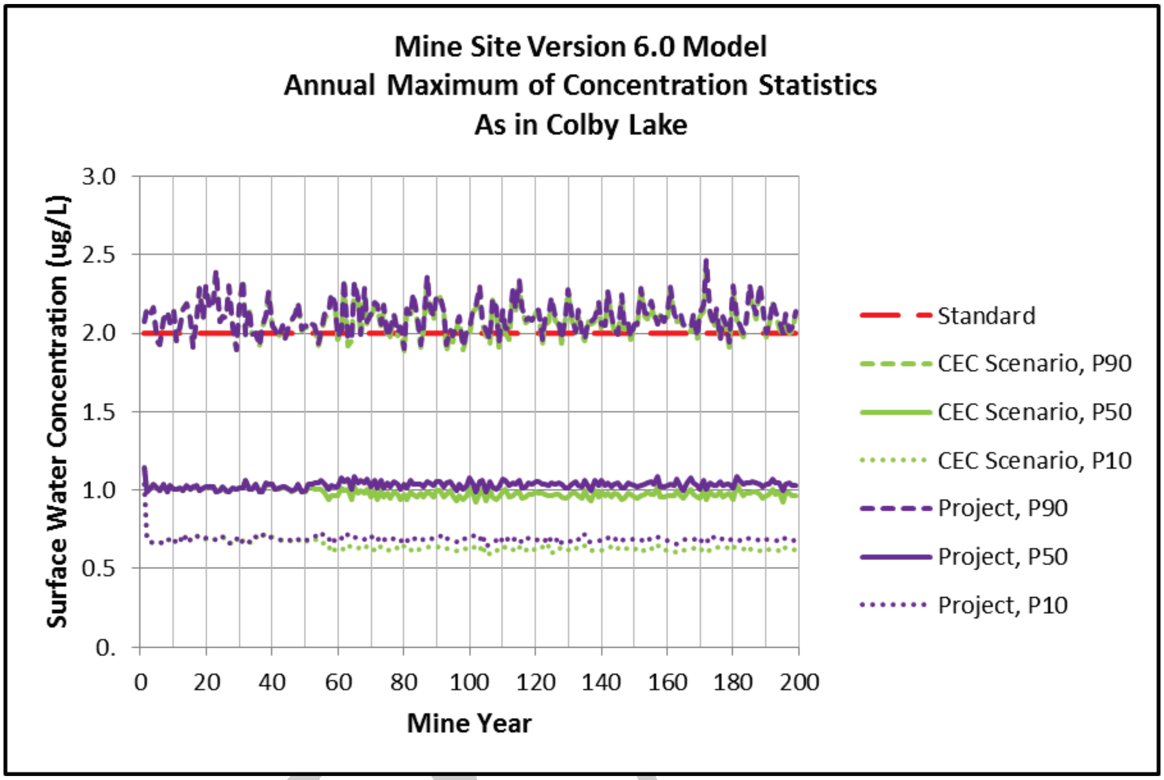
As shown by bold font in Table 5.2.2-35, the maximum P90 concentration for arsenic in Colby Lake (2.46 µg/L) exceeds the evaluation criterion for that constituent at that location (2 µg/L). As a consequence, the GoldSim-predicted arsenic in Colby Lake was identified as requiring further evaluation.

GoldSim model output indicates that the dominating chemical controls on arsenic concentrations in Colby Lake are natural surface runoff, natural groundwater baseflow, and contaminant sources contributing directly to Colby Lake, all of which are not related to the NorthMet Project Proposed Action. While much less important, other sources include Northshore discharge which operates for mine years 0 to 55 and WWTF discharge to the Partridge River, which begins about mine year 52.

To investigate the source and significance of arsenic exceedances in more detail, Figure 5.2.2-40 is a plot of the predicted P10, P50, and P90 of annual maximum arsenic concentrations for years 0 to 200 (purple lines). Also shown (in red) is the Colby Lake arsenic evaluation criterion of 2 µg/L. As observed on the plot, the NorthMet Project Proposed Action concentrations are virtually identical to CEC concentrations up to mine year 52. After that time, the NorthMet Project Proposed Action concentrations are slightly higher than the CEC concentrations; however, the difference is less than about 0.05 mg/L. The slight increase in NorthMet Project Proposed Action concentrations after year 52 results from the partially offsetting effects of: 1) ending of low-concentration (1.33 µg/L) Northshore discharge to the Partridge River that provides a dilution effect in the Lake and 2) the beginning of WWTF discharge to the Partridge River with an arsenic concentration of 4 mg/L, which increases the arsenic concentration in the Lake. This increase in loading from the WWTF is only partially offset by the decrease from the cessation of the Northshore discharge, so the overall result is a slight increase in Colby Lake arsenic after year 52. Also observed on Figure 5.2.2-40 is that only the annual maximum P90 concentrations exceed the standard.

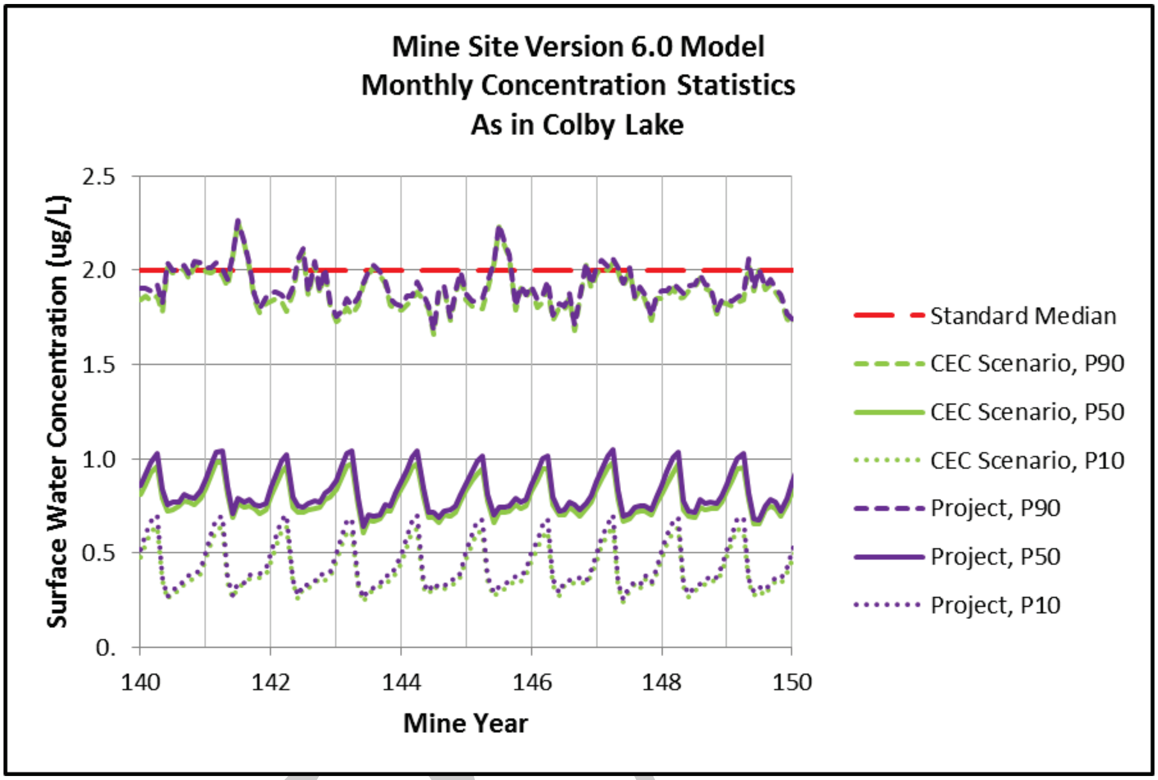
Figure 5.2.2-41 compares *monthly* P10, P50 and P90 concentrations with the evaluation criteria for a representative time period after the beginning of mine-affected groundwater emerge in the Partridge River. As can be seen on the graph, when the P90 concentrations are predicted to exceed the standard (most notably during mine years 141 and 145), the NorthMet Project Proposed Action concentrations are virtually identical to the CEC concentrations. An analysis of other time periods showed a similar result. This observation indicates that for conditions where the arsenic standard would be exceeded in Colby Lake, the NorthMet Project Proposed Action would not cause higher concentrations compared to what would occur for CEC. It is therefore concluded that the NorthMet Project Proposed Action would not cause arsenic exceedances in Colby Lake above and beyond what would occur without the NorthMet Project Proposed Action.

Finally, pilot testing of RO treatment concluded that arsenic is effectively removed by the greensand filter producing filter effluent with arsenic concentrations that were well below the Class 2B water quality standard for all three sampling events (Barr 2013f). Therefore, the assumed modeled effluent concentrations of the WWTF may be higher than what would actually be produced.



Source: PolyMet 2014v.

Figure 5.2.2-40 Colby Lake Annual Maximum Arsenic Concentrations



Source: PolyMet 2014v

Figure 5.2.2-41 Colby Lake Monthly Arsenic Concentration Statistics

<u>*Whitewater Reservoir*</u>

The NorthMet Project Proposed Action is predicted to have negligible effects on water quality in Whitewater Reservoir because only high Partridge River flows would be diverted into the reservoir from Colby Lake, which would coincide with the periods when any contaminants from the NorthMet Project Proposed Action would be diluted and because the water quality of Colby Lake is predicted to meet evaluation criteria, prior to dilution, except for the three parameters (i.e., aluminum, iron, and manganese) that are explained above.

Water Quality Effects in the Lower Partridge River

Although not specifically modeled, water quality in the Lower Partridge River would be expected to reflect the water quality condition of water flowing out of Colby Lake. As discussed above, under the NorthMet Project Proposed Action Colby Lake water is predicted to meet all water quality evaluation criteria other than for aluminum, arsenic, iron, and manganese, which are attributable to natural background conditions. The contaminant load in flow from Colby Lake attributable to the NorthMet Project Proposed Action would be further diluted downstream as the watershed area increases. The NorthMet Project Proposed Action would not result in any new surface water discharges (other than stormwater runoff from the processing plant area and Second Creek flow augmentation) or groundwater seepage that would affect the water quality of the Lower Partridge River that are not already accounted for in predicted upstream water quality.

These contaminant loads from the NorthMet Project Proposed Action, however, could contribute to cumulative effects in combination with contaminant loading from other projects. See Section 6.2.2.

Surface water currently seeps at a rate of approximately 227 gpm from the existing LTVSMC Tailings Basin to the headwaters of Second Creek. This seepage is currently partially blocked by a cutoff berm and trench and collected in a sump and pumped back to the Tailings Basin pond. Under the NorthMet Project Proposed Action, this seepage is predicted to continue during mine operations (550 gpm), reclamation, and closure and long-term maintenance (80 gpm). The NorthMet Project Proposed Action would install an engineered containment system south of the Tailings Basin designed to ensure that 100 percent of the seepage is captured during operations and closure and post-closure maintenance, this seepage would continue to be pumped to either the Tailings Basin pond or the WWTP. To mitigate the reduction of flow to Second Creek, under the NorthMet Project Proposed Action, WWTP effluent would be used to augment flow to Second Creek in closure at a minimum flow rate equal to about 80 percent of the uncaptured flow rate (or about 184 gpm). Since the effluent from the WWTP is designed to meet surface water quality standards, this discharge is not expected to cause any exceedance of water quality evaluation criteria.

NorthMet Project Proposed Action Solute Contribution Over Time

The NorthMet Project Proposed Action is predicted to meet most groundwater and surface water quality evaluation criteria at evaluation locations for all mine phases (operations, reclamation, and closure and post-closure maintenance). There is value, however, in understanding how the NorthMet Project Proposed Action would contribute to the solute load in the Partridge River over time.

The NorthMet Project Proposed Action would contribute contaminant loads to the Partridge River from seven groundwater sources: Overburden Storage and Laydown Area, Ore Surge Pile, Category 2/3 Stockpile, WWTF equalization basins, East Pit, West Pit, and the Category 1 Stockpile (which provides seepage to the West Pit and bedrock flowpaths). As shown in Table 5.2.2-37, four of these sources are temporary and would not be present during closure. The loadings from these features would not occur after the feature is removed and the associated peak concentrations in groundwater reaching the Partridge River would occur before 200 years. The East Pit, West Pit, and Category 1 Stockpile are permanent features that would continue to provide contaminant loading for a minimum of 200 years. Also contributing contaminant loads to the Partridge River would be the WWTF effluent discharge, which would continue to operate during closure and post-closure maintenance.

Table 5.2.2-37 Estimated Times for Affected Water to Reach the Partridge River

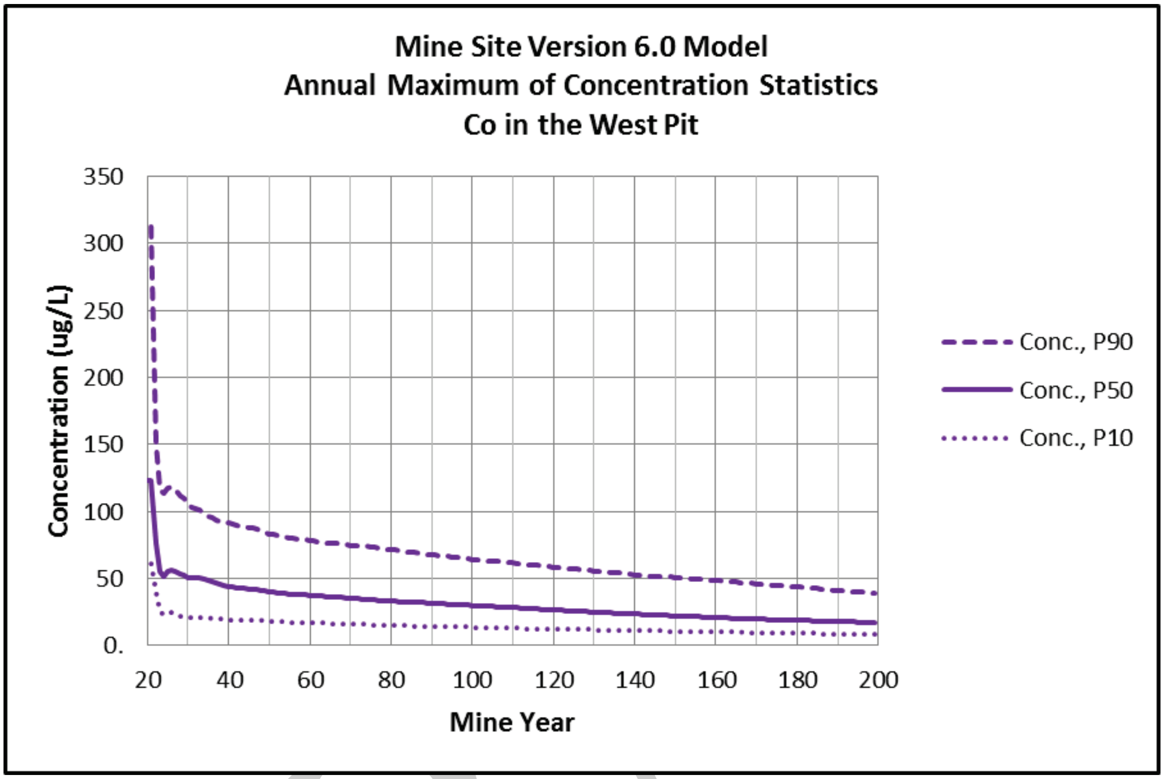
Source	Flow Rate from Source into Surficial GW Flowpath[3] (gpm)	Time Period that Source is Active[3] (Mine Year)	Time for Peak Loading at Partridge River[4] (Mine Year)
Overburden Storage and Laydown Area	14.0	0 to 20	60[(1)]
Ore Surge Pile	0.00116	0 to 21	155
Category 2/3 Stockpile	0.0194	0 to 20	55
WWTF Pond leakage	0.0135	0 to 52	160
East Pit	3.75	20 onward	150
West Pit (receives seepage from Category 1 Stockpile)	6.09	48 onward	160
WWTF discharge[2] (receives seepage from Category 1 Stockpile)	290	52 onward	52 onward

[1] For most constituents, source causes a concentration *decrease* in the flowpath; reported time is for *minimum* river loading.
[2] Discharge of WWTF effluent directly into the river.
[3] Based on GoldSim deterministic run with P50 inputs.
[4] Based on P50 results for GoldSim probabilistic run.
GW = Groundwater

The backfilled East Pit, Category 1 Stockpile, and flooded West Pit would be the only permanent mine features and would continue to contribute solute load to the surficial aquifer that eventually releases to the Partridge River. The small volume of seepage from the Category 1 Stockpile that would not be captured by the containment system would contribute solutes to the West Pit. This seepage would be expected to reduce in quantity over time as the Category 1 Stockpile geomembrane and vegetative cover is established, although concentrations are not expected to improve because most solutes are at their concentration caps.

Under the NorthMet Project Proposed Action, the water levels would be controlled by water pumped to the WWTF for treatment. The WWTF is considered a long-term facility that would require ongoing maintenance.

The water quality of both mine pits, however, is predicted to improve over time as the pits become flooded, thereby effectively eliminating oxidation of the pit walls, the primary source of solutes, except for the upper few feet where water levels may fluctuate. Figures 5.2.2-42, 5.2.2-43, and 5.2.2-44 show how the water quality in the West Pit is predicted to improve over time for three representative solutes: cobalt, nickel, and sulfate. It is expected that eventually the solute concentrations in the pits would stabilize to more or less steady-state values, although the timeframe for this would likely be greater than 200 years as indicated by Figures 5.2.2-42 to 5.2.2-44, which show solute concentrations continuing to decrease at year 200, although still above water quality standards. These predicted improvements in water quality suggest that the WWTF may not need to operate permanently, but that at some point, non-mechanical treatment systems may be sufficient to meet water quality based effluent limits.

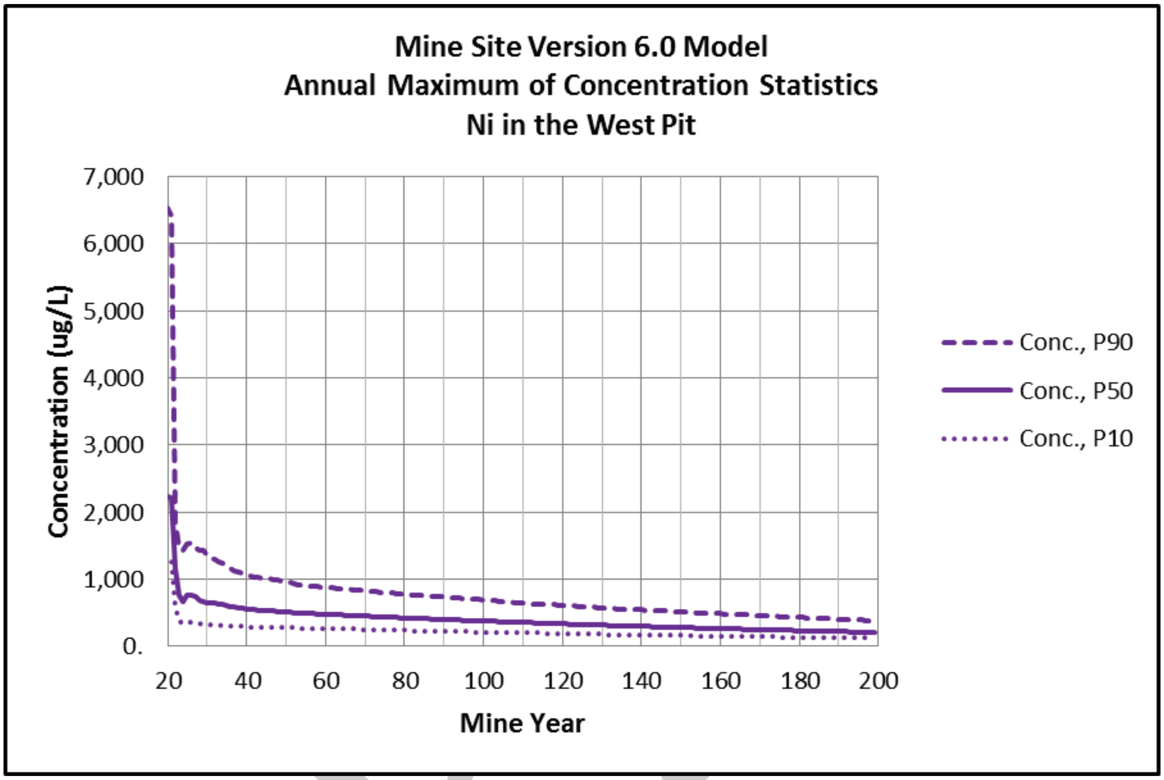


3212

3213 Source: PolyMet 2014v

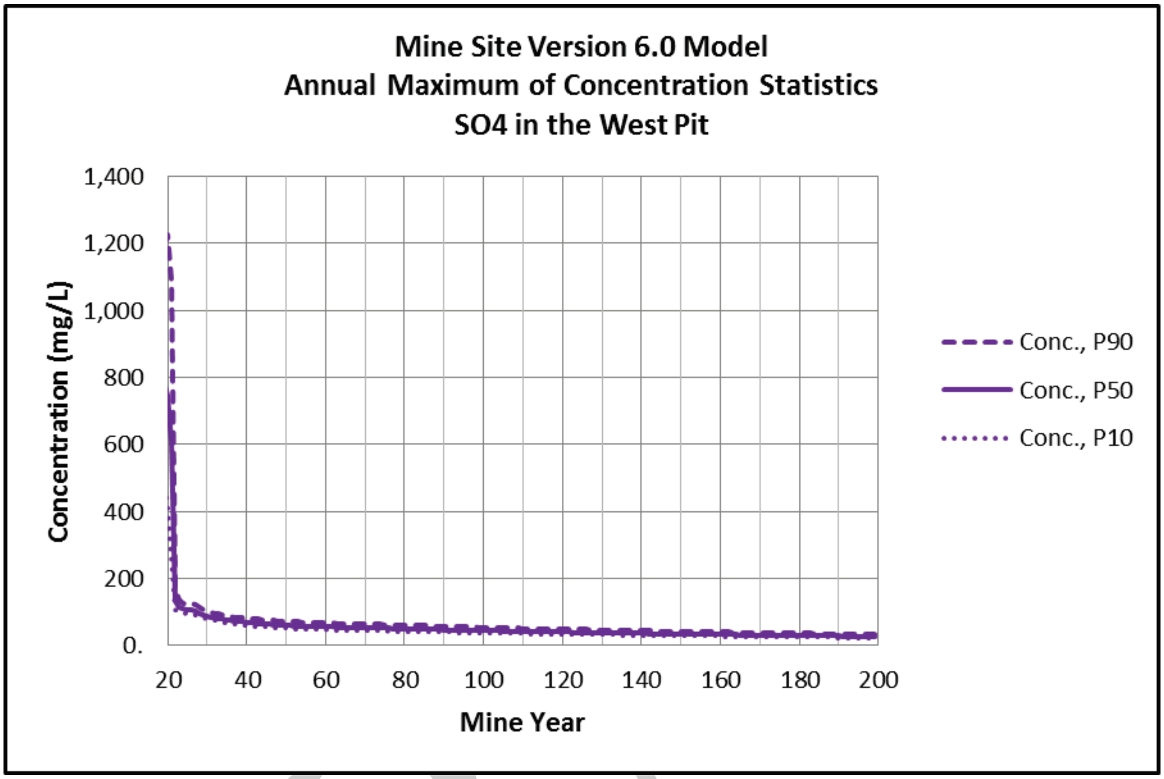
3214 *Figure 5.2.2-42 Cobalt Concentration in the West Pit during Reclamation, Closure, and*
3215 *Post-Closure Maintenance*

3216



3217
3218 Source: PolyMet 2014v

3219 ***Figure 5.2.2-43 Nickel Concentration in the West Pit during Reclamation, Closure, and***
3220 ***Post-Closure Maintenance***



Source: PolyMet 2014v

Figure 5.2.2-44 Sulfate Concentration in the West Pit during Reclamation, Closure, and Post-Closure Maintenance

The only long-term sources of solutes from the NorthMet Project Proposed Action would be groundwater seepage from the East Pit and West Pit (which includes Category 1 Stockpile seepage), with a combined total flow rate of about 10 gpm and the WWTF effluent discharge of about 290 gpm.

Mine Site Sensitivity Analyses

The sensitivity of the GoldSim Model was evaluated for changes to groundwater baseflow rates and climate change to determine what effect they have on model predictions. The following sections summarize the sensitivity analysis findings for the Mine Site.

Groundwater Baseflow Sensitivity Analysis

Groundwater baseflow calculated from the data collected at SW-003 beginning from 2011 is up to 3.5 times higher than values used in the Mine Site MODFLOW baseline model and assumed in the Mine Site GoldSim probabilistic model simulations. Although this new value is not considered representative of the long-term, average groundwater baseflow, a sensitivity analysis was carried out to evaluate how changing the value of groundwater baseflow as a target in the model calibration influences its predictions (note: “target” is a value the model is calibrated to).

As part of that sensitivity analysis, the Mine Site MODFLOW baseline model was recalibrated using groundwater baseflow about four times higher than in the baseline model (e.g., it was increased from 0.5 to 2 cfs at SW-003). Recognizing the purpose of the sensitivity analysis is to evaluate the impacts of different groundwater baseflow values, the Co-lead Agencies accomplished chose a hypothetical maximum flow derived in part from the gage SW- 003 at Dunka Road. The suggested value for this purpose is 2.0 cfs, which is slightly higher than the 1.8 cfs low-flow value determined by the MDNR using hydrograph separation for the December 2011 to March 2012 winter period. The recalibration was accomplished by increasing hydraulic conductivity and aquifer recharge, as compared to the groundwater baseflow calibration. Relative to the FEIS base modeling, the new, higher baseflow MODFLOW model version simulates:

- Faster groundwater movement;
- Slightly higher groundwater inflow rates into the West Pit and associated faster pit flooding; and
- Moderately higher groundwater inflow rates into the East Pit and associated faster backfill saturation (Barr 2015d, Appendix K).

The recalibrated MODFLOW model sensitivity version does not predict a groundwater flow rate between the Central and West Pit via bedrock that is significantly different from the predictions of the baseline model.

To develop water quality predictions, the results of the recalibrated MODFLOW model simulations were used as inputs to the new, higher baseflow version of the GoldSim model. Because the adjustment of the estimated groundwater baseflow in the Partridge River changes the ratio of groundwater to surface water runoff in the river, the calibration process for determining distributions for surface water quality was repeated for this sensitivity analysis as well.

Results of the GoldSim groundwater baseflow high rate scenario were compared with the best-estimate scenario to evaluate the degree to which predicted the NorthMet Project Proposed Action impacts are sensitive to baseflow and other related model inputs.

Results from the FEIS Goldsim model run predicts that higher peak contaminant concentrations would occur sooner than predicted by a baseline model for some constituents. However, these peaks remain below evaluation criteria for most parameters. Those simulation results show that, although the estimated concentrations in the groundwater and surface water are sensitive to the assumed value of baseflow, the NorthMet Project Proposed Action's ability to comply with the applicable groundwater and surface water quality standards is not.

The comparison of the baseline and new version (higher baseflow) models indicate that the increased contaminant loadings at the upgradient end of the flowpaths (due to higher groundwater flow rates) are offset by: (1) increased dilution from recharge water along the flowpath, and (2) increased dilution in the river from higher baseflows during winter low-flow conditions. In other words, for low (i.e., winter) streamflow conditions, the higher contaminant mass loading into the river was offset by dilution associated with the higher river groundwater baseflows.

Despite a conservative nature of this high baseflow version of the GoldSim model, its predicted contaminant concentrations remain below the applicable groundwater and surface water quality evaluation criteria (Barr 2015d, Appendix K).

This sensitivity analysis indicates that the Mine Site GoldSim model is relatively insensitive to changes in the Partridge River groundwater baseflow variable. By analogy, it is considered that the Plant Site GoldSim model is also insensitive to changes in groundwater baseflow in the Embarrass River variable.

Climate Change Sensitivity Analysis

The potential effects of a climate change upon the predictions of a GoldSim probabilistic model (the Project Model) were evaluated by running the “climate change sensitivity analysis”. The ranges of precipitation and temperature input parameters were varied following the guidance provided by Co-Lead Agencies (Kellogg 2011). In summary, the Climate Change Sensitivity Analysis Model was set by increasing: 1) the mean annual temperature by 2.0 to 5.2 degrees Celsius, 2) the mean annual precipitation from 28.1 to 29.8 in/yr, and 3) the mean annual open water evaporation by 6.5 percent. The parameter values were linearly increased from mine year 1 to mine year 60 and, then, were kept constant. Such modified model was used to run 200-year predictive simulations, similar to the Project Model.

The impacts of the modeled changes upon chemical concentrations in the East Pit pore water and West Pit Lake were analyzed for lead, sulfate, copper, and iron. The simulation results showed that the greatest changes would occur during closure and long-term maintenance (approximately mine year 45 and beyond). Lead concentrations in East and West Pits would change very little. The largest increase in sulfate concentration of 10.3 percent would occur in the East Pit wetland, but would change little outside of that wetland. The pattern of simulated changes in concentration for copper is similar to sulfate with the maximum change of 15 percent for the East Pit wetland. No significant changes in iron concentrations were simulated for any part of the modeled domain (Barr 2015d).

Climate change would affect water quality in the stock pile drainage in similar ways to the mine pit water. The larges simulated change concentration was 5.1 percent for lead, 0.9 percent for sulfate, 0.3 percent for copper, and 0.2 percent for iron.

The changes in dewatering volumes for the Pits were simulated to be very small, the largest for the period of closure and long-term maintenance: 5.2 gpm. Likewise, the simulated changes in leakage flows from the stockpiles were very small.

The rates of flow from the Pits to aquifers and contaminant concentrations in groundwater were not much affected by the simulated climate change. Surface water quality also did not change much. There is likely to be an increase in the amount of water that would need to be treated by the WWTF.

5.2.2.3.3 Embarrass River Watershed

This section discusses potential environmental effects of the NorthMet Project Proposed Action on groundwater and surface water hydrology and quality within the Embarrass River watershed. The solute-generating NorthMet Project Proposed Action features in the Embarrass River Watershed are the Tailings Basin, the WWTP discharge, the Hydrometallurgical Residue Facility, and (much less significantly) domestic sewage treatment systems and/or potable water treatment backwash systems. These potential hydrologic and contaminant sources and their predicted effects on groundwater and surface water hydrology and quality are evaluated below.

PolyMet expects that the Hydrometallurgical Plant would begin operation between mine years 3 to 5. Residue would be transported to the Hydrometallurgical Residue Facility as a mixture of solids and water. The solids would settle out into the Hydrometallurgical Residue Facility, and the water would be returned to the Hydrometallurgical Plant for reuse. However, losses would occur during processing and through evaporation or storage within the pores of the deposited residue. The discharge from the Hydrometallurgical Plant to the pond is expected to be a constant 223 gpm through operations. Average annual flows from the Hydrometallurgical Residue Facility to the Hydrometallurgical Plant during operations range from 182 to 219 gpm (PolyMet 2015i). Precipitation falling within the drainage area of the Hydrometallurgical Residue Facility pond would be managed as process water.

The design of the Hydrometallurgical Residue Facility is based on State of Minnesota Rule requirements, expected residue generation rates, hydrology within the Hydrometallurgical Residue Facility, geotechnical considerations and Hydrometallurgical Residue Facility operating plans. Additional design considerations include the potential for water treatment plant solids (gypsum) to be disposed of within the Hydrometallurgical Residue Facility and the relocation of coal ash from the existing closed Coal Ash Landfill near the Tailings Basin. PolyMet 2014c).

The Hydrometallurgical Residue Facility would have a double geomembrane liner with a leachate collection system between the liners. The upper liner would consist of an 80-mil Linear Low Density Polyethylene geomembrane. This liner would serve as the primary barrier to leakage from the Hydrometallurgical Residue Facility. Its thickness was selected by PolyMet for durability and to resist ice impacts in the event of any temporary shutdowns of the hydrometallurgical process in winter months. The leakage collection layer would consist of a continuous layer of Geocomposite Drainage Net. The leakage collection layer would collect any leakage that passes through defects in the upper liner. The leakage collection layer is included in the liner system because even with application of industry-standard quality control procedures during installation of the upper liner, some installation defects can remain. The leakage collection layer directs leakage to a sump which then pumps it back to the Hydrometallurgical Residue Facility pond. The lower liner would consist of 60-mil Linear Low Density or High Density Polyethylene above a Geosynthetic Clay Liner. The lower composite liner would provide a virtually leak-free barrier to prevent leakage that may pass through the upper liner from leaving the Hydrometallurgical Residue Facility (PolyMet 2014c).

The amount of water pumped from the leak collection system would be monitored on a long-term basis. For this reason, if the amount of pumpage were to increase or if there were any other indications of increased leakage, appropriate repairs and mitigation measures would be undertaken. For these reason, it is assumed for purposes of the FEIS that the leakage from this facility into underlying groundwater or adjacent surface water would be negligible and therefore is not further evaluated. Details on the design and operation of this facility are in Chapter 3. A detailed Residue Management Plan for this facility would be required during permitting (PolyMet 2014r).

Effects on Groundwater Hydrology

This section discusses the environmental consequences of the NorthMet Project Proposed Action on groundwater hydrology within the Embarrass River Watershed, specifically from the Tailings Basin and associated engineering controls. There are no other NorthMet Project Proposed Action area facilities within the Embarrass River Watershed that would affect groundwater hydrology.

As discussed in Chapter 3, PolyMet proposes to re-use the existing LTVSMC Tailings Basin. Seepage from the existing LTVSMC Tailings Basin has decreased since LTVSMC operations ended in 2001, reaching a current steady state of approximately 2,820 gpm with 2,590 gpm migrating within the Embarrass River Watershed. Once the seepage reaches the toe of the Tailings Basin, it divides between flow that remains as groundwater (referred to as groundwater seepage) and flow that exceeds the hydraulic capacity of the aquifer and upwells to the surface (referred to as surface seepage). Under existing conditions, about 200 gpm of Tailings Basin seepage remains as groundwater and about 2,390 gpm upwells to the surface and ultimately contributes to surface water flow in the Embarrass River. The Tailings Basin seepage reaches the Embarrass River via its tributaries (Mud Lake Creek, Trimble Creek, and Unnamed Creek) and by flow through wetlands. On the southern side of the Tailings Basin, most of the seepage is collected and returned to the Tailings Basin. Some of this seepage is not captured and migrates to the Second Creek, a tributary of the Partridge River (PolyMet 2015j).

Groundwater seepage from the Tailings Basin flows in three flowpaths to the Embarrass River identified as the north, northwest, and west flowpaths (see Figure 5.2.2-9). On the eastern side of the Tailings Basin, because of the presence of bedrock outcrops, natural groundwater flow is toward the Tailing Basin. Essentially all of the groundwater that flows south toward Second Creek in the Partridge River Watershed would be captured and pumped back into the Tailings Basin.

The addition of tailings and changes in water management due to the NorthMet Project Proposed Action would result in increased seepage from the Tailings Basin relative to existing legacy LTVSMC seepage. As Table 5.2.2-38 indicates, seepage is predicted to increase from the current approximately 2,820 gpm to a maximum of 3,880 gpm during operations. Most of this seepage would travel to the north, northwest, and west of the Tailings Basin and could affect groundwater levels in those areas.

Table 5.2.2-38 Tailings Basin Seepage

TB Toe	Continuation of Existing Conditions				Maximum Rates for Mine Years 0–25[1]					Long-Term Maintenance				
	TB Seepage	Seepage to GW	Surface Seepage	Collected Seepage	TB Seepage	Seepage to GW	Surface Seepage	Bypass to GW Flowpath	Collected Seepage	TB Seepage	Seepage to GW	Surface Seepage	Bypass to GW Flowpath	Collected Seepage
North	1,540	40	1,500	0	2,160	40	2,120	4	2,156	450	40	410	4	446
Northwest	440	50	390	0	680	50	630	5	675	400	50	350	5	395
West	610	110	500	0	880	110	770	11	869	670	110	560	11	659
South	230	0	0	230	550	0	550	0	550	80	0	80	0	80
East	0	0	0	0	310	0	310	0	310	20	0	20	0	20
Total	2,820	200	2,390	230	3,880[4,7]	200	3,680[5,7]	20	3,860[6,7]	1,620	200	1,420	20	1,600
To Embarrass River		2,590[2]					20[3]					20[3]		

Source: PolyMet 2015j.

Note: All flows in gpm.
[1] Maximum rates occur at different times at different toes.
[2] Combination of surface seepage and groundwater.
[3] Groundwater only.
[4] Maximum total for single month within the time range of 0–25 years.
[5] Maximum total minus seepage to groundwater.
[6] Maximum total minus by-pass to groundwater flowpaths.
[7] Not a summation of values above.

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The NorthMet Project Proposed Action would increase Tailings Basin seepage rates by 1,060 gpm. The hydraulic capacity of the surficial aquifer would not change. This increase in upwelling could have a significant effect on downgradient wetlands and waterways. Therefore, PolyMet proposed that the containment system would wrap around the northeastern, northern, western, and eastern sides of the Tailings Basin. This system is designed to capture 100 percent of the surface seepage and 100 percent of the groundwater seepage, but is conservatively modeled to collect 100 percent of surface seepage and only 90 percent of the groundwater seepage on the northern, northwestern, and western sides to account for imperfect construction of the cutoff wall at the bedrock (see Figure 5.2.2-14 and Figure 5.2.2-15). As Table 5.2.2-37 indicates, the net effect of the containment system would be to decrease groundwater seepage from the Tailings Basin downgradient of the containment system from approximately 200 to 20 gpm. This decrease in groundwater seepage would be mitigated by a proposed flow augmentation program, which is described later in this section.

As Table 5.2.2-38 indicates, seepage from the Tailings Basin to the Embarrass River watershed is predicted to decrease from the estimated current rate of 2,820 gpm to about 1,620 gpm at closure under the NorthMet Project Proposed Action (about a 42 percent decrease). The surface and groundwater seepage containment system would remain in place, which would capture all but an estimated 20 gpm of Tailings Basin seepage. The decrease in groundwater seepage would not be expected to have a significant effect on groundwater or wetlands downgradient of the surface and groundwater seepage containment system because of the proposed flow augmentation, which would maintain hydrology within ± 20 percent of existing conditions. There would be sufficient natural recharge to maintain saturation in the surficial (unconsolidated) unit. The effects of the containment system on surface water hydrology are discussed later in this section.

Effects on Groundwater Quality

The NorthMet Project Proposed Action could affect surficial groundwater quality within the Embarrass River Watershed by leaching metals, sulfate, and other solutes from the NorthMet Tailings Basin. However, current conditions at the Tailings Basin are already affecting the groundwater. The following two paragraphs offer a summary comparison between the current conditions and the conditions projected to take effect as a result of the NorthMet Project Proposed Action.

Current Conditions

Under current conditions, the seepage emerging from the LTVSMC Tailings Basin at its northern, northwestern, and western toes feeds groundwater (at a rate of about 200 gpm) and surface waters at a rate of about 2,390 gpm). All the seepage-affected groundwater and surface water migrates to the Embarrass River via its tributaries, through wetlands and via migration along the northern, northwestern, and western groundwater flowpaths (see Figure 5.2.2-9). Tailings seepage from its southern toe is collected and returned to the Tailings Basin, such that this seepage does not affect the environment. Groundwater flows toward the Tailings Basin at its eastern toe, so the seepage in that part of the toe does not affect the environment either.

Proposed NorthMet Project Proposed Action Conditions

The only untreated Tailing Basin water entering the surrounding environment would be groundwater bypassing the northern, northwestern, and western parts of the containment system at a rate of 20 gpm. This 20 gpm represents a conservative engineering assumption (actual rate may be lower). This signifies a 90 percent reduction of the groundwater flow rates occurring under current conditions (20 gpm vs. 180 gpm). Most of the seepage-affected groundwater bypassing the containment system would flow along the north, northwest, and west flowpaths towards the Embarrass River and would affect downgradient groundwater quality (see Figure 5.2.2-9).

<u>Effects on Groundwater Quality</u>

Several sources would contribute solutes to the Tailings Basin, including both the existing LTVSMC tailings and NorthMet Project Proposed Action tailings themselves, Mine Site process water (which could be pumped to the Tailings Basin through year 11, and possibly through year 20 depending on the NorthMet Project Proposed Action water budget), Colby Lake makeup water, and a negligible amount of watershed runoff.

The contribution from the Mine Site (to the Tailings Basin's water quality) would be influenced by the predictions of stockpile leachate and mine pit water quality and the ability of the WWTF to achieve design effluent concentrations prior to pumping to the Tailings Basin.

Some solutes can be released from tailings by direct dissolution of minerals, but solutes of concern are primarily released by oxidation of sulfide minerals in the tailings. The oxidation rate in tailings, and thus the rate of solute release, is typically limited by the rate that atmospheric oxygen can diffuse into the facility. The diffusion of oxygen and the rate of oxidation and associated solute release would depend strongly on the tailing's moisture content, where higher moisture content corresponds to lower rates of oxygen diffusion and associated oxidation and contaminant release. Thus, the unsaturated tailings in the embankment and beach areas are expected to have higher oxidation rates than the saturated tailings below the pond.

Laboratory testing indicated that average sulfur concentration in the NorthMet tailings would be 0.12 percent, which is low enough to ensure that the tailings would not produce acidic leachate. Pore water metal concentrations could increase dramatically if pH were to decrease, especially for nickel and cobalt (SRK 2007c). The oxyanions (arsenic, antimony, and selenium), however, tend to have increasing solubility with higher pHs.

Testing of tailings containing 0.2 percent sulfur by the MDNR from the nearby Babbitt prospect within the Duluth Complex did not result in acidic leachate because silicate weathering was sufficient to neutralize the acid produced. Humidity cell test results for NorthMet Project Proposed Action tailings have tended to support the research by the MDNR and the results from the Babbitt Deposit (Day 2008). Leachate showed an initial decline in pH, but has subsequently remained between 6.0 and 7.8 with no trend toward lower pHs.

Solutes released by oxidation (primarily sulfate and metals) would be mobilized and flushed from the tailings by percolating water. The rate of percolation would depend on the net infiltration of meteoric water at the tailing's surface and the rate of pond leakage. The seepage from the NorthMet Project Proposed Action tailings would pass through the underlying existing LTVSMC tailings (i.e., previous taconite tailings). These underlying tailings may attenuate to some extent the metals leached from the NorthMet Project Proposed Action tailings, or may contribute additional solutes to seepage, or both.

The Tailings Basin pond would receive 1) treated Mine Site process water (during mine operations); 2) tailings slurry water from Processing Plant (during mine operations); 3) captured untreated seepage from Tailings Basin's toes; 4) rainfall, snowmelt, and local storm runoff; 5) filtered backwash from the WWTP; 6) sewage treatment effluent; and 7) treated water from WWTP.

The Tailings Basin pond, in turn, would become a primary source of contaminants due to the pond's infiltration into the tailings. Therefore, the chemical composition of the Tailings Basin's pond water (becoming a permanent feature of the Tailings Basin) would be an important influence upon the quality of water that would be discharged from the WWTP and seep from the Tailings Basin.

Consequently, PolyMet proposes to use the WWTP to treat the pond water during reclamation, and as necessary during closure, to improve the pond's water quality. The presence of the pond in closure would provide benefits as it would create a saturated layer that would permanently reduce oxygen diffusion and associated solute release in the underlying tailings.

Engineering Controls

The LTVSMC Tailings Basin is not lined. Several tailings and water management options were considered in the development of the NorthMet Project Proposed Action (Chapter 3 alternatives section). The NorthMet Project Proposed Action does not include a liner for the Tailings Basin. . In lieu of a liner, PolyMet proposes the following engineering controls to reduce the release and transport of solutes from the Tailings Basin (see Figure 5.2.2-22):

- Collection of Tailings Basin's seepage by surface and groundwater seepage containment system;
- Installation of bentonite amendment of the existing tailings dam to reduce infiltration;
- Installation of bentonite amendment of the Tailings Basin's beaches to reduce infiltration and oxygen diffusion into Tailings;
- Installation of bentonite amendment of pond bottom to reduce leakage into Tailings; and
- Mechanical treatment of the collected tailings seepage and pond water by the WWTP.

<u>*Tailings Basin Containment System*</u>

The containment system would be installed prior to plant operations and would consist of a surface water and groundwater collection system along the outside perimeter of the Tailings Basin where seepage has the potential to enter the surficial aquifer (see Figure 3.2-28). The design includes a hydraulic barrier (cutoff wall) that would be keyed into bedrock, and a collection trench and drain pipe installed on the upgradient side (see Figure 5.2.2-14 and 5.2.2-15). Above the hydraulic barrier would be a berm to stop surface seeps from leaving the site. The trench and piping would convey the collected seepage to several pumping stations, which would pump the seepage during operations to either the Tailings Basin pond for re-use, or to the WWTP for treatment prior to discharge. The containment system would continue to operate during reclamation, and closure and long-term maintenance, although in those phases, the seepage could not be re-used as process water, but would be treated at the WWTP and used to accelerate filling of the West Pit (during reclamation) and for streamflow augmentation (during reclamation and closure). Figure 5.2.2-14 illustrates the functioning of the proposed containment systems along the north-, northwest-, and west toes, while Figure 5.2.2-15 shows the functioning of the systems at the east toe. It is designed to capture all of the Tailings Basin groundwater and surface water seepage, the containment system is assumed for purposes of impact evaluation to capture:

- 100 percent of the Tailings Basin's surface seepage;
- 100 percent of the groundwater approaching the containment system from the Tailings Basin's east and south toes; and
- 90 percent of the groundwater approaching the containment systems from the Tailings Basin's north, northwest and west toes (PolyMet 2015d).

During operations, the maximum flows collected by the containment system would be 3,680 gpm originating as surface seepage and 180 gpm as groundwater seepage. During closure, the collection rates would be 1,420 gpm of surface seepage and 180 gpm of groundwater seepage.

Wastewater Treatment Plant

PolyMet proposes a WWTP to treat the Tailings Basin pond's water and tailings seepage collected by the surface and groundwater seepage containment systems. The WWTP would treat water throughout the entire mine life (operations, reclamation, and closure and long-term maintenance). The WWTP would treat all Tailings Basin seepage except the small quantity (approximately 20 gpm on average) that would bypass the containment systems. The WWTP would discharge treated effluent to augment streamflow during operations. During reclamation, some WWTP effluent would be pumped to the West Pit to accelerate its flooding. The level of water treatment at the WWTP would be sufficient to meet surface water evaluation criteria.

Bentonite-amended Tailings Cover

For the NorthMet Project Proposed Action during operations, PolyMet would cover the tailings dam embankments with a 12-inch-thick bentonite-amended soil layer, as allowed by construction activities. On top of the bentonite-amended layer would be an 18-inch-thick vegetated soil cover. After operations cease in year 20, PolyMet would place a similar two-layer cover on top of the dry tailings beaches. The objective of the cover system would be to 1) reduce infiltration of meteoric water and 2) maintain the bentonite layer at a high saturation to limit oxygen diffusion into the tailings.

Bentonite-amended Pond Bottom

PolyMet would also place a bentonite layer at the bottom of the tailings pond to reduce downward leakage of pond water into the tailings. The thickness and effective hydraulic conductivity of the bentonite layer would be designed to achieve a pond seepage flux of 6.5 in/yr or less.

Groundwater Transport and Evaluation Locations

Groundwater flow and solute transport away from the Tailings Basin towards the Embarrass River is tracked in three groundwater surficial flowpaths: north, northwest, and west (see Figure 5.2.2-9). Within each flowpath there is a groundwater evaluation location, coincident with the property boundary, along which predicted solute concentrations are compared to the groundwater evaluation criteria to assess potential effects. Because solute effects on surface water are of interest, the solute concentrations at locations where groundwater releases to surface water (generally at or close to the Embarrass River) are also tracked in the model because it helps to interpret the surface water chemistry in the Embarrass River and its tributary streams.

For the North, Northwest, and West Surficial flowpaths, the time at which contaminants leached from the Tailings Basin would begin to affect water quality at their respective evaluation locations depends on the following variables:

- The amount of affected water that would seep past the Tailings Basin containment system. GoldSim conservatively assumes that 10 percent of the approaching groundwater would bypass the system and this would begin at time zero. Note that the analysis assumes that all tailings surface seepage is captured. The rate at which contaminants would move in groundwater would be the same as the groundwater seepage velocity downgradient of the containment system for all but four constituents (arsenic, antimony, copper, and nickel). Because no attenuation values are used for the constituents other than arsenic, antimony, copper, and nickel–the modeled rate of groundwater transport would be faster than the actual rate of transport in the ground. Note that this velocity would increase in the downgradient direction due to meteoric recharge that would add flow to the groundwater system. Transport of the four attenuated constituents would be 10 to 100 times slower than the groundwater flow because of sorption.
- The distance between the location of solute release (Tailings Basin containment system) and the flowpath evaluation location.
- The effects of hydrodynamic dispersion, which tends to spread out the leading edge of the solute plume.

To ensure that the water quality modeling would identify the potential effects on groundwater and surface water, a 500-year GoldSim probabilistic (Monte Carlo) simulation was performed. Lead was used to illustrate groundwater transport at the Plant Site because it is not attenuated and would enter the surficial flowpaths at concentrations higher than baseline groundwater. As a consequence, the movement of solute fronts associated with this constituent is readily discernible on concentration-versus-time and concentration-versus-distance plots for the modeled flowpaths. Transport of other non-attenuated solutes should be similar to lead, but the change in concentrations is not always as visually noticeable as it is for lead. Based on the GoldSim results, P90 lead concentrations at the evaluation locations and at locations where groundwater would release to surface water are shown on Figures 5.2.2-45 and 5.2.2-46, respectively.

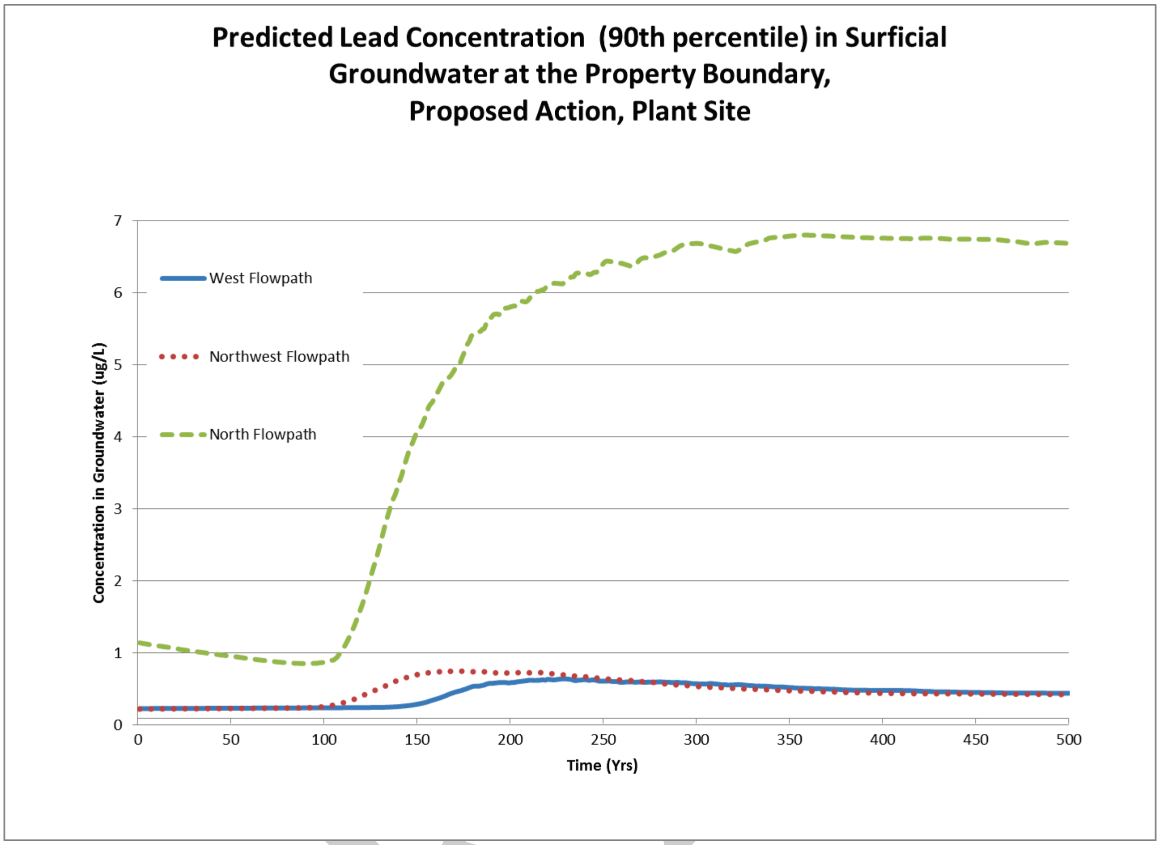

Figure 5.2.2-45 Predicted P90 Lead Concentrations at the Evaluation Locations Based on the GoldSim Probabilistic Simulation for the Plant Site

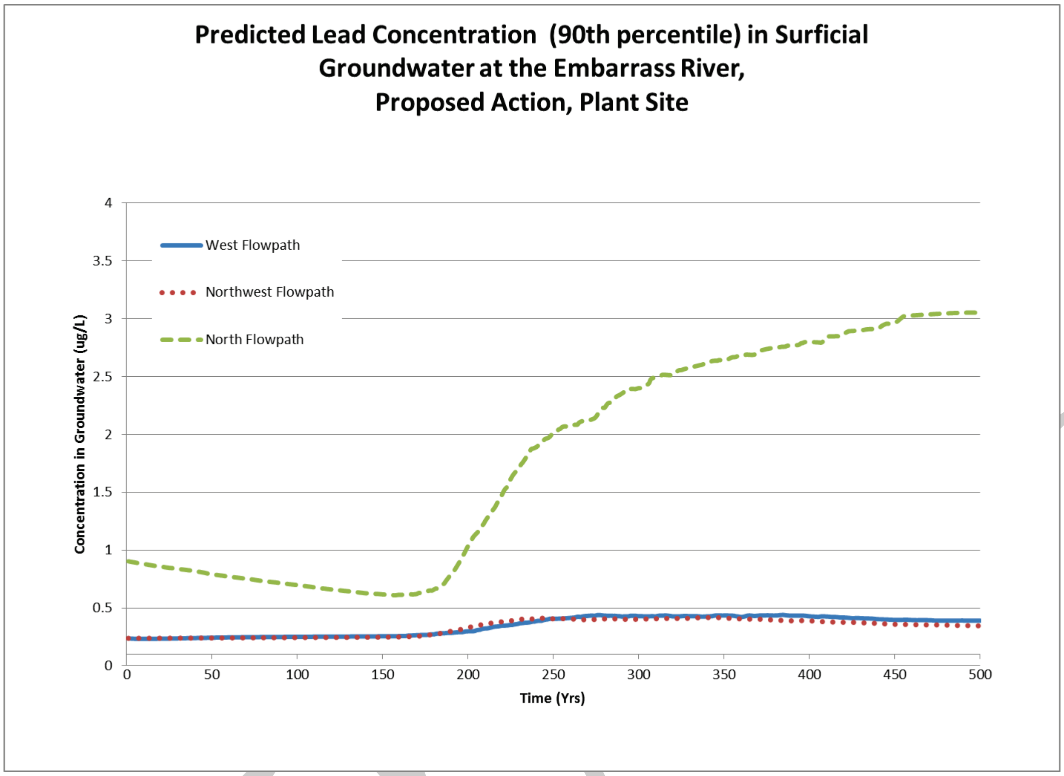

Figure 5.2.2-46 Predicted P90 Lead Concentrations at the Locations of Groundwater Release to Surface Water Based on the GoldSim Probabilistic Simulation for the Plant Site

Surficial Groundwater Quality at the Evaluation Locations

Results of a 500-year GoldSim water quality modeling simulation were reviewed for all 29 solutes at all three surficial flowpath evaluation locations. A screening process was used to identify any constituents and locations that warranted a more robust examination because of potential exceedances of water quality evaluation criteria. That process involved comparing the maximum P90 water quality prediction from among the 5,988 months covered by the simulation (i.e., 12 months times 499 years, with the first year of simulation excluded for screening review due to potential numerical artifacts in the model results) for each constituent at each of the three evaluation locations. These NorthMet Project Proposed Action modeled values were compared with both CEC Scenario modeled values and the evaluation criteria (discussed previously). Each contaminant that was identified as exceeding the numerical evaluation criteria was then evaluated in more detail to understand the details and context of the potential exceedance.

Table 5.2.2-39 presents the maximum P90 values for the NorthMet Project Proposed Action Scenario and the CEC Scenario in comparison with the groundwater evaluation criteria. Figure 5.2.2-47 illustrates the range of model predictions for each solute (minimum P10 to maximum P90 values) over the 500-year simulation. Figure 5.2.2-48 illustrates the relative difference between the NorthMet Project Proposed Action and CEC Scenarios. If the values were the same, the relative change ratio would be 1; values greater than 1 indicate that the NorthMet Project Proposed Action would result in higher solute concentrations compared to the CEC Scenario. Conversely, values less than 1 indicate that the NorthMet Project Proposed Action would result in lower solute concentrations than the CEC Scenario.

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Table 5.2.2-39 Maximum P90 Groundwater Concentrations over a 500-year Model Simulation Period at All Evaluation Locations along Modeled Flowpaths in the Plant Site Surficial Aquifer

Parameter	Groundwater Evaluation Criteria[1]	Units	North Flowpath at Property Boundary		North Flowpath before MLC-2		Northwest Flowpath at Property Boundary		Northwest Flowpath before PM-19		West Flowpath at Property Boundary		West Flowpath before Embarrass River	
General			**NorthMet Project Proposed Action**	**CEC Scenario**	**NorthMet Project Proposed Action**	**CEC Scenario**	**NorthMet Project Proposed Action**	**CEC Scenario**	**NorthMet Project Proposed Action**	**CEC Scenario**	**NorthMet Project Proposed Action**	**CEC Scenario**	**NorthMet Project Proposed Action**	**CEC Scenario**
Alkalinity	NA	mg/L	241	243	199	200	205	220	172	179	190	201	171	175
Calcium	NA	mg/L	45.3	39.5	35.5	36.3	81.6	87.3	66.6	69.2	73.8	78.3	65.0	67.8
Chloride	250	mg/L	17.9	18.1	13.5	13.6	17.1	17.6	12.9	13.1	15.2	15.3	12.7	12.9
Fluoride	2.0	mg/L	**3.4**	**3.4**	**2.5**	**2.5**	0.1	0.1	0.16	0.13	0.18	0.18	0.18	0.18
Hardness	NA	mg/L	345	353	282	287	750	813	573	603	658	700	556	583
Magnesium	NA	mg/L	60.5	62.5	47.2	48.5	132.8	147	99.1	104.5	115.4	124.1	95.9	100.4
Potassium	NA	mg/L	8.3	8.4	6.6	6.6	8.3	9.3	6.5	6.8	7.4	8.1	6.4	6.7
Sodium	NA	mg/L	58.1	58.8	43.6	43.8	45.0	50.3	33.8	36.7	40.1	43.5	33.5	35.6
Sulfate	250	mg/L	188	191	139	139	**252**	**286**	185	202	243	**277**	200	219
TDS	500	mg/L	**517**	**520**	407	407	**659**	**690**	**507**	**517**	**609**	**633**	**515**	**527**
Metals														
Aluminum	NA	µg/L	68.0	41.2	73.6	55.1	69.4	47.9	74.9	58.1	72.7	52.9	69.4	55.9
Antimony	6.0	µg/L	0.41	0.40	0.42	0.41	0.39	0.45	0.41	0.40	0.41	0.43	0.41	0.41
Arsenic	10	µg/L	3.8	3.8	2.9	2.9	1.0	1.0	0.9	0.9	1.1	1.1	.99	.99
Barium	2,000	µg/L	177.7	179.1	148.2	148.8	70.3	46.5	75.7	58.6	73.6	53.7	70.1	59.8
Beryllium[2]	0.54	µg/L	0.26	0.28	0.22	0.25	0.31	**0.65**	0.24	0.49	0.27	**0.59**	0.24	0.49
Boron	1,000	µg/L	246.4	250	188	190	381.5	408	284	300	338	345	281	283
Cadmium	4.0	µg/L	0.38	0.16	0.22	0.14	0.15	0.21	0.14	0.18	0.15	0.21	0.14	0.18
Chromium III	100	µg/L	1.53	0.78	1.26	0.91	1.07	0.85	1.11	0.95	1.10	0.90	1.07	0.94
Cobalt	NA	µg/L	4.0	1.6	1.6	1.0	1.8	3.1	1.3	2.0	1.7	2.9	1.4	2.3
Copper	NA	µg/L	2.2	2.2	2.3	2.3	2.4	2.4	2.4	2.4	2.5	2.5	2.5	2.5
Iron	NA	µg/L	1,770	1,907	1,307	1,320	3,884	4,441	2,833	3,119	3,668	4,242	3,003	3,350
Lead	NA	µg/L	6.80	1.15	3.1	0.90	0.75	0.27	0.42	0.26	0.64	0.30	0.44	0.27
Manganese[2]	704	µg/L	434	311	376	319	**971**	**1,110**	**778**	**844**	**865**	**958**	**754**	**808**
Nickel	100	µg/L	4.0	3.9	4.4	4.4	5.0	5.0	5.0	5.0	5.2	5.2	5.1	5.1
Selenium	30	µg/L	1.11	0.79	0.95	0.80	0.86	0.86	0.88	0.84	0.87	0.89	0.87	0.83
Silver	30	µg/L	0.14	0.14	0.11	0.12	0.11	0.18	0.10	0.14	0.11	0.18	0.10	0.15
Thallium	0.6	µg/L	0.20	0.19	0.20	0.19	0.19	0.16	0.20	0.17	0.19	0.18	0.18	0.16
Vanadium	50	µg/L	6.2	5.1	5.9	5.3	5.1	3.1	5.5	4.2	5.3	3.7	5.4	4.2
Zinc	2,000	µg/L	32.6	13.7	21.4	14.5	14.8	8.9	15.4	11.6	15.4	10.5	14.7	11.7

Source: PolyMet 2015o.

Bold faced numbers exceed Groundwater Evaluation Criteria

[1] References for the groundwater evaluation criteria are summarized in Table 5.2.2-2; concentrations that exceed the evaluation criteria are in bold.

[2] The evaluation criterion differs by location based on background water quality (see Table 5.2.2-1).

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Bold-faced numbers in the screening table (Table 5.2.2-38) indicate which of the 29 model-simulated constituents were identified as having NorthMet Project Proposed Action maximum P90 concentrations (over 500 years) that exceed evaluation criteria at evaluation locations in the Plant Site surficial groundwater flowpaths:

- Fluoride in North Flowpath at property boundary
- Sulfate in Northwest Flowpath at property boundary
- TDS in North Flowpath at property boundary
- TDS in Northwest Flowpath at property boundary
- TDS in West Flowpath at property boundary
- Manganese in Northwest Flowpath at property boundary
- Manganese in West Flowpath at property boundary

These four constituents and associated evaluation locations are listed in Table 5.2.2-40. In this table, maximum P50 and P90 concentrations for the NorthMet Project Proposed Action are compared with analogous values associated with the CEC for three phases of the GoldSim 500-year simulation (operations, reclamation, and post-closure maintenance). In all cases the NorthMet Project Proposed Action maximum P90 concentration of a phase is lower than the comparable maximum P90 concentration for CEC.

A further evaluation was performed by conducting a timestep-by-timestep analysis of the GoldSim results. The analysis indicated that over the 500-year simulation, there were no (monthly) timesteps for which the NorthMet Project Proposed Action P90 contaminant concentration was higher than the evaluation criterion and higher than the P90 concentration for CEC. The same result occurred when the comparison was made with P50 concentrations.

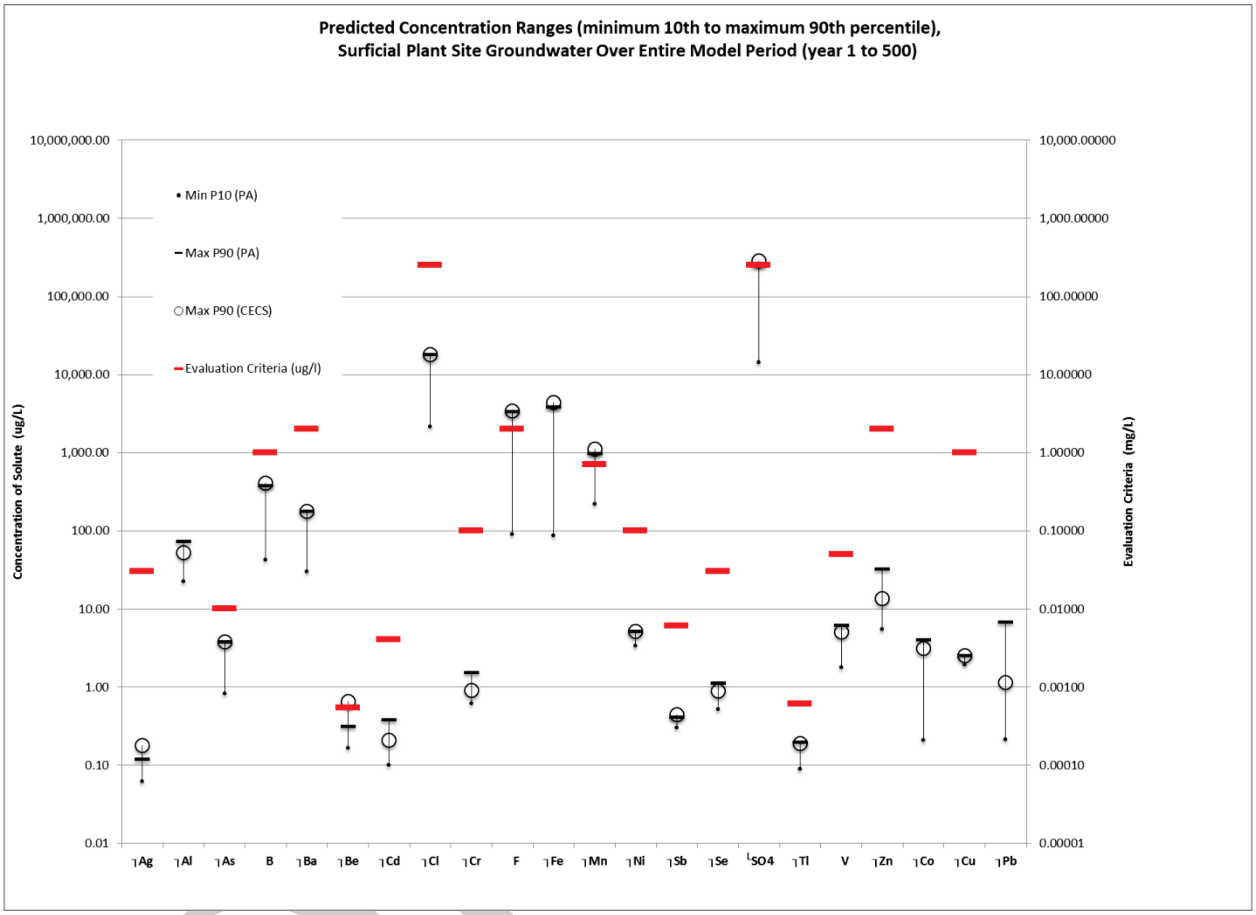
This assessment of the GoldSim results provides strong evidence that the NorthMet Project Propose Action would not cause impacts to Plant Site groundwater quality above and beyond what would occur without the NorthMet Project Proposed Action.

Table 5.2.2-40 GoldSim-Predicted Maximum P50 and Maximum P90 of Groundwater Concentrations at the Plant Site for Selected Constituents for Different Project Phases

Constituent[1]	Units	Surficial Groundwater Flowpath[1]	Evaluation Location[1]	Evaluation Criterion	Operations (years 0–20) PA	Operations (years 0–20) CEC	Reclamation (years 20–56) PA	Reclamation (years 20–56) CEC	Post-Closure Maintenance (years 56–500) PA	Post-Closure Maintenance (years 56–500) CEC	Note
a. Maximum P50 of Annual Concentrations from GoldSim Output											
Fluoride	mg/L	North	Property Boundary	2	2.84	2.84	2.49	2.84	2.03	2.86	(2)
Sulfate	mg/L	Northwest	Property Boundary	250	212	212	186	212	150	210	(2)
TDS	mg/L	North	Property Boundary	500	451	451	407	451	344	444	(2)
TDS	mg/L	Northwest	Property Boundary	500	570	570	510	570	422	567	(2)
TDS	mg/L	West	Property Boundary	500	501	501	459	501	391	501	(2)
Manganese	µg/L	Northwest	Property Boundary	704	860	860	785	860	681	854	(2)
Manganese	µg/L	West	Property Boundary	704	744	744	692	744	616	743	(2)
b. Maximum P90 of Annual Concentrations from GoldSim Output											
Fluoride	mg/L	North	Property Boundary	2	3.38	3.38	3.04	3.38	2.62	3.41	(3)
Sulfate	mg/L	Northwest	Property Boundary	250	253	253	227	255	192	286	(3)
TDS	mg/L	North	Property Boundary	500	520	520	478	519	418	517	(3)
TDS	mg/L	Northwest	Property Boundary	500	662	662	601	662	519	690	(3)
TDS	mg/L	West	Property Boundary	500	610	610	565	611	497	633	(3)
Manganese	µg/L	Northwest	Property Boundary	704	974	974	902	989	803	1,110	(3)
Manganese	µg/L	West	Property Boundary	704	866	866	813	869	738	958	(3)

PA: GoldSim NorthMet Project Proposed Action Scenario

[1] Identified in Table 5.2.2-39 as requiring further evaluation.
[2] No timesteps for which PA > Criteria and PA > CEC for P50 concentrations.
[3] No timesteps for which PA > Criteria and PA > CEC for P90 concentrations.



Notes: PA = NorthMet Project Proposed Action

Figure 5.2.2-47 Predicted Groundwater Concentration Ranges (Minimum 10th to Maximum 90th Percentile) at All Plant Site Surficial Groundwater Evaluation Locations Based on the GoldSim Probabilistic Model

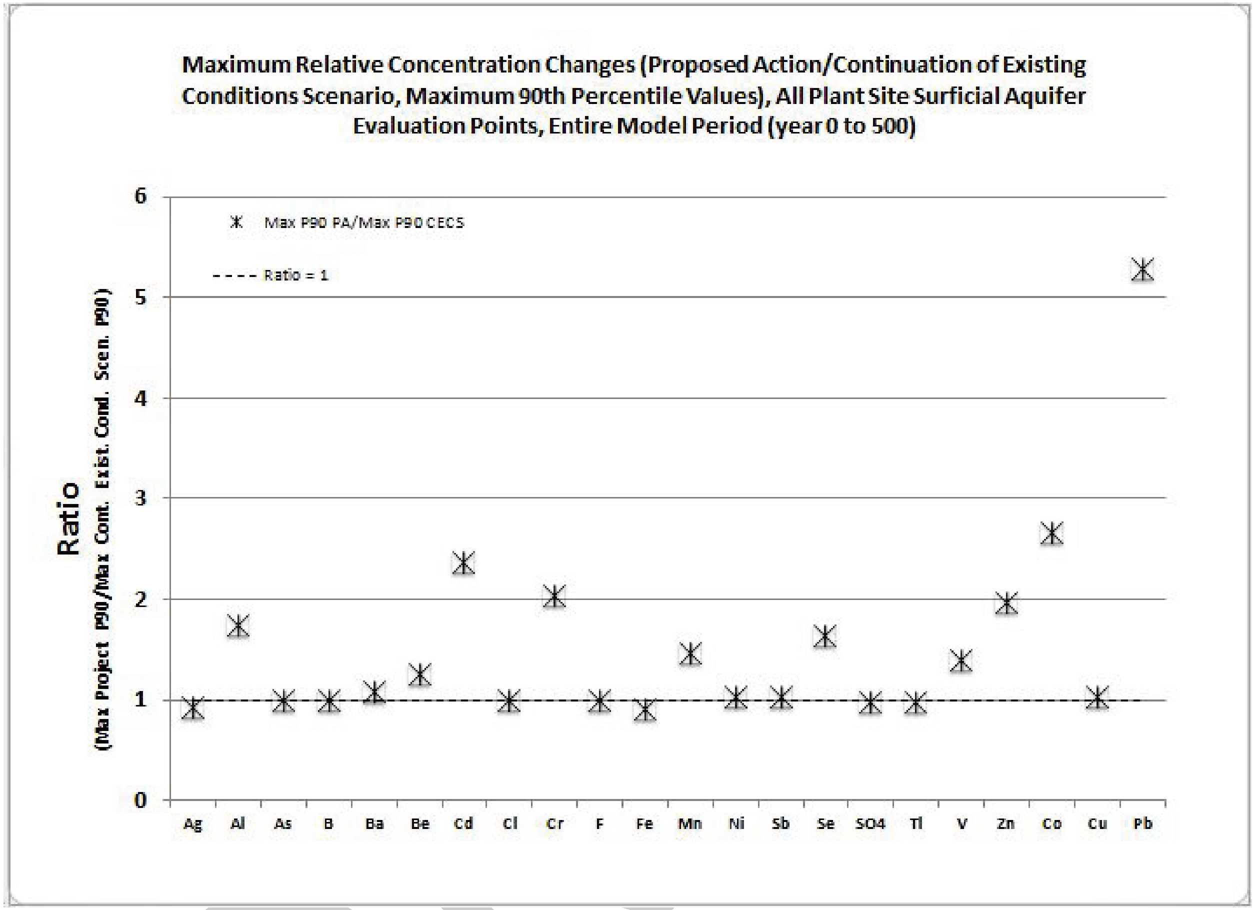


Figure 5.2.2-48 Maximum Relative Concentration Changes (NorthMet Project Proposed Action/CEC Scenario) at Surficial Aquifer Evaluation Locations, Entire Model Period

<u>Effects on Surface Water Hydrology in the Embarrass River Watershed</u>

This section describes the effects of the NorthMet Project Proposed Action on the surface water hydrology of the Embarrass River and its tributaries. The effects of the NorthMet Project Proposed Action on surface water hydrology, especially in the three tributary streams draining the Tailings Basin (i.e., Mud Lake Creek, Trimble Creek, and Unnamed Creek) are complex, as some project features/engineering controls would tend to increase flows while others would decrease flows and change over time. For example, during mine operations, the NorthMet Project Proposed Action would increase seepage from the Tailings Basin toe as a result of tailings deposition, but nearly all of this seepage would be captured by the containment system; this reduction in flow would, in turn, be mitigated by the proposed streamflow augmentation with treated water or the construction of a swale. The NorthMet Project Proposed Action would also slightly modify some watershed areas within the Embarrass River, which would affect streamflows. These NorthMet Project Proposed Action effects on surface water hydrology are described in more detail below.

The State of Minnesota aims to maintain existing flows to which streams and aquatic habitat have adapted. This may or may not be a pre-mining flow regime. In the case of the NorthMet Project Proposed Action where the existing LTVSMC tailings basin seeps water, containing the seeps creates a need to discharge clean water within a range of existing flows to maintain existing hydrology, geomorphology, aquatic communities, connectivity, water quality, and biology (Chisholm 2006).

Mud Lake Creek Watershed Alteration

The Tailings Basin has a contributing watershed immediately to the east of Cell 1E that provides groundwater and surface water flow into the Tailings Basin. The East Dam would be constructed to enable tailings deposition into Cell 1E. The watershed that currently drains into Cell 1E would be rerouted via a constructed drainage swale to drain to the headwaters of Mud Lake Creek. In addition, a containment facility with a cut-off wall would be constructed adjacent to the east embankment, and this would divert groundwater east of the Tailings Basin into the swale as well (see Figure 5.2.2-49). There would be no need for augmentation to Mud Lake Creek because of the additional runoff water diverted to the stream (PolyMet 2015j). Figure 5.2.2-49 shows the approximate location of the drainage swale. Construction of the swale diversion would increase the Mud Lake Creek Watershed area at MLC-3 from 1.34 mi^2 to 2.24 mi^2 (PolyMet 2015j, Appendix B).

Effects on Embarrass River Tributary Streamflow

The NorthMet Project Proposed Action includes construction of surface water and groundwater seepage containment systems along the sides of the Tailing Basin. The containment system on the North, Northwest and West sides would capture all surface seepage and nearly all groundwater Tailings Basin seepage that would flow away from the Tailings Basin. In addition, a containment system would be constructed along the east embankment to prevent westward flowing groundwater and surface water fed by Spring Mine Lake from draining into the Tailings Basin. A gravel-filled trench would collect 100 percent of surface and groundwater tailings seepage that would occur as the Tailings Basin is raised. Seepage and local runoff captured by these systems would be pumped back into the Tailings Basin pond or to the WWTP. As indicated in Table 5.2.2-38, the containment systems would capture nearly all seepage entering the tributary streams. WWTP-treated effluent would be used to restore streamflows in the affected tributaries. This is referred to as augmentation.

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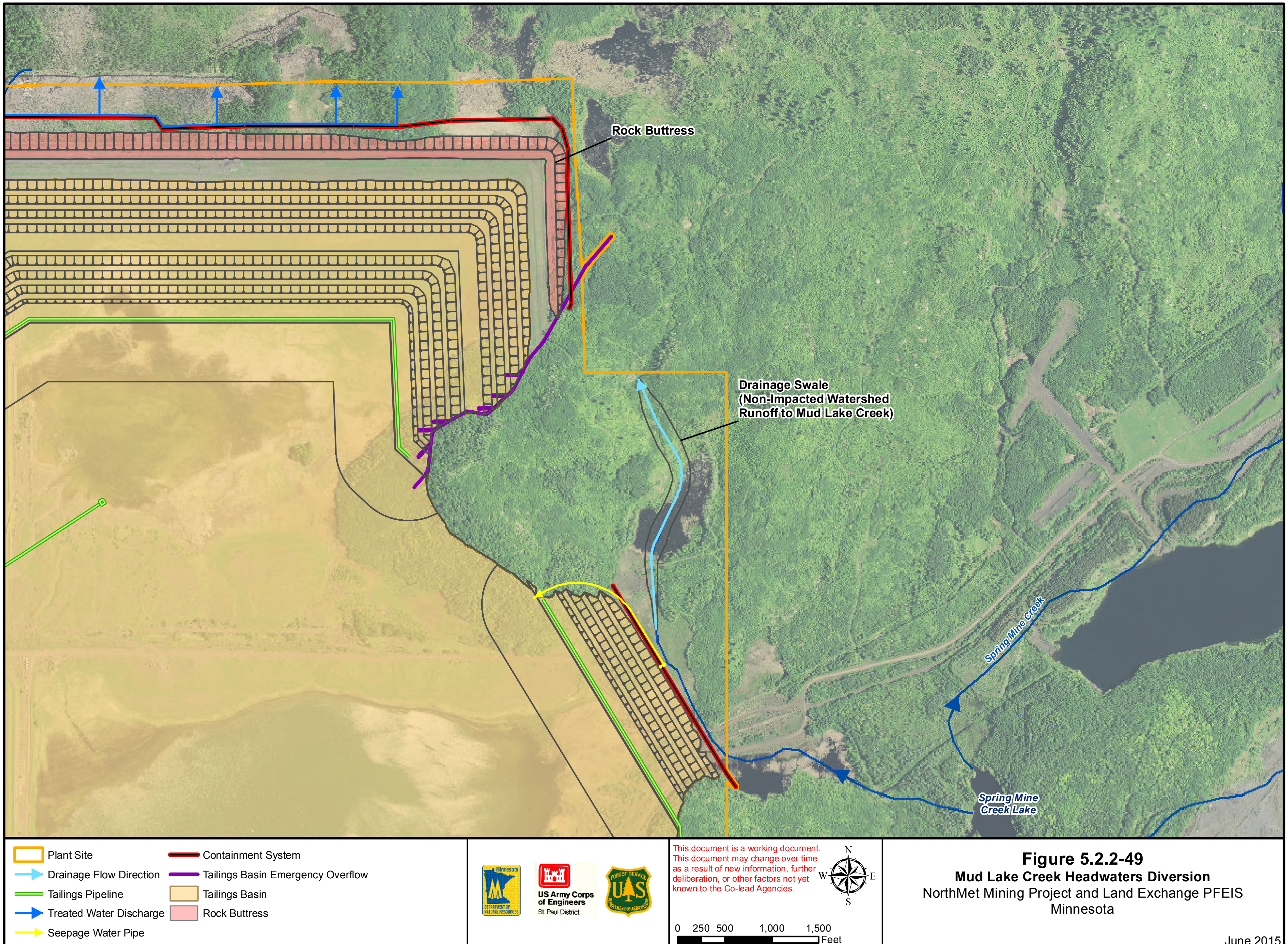

Figure 5.2.2-49

Mud Lake Creek Headwaters Diversion

NorthMet Mining Project and Land Exchange PFEIS

Minnesota

June 2015

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PolyMet has proposed to augment flow by distributing treated effluent from the WWTP among Unnamed Creek and Trimble Creek to maintain average annual flow to within 20 percent of existing conditions to maintain existing aquatic ecology. To ensure there would be enough treated effluent from the WWTP to augment the tributary streamflow, water from Colby Lake and if required, the optional Hydrometallurgical Residue Facility Wick Drain System, would be sent to the WWTP to be treated to increase the treated effluent available. Volumes for withdrawal are shown in Table 5.2.2-41.

Table 5.2.2-41 Plant Site Water Appropriation During Operations

Water Source Location	Source Water	90th Percentile Maximum Estimated Daily Volumes (Million Gallons per Day)	90th Percentile Maximum Estimated Annual Volume (Million Gallons per Year)
Colby Lake	Surface Water	15.1 MGD (Mine Year 1)	1,300 MGY (Mine Year 1)
Hydrometallurgical Residue Facility Wick Drain System[1]	Groundwater	TBD in permitting	TBD in permitting

Source: PolyMet 2015i

[1] The Hydrometallurgical Residue Facility wick drain system is an optional feature of the Hydrometallurgical Residue Facility and, if required, would tie into the FTB Containment System for collection. Appropriation quantities for the wick drain system would be determined in permitting, if required.

The total flow required from the WWTP effluent to augment Trimble Creek, Unnamed Creek and Second Creek after construction of the Mud Lake Creek drainage swale would range from 1,698 to 3,442 gpm (Table 5.2.2-42) (PolyMet 2015j). Table 5.2.2-41 shows the minimum required and maximum allowable (plus or minus 20 percent of existing average annual tributary streamflow) augmentation that would be discharged on an average annual basis to each of the three tributaries for operations, reclamation and long-term maintenance. The discharge locations would be downstream of the surface and groundwater seepage containment system. Depending on site conditions, the augmentation water would be piped directly to the stream channels or released from a distribution pipe that parallels the North and Northwest containment system, whereas West of the Tailings Basin, augmentation flow to Unnamed Creek would be via a single discharge near the current SD-006 discharge.

Table 5.2.2-42 WWTP Flow Requirements for Stream Augmentation

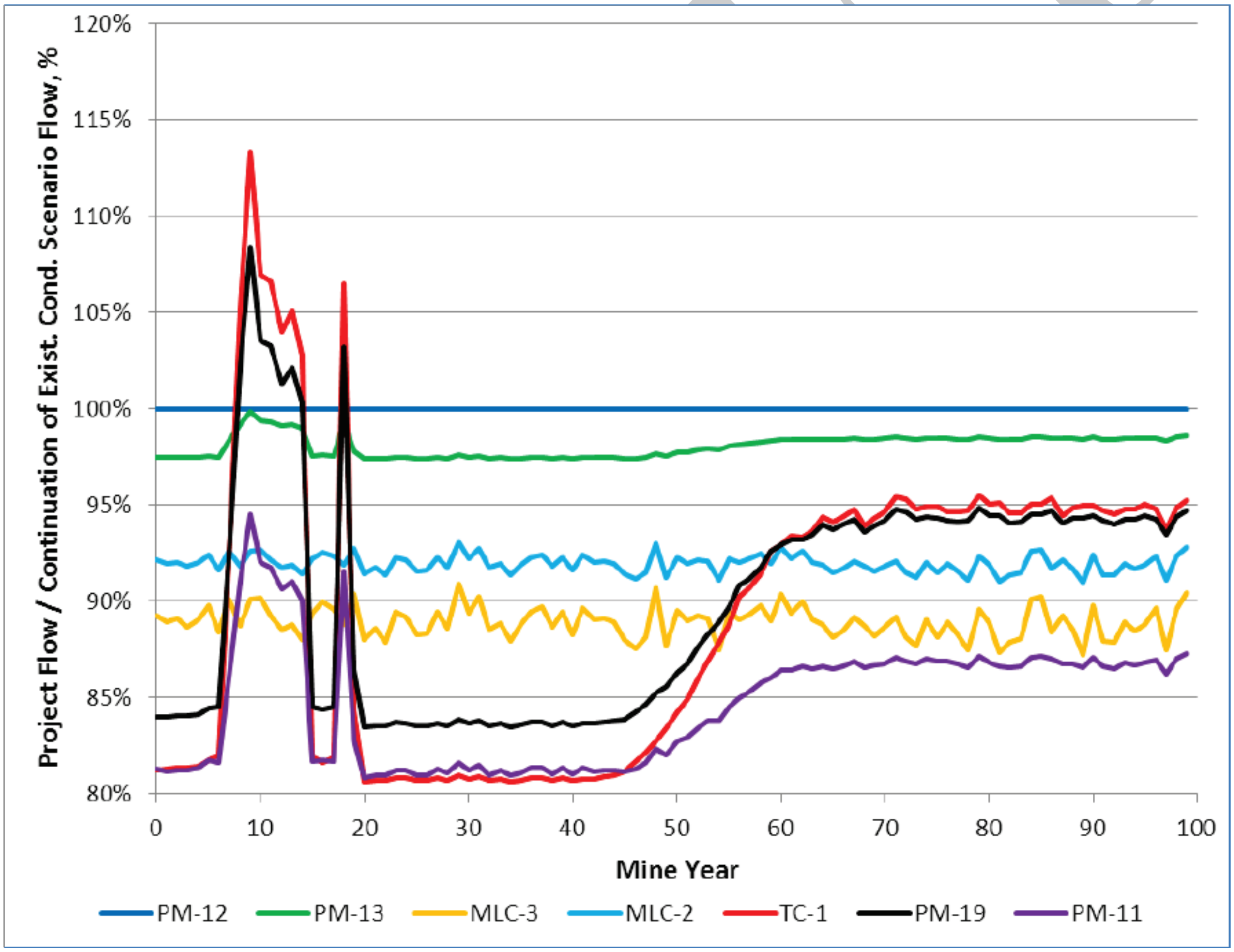
Description	Trimble Creek (gpm)	Unnamed Creek (gpm)	Second Creek (gpm)
Minimum Requirement from WWTP	1,178	336	184
Maximum Allowable from WWTP	2,066	836	276
Expected Flows from WWTP - Operations	1,190 – 1,890	340 – 540	185 – 295[1]
Expected Flows from WWTP - Reclamation	1,180	336	184

Expected Flows from WWTP - Closure and Long-Term Maintenance	1,485	423	232

Source: PolyMet 2015i, Table 2-3

[1] Note the highest modeled flows to Second Creek did exceed the maximum allowable by about 20 gpm due to the simplified distribution of WWTP effluent in the modeling and the tight target flow range at SD-026. However, the high flow rate (295 gpm) is within the observed flows at SD026 from July 1999 through September 2014 (range is from less than 10 gpm to nearly 2,500 gpm).

Figure 5.2.2-50 shows the predicted effectiveness of the proposed flow augmentation in maintaining annual average Embarrass River tributary streamflow within 20 percent of the CEC Scenario. The graph only shows up to year 100 because the results are steady beyond that point.



Source: PolyMet 2015j, Figure 6-82.

Figure 5.2.2-50 Average Annual Embarrass River and Tributary Flows in the NorthMet Project Proposed Action Model (Percent of CEC Scenario)

Hydrologic fluctuations throughout operations and reclamation would be due to changes in the available amount of WWTP effluent. At no time, however, would tributary flow change by more than the 20 percent from existing flows.. Upstream of the NorthMet Project Proposed Action, at PM-12, the projected flow remains unchanged. Results for Mud Lake Creek show that starting in mine year 0 – upon construction of the drainage swale that would direct additional runoff into Mud Lake Creek the minimum required flow – 80 percent of existing conditions, is met at MLC-3 and MLC-2. Figure 5.2.2-50 shows that flow at MLC-3 and MLC-2 are relatively constant, indicating that the drainage swale is effective in preventing hydrologic impacts to Mud Lake Creek (PolyMet 2015j). Trimble Creek and Unnamed Creek show the effects of varying quantities of WWTP discharge, but at all times the NorthMet Project Proposed Action augmented stream flows are within 20 percent of the annual average CEC scenario. The effect of the NorthMet Project Proposed Action would decrease with distance downstream, as can be seen at PM-13, where the maximum change in flow would be approximately 3 percent in the annual average flow during operations, with a closure and long-term maintenance decrease of less than 2 percent (PolyMet 2015j).

Effects on Surface Water Quality

As shown on Figure 5.2.2-50, Embarrass River tributaries that would be affected by mine facilities include Unnamed Creek, Trimble Creek, and Mud Lake Creek. These tributaries currently receive Tailings Basin seepage with its associated water quality. Because the tributaries discharge into the Embarrass River, their flow rates and water quality affect Embarrass River concentrations.

Results of the GoldSim water quality modeling were reviewed for all 29 solutes at five tributary streams (i.e., MLC-2, MLC-3, TC-1, PM-19, and PM-11) and three Embarrass River (i.e., PM-12, PM-12.2, and PM-13) evaluation locations (see Table 5.2.2-43). Model results for the NorthMet Project Proposed Action and CEC scenario are essentially identical at stations PM-12 and PM-12.2, the two stations that are upstream of the NorthMet Project area and thus would not be affected by the NorthMet Project Proposed Action (see Table 5.2.2-43). The differences in water quality between these two stations can be attributed to a significant chemical load (notably sulfate) that enters the Embarrass River just upstream of PM-12.2 via a tributary stream originating at the 5NW Pit.

A screening process was used to identify any constituents and locations that warranted a more robust examination because of potential exceedances of water quality evaluation criteria (see Table 5.2.2-40 for the Embarrass River tributary streams evaluation locations and Table 5.2.2-41 for the Embarrass River mainstem evaluation locations). The screening process involved comparing the single-highest monthly P90 water quality prediction from among the 5,988 months covered by the simulation (i.e., 12 months times 499 years, with the first year of simulation excluded for screening review due to potential numerical artifacts in the model results) for each constituent for each of the eight evaluation locations. If the maximum P90 concentration exceeded the evaluation criteria, the screening process identified it for further analysis.

Tables 5.2.2-44 and 5.2.2-45 show that the maximum P90 concentrations for the NorthMet Project Proposed Action would not exceed the applicable evaluation criteria, with the following exceptions:

- The aluminum criterion would be exceeded at all locations except TC-1 (on Trimble Creek) for both the CEC scenario and the NorthMet Project Proposed Action;
- The 10 mg/L wild rice sulfate criterion would be exceeded at PM-13 for both the CEC scenario and the NorthMet Project Proposed Action.

More detailed discussion of these constituents is provided in subsequent subsections of this FEIS.

Table 5.2.2-43 screens metals with hardness-based evaluation criteria. It was not possible to develop a single evaluation criterion to which the GoldSim-predicted solute concentrations could be compared. The approach to screening was therefore based on evaluating the frequency of the occurrence of an exceedance for each timestep. A 5 percent frequency of exceedance criterion was used for metals with hardness-dependent evaluation criteria. The 5 percent threshold was selected because it is sufficiently conservative for purposes of identifying solutes where additional discussion is necessary to understanding potential environmental effects. The bolded value for lead and PM-11 is the only value that exceeded the frequency of exceedance threshold of 5 percent. Lead is discussed further below.

Table 5.2.2-43 Plant Site Surface Water Quality - Initial Screening of Constituents with Hardness-Based Evaluation Criteria [1]

a. Embarrass River

	PM-12		PM-12.2		PM-12.3		PM-12.4		PM-13	
Constituent	**Exceedance Probability of PA > CRT (%)**	**Probability of PA > CRT *and* CEC ≤ CRT (%)**	**Exceedance Probability of PA > CRT (%)**	**Probability of PA > CRT *and* CEC ≤ CRT (%)**	**Exceedance Probability of PA > CRT (%)**	**Probability of PA > CRT *and* CEC ≤ CRT (%)**	**Exceedance Probability of PA > CRT (%)**	**Probability of PA > CRT *and* CEC ≤ CRT (%)**	**Exceedance Probability of PA > CRT (%)**	**Probability of PA > CRT *and* CEC ≤ CRT (%)**
Cadmium	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Chromium III	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Copper	0.98	0.00	0.10	0.00	0.23	0.13	0.25	0.17	0.08	0.05
Lead	1.55	0.00	0.02	0.00	0.10	0.08	0.13	0.08	0.00	0.00
Nickel	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Zinc	0.71	0.00	0.10	0.00	0.18	0.10	0.22	0.15	0.10	0.03

b. Tributary Streams

	MLC-2		MLC-3		TC-1		PM-19		PM-11	
Constituent	**Exceedance Probability of PA > CRT (%)**	**Probability of PA > CRT *and* CEC ≤ CRT (%)**	**Exceedance Probability of PA > CRT (%)**	**Probability of PA > CRT *and* CEC ≤ CRT (%)**	**Exceedance Probability of PA > CRT (%)**	**Probability of PA > CRT *and* CEC ≤ CRT (%)**	**Exceedance Probability of PA > CRT (%)**	**Probability of PA > CRT *and* CEC ≤ CRT (%)**	**Exceedance Probability of PA > CRT (%)**	**Probability of PA > CRT *and* CEC ≤ CRT (%)**
Cadmium	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Chromium III	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Copper	0.77	0.70	1.15	1.12	0.63	0.63	0.57	0.57	1.25	1.25
Lead	1.18	1.15	2.05	2.05	3.90	3.90	1.28	1.28	7.13	**7.13**
Nickel	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.00	0.00
Zinc	0.57	0.53	0.83	0.83	0.27	0.25	0.23	0.22	0.60	0.60

Source: GoldSim output file: "SW_NonDEg_Timeseries_PlantSite.xlsm" (NorthMet GoldSim model, version 6)

CEC = Continuation of Existing Conditions solute concentration
CRT = Hardness-based evaluation criterion
PA = NorthMet Project Proposed Action solute concentration
Bolded values indicate constituents with {PA > CRT ***and*** CEC ≤ CRT} probability greater than 5%; retained for further evaluation.

[1] Maximum of annual average values from Barr exceedance plots (see PolyMet 2015j, Attachment J) or other GoldSim outputs

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Table 5.2.2-46 below compares the P50 and P90 modeled concentrations for the NorthMet Project Proposed Action and the CEC Scenario for selected key constituents during mine operations, reclamation, and closure and post-closure maintenance at PM-13, which is the most downstream evaluation location that would reflect all NorthMet Project Proposed Action-related contaminant loadings. As these data show, the sulfate concentrations would decrease for the NorthMet Project Proposed Action relative to the CEC Scenario across all three probability values and all three mine phases.

Current Tailings Basin seepage with high sulfate concentrations reaches the Embarrass River, affecting sulfate concentrations at PM-13. Under the NorthMet Project Proposed Action, nearly all of this seepage would be collected and prevented from reaching the river, and the flow is replaced by treated WWTP effluent with a low sulfate load. As a result, the sulfate load to the Embarrass River is reduced, as reflected by lower sulfate concentrations at PM-13 under the NorthMet Project Proposed Action compared with the CEC Scenario. However, this reduction is not sufficient to meet the 10 mg/L wild rice sulfate evaluation criterion that applies at PM-13.

Comparison of GoldSim-predicted CEC scenario and NorthMet Project Proposed Action conditions at PM-13 for arsenic, copper, lead, nickel, and zinc indicates that NorthMet Project Proposed Action concentrations of these metals would all be higher than CEC Scenario concentrations during all phases. The reason for increased PM-13 concentrations for these metals is that concentrations of these metals in the WWTP effluent, which is used for stream augmentation, would be higher than the concentrations in the existing LTVSMC Tailings Basin seepage (assumed for CEC scenario). As a consequence, there would be an increase in solute loading to the Embarrass River during operations and closure and post-closure maintenance when compared to the CEC scenario.

3870 -Page Intentionally Left Blank-

Table 5.2.2-44 Plant Site Tributary Surface Water – Maximum P90 Solute Concentration Over Entire 500-Year Simulation Period Based on GoldSim Probabilistic Model

Parameter	Stream Standard	Units	MLC-2		MLC-3		TC-1		PM-19		PM-11	
General			**NorthMet Project Proposed Action**	**CEC Scenario**	**NorthMet Project Proposed Action**	**CEC Scenario**	**NorthMet Project Proposed Action**	**CEC Scenario**	**NorthMet Project Proposed Action**	**CEC Scenario**	**NorthMet Project Proposed Action**	**CEC Scenario**
Alkalinity	NA	mg/L	132	266	103	284	101	286	104	278	102	260
Calcium	NA	mg/L	29.7	41.4	26.0	43.8	35.1	61.8	36.6	61.6	35.1	105
Chloride	230	mg/L	10.2	20.7	10.2	22.3	6.2	22.9	7.5	22.2	8.8	22.1
Fluoride	NA	mg/L	1.1	3.9	0.22	4.2	0.13	3.3	0.15	3.1	0.18	0.21
Hardness	500	mg/L	176	396	108	439	100	**622**	128	**613**	100	**1,054**
Magnesium	NA	mg/L	25.9	71.7	12.4	80.5	7.75	115	10.0	114	10.3	196
Potassium	NA	mg/L	3.78	9.36	2.45	10.21	1.45	10.96	1.82	10.7	2.08	11.7
Sodium	NA	mg/L	21.0	66.8	5.46	73.3	3.81	73.3	4.67	70.6	4.76	64.5
Sulfate	NA	mg/L	63.0	224	14.6	261	12.2	301	19.5	289	13.5	427
TDS	700	mg/L	234	597	133	666	127	**760**	143	**738**	136	**983**
Metals Total												
Aluminum	125	µg/L	**187**	**158**	**189**	**139**	112	111	**135**	**129**	**159**	**151**
Antimony	31	µg/L	0.40	0.44	0.39	0.46	20.3	0.50	19.0	0.49	19.6	0.68
Arsenic	53	µg/L	4.44	4.41	4.51	4.79	10.0	4.21	9.82	3.97	10.0	3.61
Barium	NA	µg/L	93.9	194	61.9	208	5.00	167	10.7	160	5.00	29.4
Beryllium	NA	µg/L	0.19	0.30	0.17	0.32	0.66	0.47	0.62	0.47	0.64	0.83
Boron	500	µg/L	94.5	282	28.0	311	368	379	349	370	356	**517**
Cadmium	NA[1]	µg/L	0.16	0.17	0.12	0.18	2.00	0.19	1.95	0.19	2.00	0.26
Chromium III	NA[1]	µg/L	1.78	1.57	1.87	1.43	7.60	1.14	7.39	1.33	7.53	1.49
Cobalt	5	µg/L	2.73	2.48	2.78	2.35	5.00	2.86	4.93	2.74	5.00	4.73
Copper	NA[1]	µg/L	2.23	2.73	2.23	2.94	9.00	3.42	8.87	3.30	9.00	5.25
Iron	NA	µg/L	12,396	10,460	12,587	9,236	6,979	7,426	8,331	8,673	10,490	10,625
Lead	NA[1]	µg/L	1.43	1.26	0.50	1.38	3.00	1.13	2.95	1.07	3.00	0.42
Manganese	NA	µg/L	1,302	1,113	1,353	979	712	867	886	982	1,085	1,379
Nickel	NA[1]	µg/L	4.08	4.55	4.02	4.83	50.0	5.89	49.1	5.77	50.0	9.84
Selenium	5	µg/L	0.87	0.76	0.82	0.76	5.00	0.79	4.87	0.77	4.99	0.93
Silver	1	µg/L	0.13	0.15	0.13	0.17	0.33	0.19	0.32	0.18	0.32	0.25
Thallium	0.56	µg/L	0.17	0.19	0.16	0.20	0.24	0.18	0.23	0.18	0.23	0.16
Vanadium	NA	µg/L	5.16	4.79	4.70	4.66	9.57	3.74	9.34	3.72	9.52	1.00
Zinc	NA[1]	µg/L	19.2	18.1	19.2	16.8	100	13.9	98.2	15.3	99.9	15.8

Source: PolyMet 2014w.

Notes:
For each constituent at each location, the maximum solute concentration over the entire 500-year simulation period is recorded for each of 500 realizations of the Monte Carlo run. At the end of the Monte Carlo run, there is a list of 500 maximum concentration values for each constituent at each location. Each list is converted to a cumulative frequency distribution. Each value in this table is the 90th percentile concentration from the associated distribution.

Bold value indicates exceedance of the evaluation criterion.

[1] Parameter has a hardness-based evaluation criterion and is screened using a different procedure (see Table 5.2.2.43)

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Table 5.2.2-45 Plant Site Embarrass River Surface Water – Maximum P90 Solute Concentration

Parameter	Stream Standard	Units	PM-12		PM-12.2		PM-13	
General			**PA**	**CEC Scenario**	**PA**	**CEC Scenario**	**PA**	**CEC Scenario**
Alkalinity	NA	mg/L	100	100	100	100	101	179
Calcium	NA	mg/L	23.4	23.4	41.5	41.5	33.9	49.3
Chloride	230	mg/L	10.1	10.1	9.9	9.9	9.7	13.1
Fluoride	NA	mg/L	0.21	0.21	0.21	0.21	0.21	1.4
Hardness	500	mg/L	96.7	96.7	463	463	208	453
Magnesium	NA	mg/L	12.3	12.3	88.3	88.3	31.6	81.3
Potassium	NA	mg/L	2.44	2.44	18.6	18.6	6.19	9.13
Sodium	NA	mg/L	5.41	5.41	32.9	32.9	12.5	42.1
Sulfate[(2)]	NA	mg/L	14.3	14.3	375	375	114	217
TDS	700	mg/L	128	128	626	626	269	521
Metals Total								
Aluminum	125	µg/L	**188**	**188**	**180**	**180**	**180**	**179**
Antimony	31	µg/L	0.36	0.36	0.33	0.33	9.17	0.40
Arsenic	53	µg/L	4.36	4.36	4.15	4.15	5.81	4.21
Barium	NA	µg/L	49.8	49.8	39.3	39.3	35.4	93.7
Beryllium	NA	µg/L	0.15	0.15	0.14	0.14	0.31	0.33
Boron	500	µg/L	26.5	26.5	70.1	70.1	151	225
Cadmium	NA[1]	µg/L	0.11	0.11	0.11	0.11	1.01	0.15
Chromium III	NA[1]	µg/L	1.80	1.80	1.71	1.71	4.13	1.70
Cobalt	5	µg/L	2.72	2.72	2.63	2.63	2.96	2.63
Copper	NA[1]	µg/L	2.06	2.06	2.07	2.07	5.67	2.55
Iron	NA	µg/L	12,476	12,476	11,927	11,927	11,808	11,687
Lead	NA[1]	µg/L	0.50	0.50	0.48	0.48	1.73	0.59
Manganese	NA	µg/L	1,305	1,305	1,279	1,279	1,239	1,247
Nickel	NA[1]	µg/L	3.23	3.23	3.39	3.39	28.42	4.54
Selenium	5	µg/L	0.78	0.78	0.78	0.78	2.74	0.76
Silver	1	µg/L	0.13	0.13	0.13	0.13	0.18	0.14
Thallium	0.56	µg/L	0.13	0.13	0.13	0.13	0.17	0.15
Vanadium	NA	µg/L	3.68	3.68	4.23	4.23	6.53	3.73
Zinc	NA[1]	µg/L	19.0	19.0	18.3	18.3	57.0	18.5

Source: PolyMet 2014w.

Notes:
Bold value indicates exceedance of the evaluation criterion.

[1] Parameter has a hardness-based evaluation criterion and is screened using a different procedure (see Table 5.2.2.43)
[2] Sulfate 10 mg/L wild rice evaluation criterion applies at PM-13.

Table 5.2.2-46 Comparison of the Maximum P50 and P90 Values for NorthMet Project Proposed Action and CEC Scenario Concentrations at PM-13 for Selected Key Constituents, by Phase

Parameter	Units	Maximum P50 Operations (Years 2-20)		Maximum P50 Reclamation (Years 21-55)		Maximum P50 Closure & Post-Closure Maintenance (Years 56-500)		Maximum P90 Operations (Years 2-20)		Maximum P90 Reclamation (Years 21-55)		Maximum P90 Closure & Long-Closure Maintenance (Years 56-500)	
		PA[1]	CEC	PA[1]	CEC	PA[1]	CEC	PA[1]	CEC	PA[1]	CEC	PA[1]	CEC
Sulfate	mg/L	88.8	187.2	89.0	185.4	89.0	184.8	111.7	209.1	112.5	217.4	113.6	215.1
Aluminum	µg/L	100.5	100.2	104.5	103.0	102.1	100.9	168.3	165.1	173.3	169.8	179.9	178.7
Arsenic	µg/L	5.0	1.9	3.8	1.9	3.7	1.9	5.8	3.9	4.4	3.9	4.9	4.2
Copper	µg/L	4.9	1.9	3.9	1.8	3.8	1.7	5.7	2.3	4.5	2.6	4.5	2.5
Lead	µg/L	1.5	0.5	1.1	0.5	1.1	0.5	1.7	0.6	1.3	0.6	1.3	0.6
Nickel	µg/L	23.7	3.3	17.2	3.1	16.7	3.1	28.4	4.0	20.8	4.5	20.4	4.5
Zinc	µg/L	48.0	9.4	33.3	9.3	15.0	9.3	57.0	18.0	42.6	18.3	21.3	18.5

Source: PolyMet 2014w.

[1] NorthMet Project Proposed Action

Aluminum in Surface Waters of the Embarrass River Watershed

As shown by bold font in screening Tables 5.2.2-44 and 5.2.2-45, the maximum P90 values for aluminum would exceed the 125 µg/L water quality criterion at nearly all surface water evaluation locations for both the NorthMet Project Proposed Action and CEC scenarios. The exceedances are shown for Embarrass River stations PM-12, PM12.2, and PM-13, and for tributary stations MLC-2 and MLC-3 on Mud Lake Creek, PM-19 on Trimble Creek, and PM-11 on Unnamed Creek (map locations are shown on Figure 5.2.2-9). These screening level exceedances indicate the need for further evaluation of aluminum in surface waters at the Plant Site.

Based on GoldSim results, Table 5.2.2-47 was developed to provide a better analysis of aluminum at surface water evaluation locations. For three different phases of the project, maximum P90 values of annual maximum aluminum concentrations are listed for both the NorthMet Project Proposed Action and CEC scenarios. The three NorthMet Project Proposed Action phases considered are operations (mine years 1 to 20), reclamation (years 21 to 56), and post-closure maintenance (years 56 to 200). Inspection of GoldSim outputs indicated that predicted surface water concentrations were generally stable or decreasing after 200 years due to depletion of the chemical sources at the Tailings Basin, so mine years 201-500 were not included in the evaluation. Highlighted in the table are conditions where 1) the CEC value is *lower* than the evaluation criterion (yellow) and 2) where the NorthMet Project Proposed Action concentration exceeds the criterion while the comparable CEC concentration does not (blue). Based on Table 5.2.2-47, the following observations are made:

- All maximum P50 values of annual aluminum for the three operating phases are below the 125 µg/L aluminum evaluation criterion. Most maximum P90 values of annual aluminum for the three operating phases are above the aluminum evaluation criterion. The maximum P90 values of annual aluminum are on average 66 µg/L higher than corresponding P50 values.
- For the P90 values, the maximum difference between NorthMet Project Proposed Action concentrations and comparable CEC concentrations is most significant for Mud Lake Creek (46 µg/L), but relatively small for the other tributary streams (5 µg/L for Trimble Creek and 9 µg/L for Unnamed Creek). The difference for the Embarrass River is very small (2 µg/L).
- There is only one case where the NorthMet Project Proposed Action concentration exceeds the evaluation criterion while the analogous CEC concentration is below the criterion. This occurs at PM-19 (Trimble Creek) for the maximum P90 of annual aluminum during the operations phase. However, closer inspection of the table shows that the NorthMet Project Proposed Action concentration of 129 µg/L is just above the criterion (125 µg/L) and is only 5 µg/L higher than the corresponding CEC concentration of 124 µg/L, which is just below the criterion.

Table 5.2.2-47 Maximum P50 and Maximum P90 of Annual Aluminum Concentrations for Different Project Phases

Stream	Evaluation Location	Evaluation Criterion	Operations (years 2-20)		Reclamation (years 21-55)		Post-Closure Maintenance (years 56-200)	
			PA	CEC	PA	CEC	PA	CEC
a. Maximum P50 of Annual Values from GoldSim Output								
Mud Lake Creek	MLC-3	125	105	74	109	77	107	76
	MLC-2	125	104	89	107	90	106	89
Trimble Creek	TC-1	125	57	55	60	56	56	55
	PM-19	125	70	67	74	70	68	69
Unnamed Creek	PM-11	125	89	83	91	84	87	83
Embarrass River	PM-12	125	105	105	109	109	107	107
	PM-12.2	125	101	101	104	104	103	103
	PM-13	125	100	100	105	103	102	101
b. Maximum P90 of Annual Values from GoldSim Output								
Mud Lake Creek	MLC-3	125	180	138	185	136	185	139
	MLC-2	125	178	155	180	155	180	158
Trimble Creek	TC-1	125	110	107	111	104	110	110
	PM-19	125	129	124	130	125	130	126
Unnamed Creek	PM-11	125	156	147	158	148	158	151
Embarrass River	PM-12	125	178	178	181	181	182	182
	PM-12.2	125	171	171	175	175	175	175
	PM-13	125	172	170	174	170	176	174

Note:
All concentrations are in mg/L.

Based on an evaluation of the above observations in Table 5.2.2-47, it is generally concluded that the NorthMet Project Proposed Action is not the cause for the exceedances of the aluminum evaluation criterion at the P90 level in surface water at the Plant Site. There is only one case where the predicted NorthMet Project Proposed Action concentration is above the criterion while the analogous CEC concentration is below, but the difference between the two values is only 5 µg/L, which is within the range of measurement error and is not considered significant.

The fact that predicted maximum P90 concentrations are on average 66 µg/L higher than analogous P50 concentrations is explained by the cumulative probability distribution for surface runoff concentration used as input to the GoldSim model. Evaluation of the GoldSim outputs shows that predicted aluminum concentrations in surface water are dominated by mass loading from surface runoff and the loading from other sources (including all project-related chemical sources) is minor. As such there is no real link between the NorthMet Project Proposed Action and predicted P90 aluminum concentrations in surface water, which are commonly above the aluminum evaluation criterion.

Unlike the other Embarrass River tributaries, aluminum concentrations in Mud Lake Creek are predicted to be significantly higher for the NorthMet Project Proposed Action compared to the CEC scenario. What makes Mud Lake Creek different from the other tributaries is that under the NorthMet Project Proposed Action its drainage area above MLC-3 (2.24 mi^2) would be larger than for CEC (1.36 mi^2). This is because for the CEC, surface water and groundwater flowing toward the east toe of the Tailings Basin are assumed to continue to migrate through the Tailings Basin footprint and not provide any surface flow or groundwater to Mud Lake Creek. Under the

NorthMet Project Proposed Action, a seepage containment system with barrier wall would be constructed along the East Toe, which would capture 100 percent of Tailings Basin seepage and divert surface flow and upwelling groundwater to the Mud Lake Creek via the constructed swale. Since aluminum in surface water tends to be dominated by surface runoff, there would be a greater aluminum load to Mud Lake Creek under the NorthMet Project Proposed Action compared to the CEC. The larger Mud Lake Creek watershed area under the NorthMet Project Proposed Action is responsible for the higher associated modeled aluminum concentrations. The higher aluminum concentrations in Mud Lake Creek are related to natural surface runoff and not to chemical sources associated with chemical sources from the NorthMet Project Proposed Action.

Lead in Surface Water at PM-11

As shown in initial screening Table 5.2.2-50, the 7.13 percent frequency of exceedance for lead at PM-11 (when the CEC scenario does not exceed) is greater than the 5 percent threshold, so lead was retained for further consideration. Examination of GoldSim outputs show that when lead concentrations at PM-11 are predicted to exceed associated hardness-based evaluation criteria, the flow at PM-11 is dominated by WWTP discharges. In GoldSim, the WWTP effluent lead concentration is assumed to be 3 µg/L, which is the water quality standard for lead at the hardness of the discharge. Pilot testing of the proposed WWTP processes (Barr 2013f) has indicated that the WWTP is capable of discharging lead at lower concentrations, so the 3 µg/L concentration used in GoldSim is likely a higher value than what would actually be achieved. In addition, if necessary engineering modifications to the proposed WWTP could be made to ensure that WWTP effluent would have lead concentrations less than or equal to 2 µg/L. See Section 5.2.2.3.5 for a brief description of what adaptive mitigation measures could be made to achieve a lead effluent concentration of 2 µg/L.

To investigate the effect on WWTP effluent lead concentration on surface water concentrations at PM-11, a subsidiary GoldSim simulation (PolyMet 2015s) was performed for which the only change to the inputs was lowering the assumed WWTP effluent lead concentration from 3 to 2 µg/L. In making this change, the predicted frequency of lead exceedance at PM-11 (when the CEC scenario does not exceed) was reduced to 1.3 percent, which is substantially less than the 5 percent screening threshold. Given that pilot testing shows that 2 µg/L lead concentration is achievable in the WWTP effluent, it is likely that actual lead concentrations at PM-11 would have acceptably low frequencies of exceedance. If however, the proposed WWTP generates effluent with higher lead concentrations than expected, adaptive engineering measures could be invoked at the WWTP to lower the frequency of lead exceedances (see Section 5.2.2.3.5).

Sulfate in Surface Water in the Embarrass River

For the Embarrass River, the only surface water evaluation location that has a sulfate evaluation criterion is PM-13, because it has been identified as a MPCA staff-recommended wild rice production water. Therefore, a sulfate evaluation criterion of 10 mg/L was established for the FEIS. As shown in screening Table 5.2.2-45, the GoldSim maximum P90 concentration at PM-513 for the CEC scenario is 179 µg/L, which is well above 10 mg/L. Given that existing sulfate at PM-13 is above the evaluation criterion, the MPCA developed a set of specific water quality criteria for sulfate at the Plant Site. These are each evaluated at the end of this section.

As with the previous sections, Table 5.2.2-48 shows predicted maximum P50 and P90 annual sulfate concentrations at PM-13, and PM-12 and PM-12.2 for comparison. The table provides the following observations:

- At PM-12 and PM-12.2, there is virtually no change in sulfate between CEC scenario and NorthMet Project Proposed Action conditions.
- In progressing downstream from PM-12 to PM-12.2, there is generally a large increase in sulfate concentrations.
- The GoldSim-predicted PM-13 sulfate concentrations for both the NorthMet Project Proposed Action and the CEC scenario are significantly higher than historically measured sulfate at PM-13.
- At PM-13, the concentration for the NorthMet Project Proposed Action is generally about 100 µg/L less than the associated CEC scenario.
- At PM-13, there are no cases (both the NorthMet Project Proposed Action and CEC) where sulfate is below the 10 mg/L wild rice evaluation criterion.

Table 5.2.2-48 Maximum P50 and Maximum P90 of Annual Sulfate Concentrations for Different Project Phases

Evaluation Location	Evaluation Criterion	Operations (years 2-20)		Reclamation (years 21-55)		Post-Closure Maintenance (years 56-200)	
		PA	CEC	PA	CEC	PA	CEC
a. Maximum P50 of Annual Concentrations from GoldSim Output							
PM-12	n/a	5.6	5.6	5.7	5.7	5.7	5.7
PM-12.2	n/a	294	294	294	294	294	294
PM-13	10	89	188	89	185	90	185
b. Maximum P90 of Annual Concentrations from GoldSim Output							
PM-12	n/a	12.6	12.6	14.0	14.0	14.3	14.3
PM-12.2	n/a	367	367	368	368	371	371
PM-13	10	113	209	114	217	114	217

Notes:
PA = NorthMet Project Proposed Action
All concentrations are in mg/L.

Explanations for these observations are provided below.

First, the similarity of CEC scenario and the NorthMet Project Proposed Action is reasonable for PM-12 and PM-12.2 because these evaluation locations are upstream of all mine facilities and would not be expected to exhibit any effects from the NorthMet Project Proposed Action. Also, the increase in sulfate at PM-12.2 is explained by surface discharge from Pit 5NW, which enters the Embarrass River just upstream of PM-12.2 and has sulfate concentrations of about 1,000 mg/L. The chemical sulfate load from Pit 5NW largely controls the magnitude of sulfate in downstream portions of the Embarrass River including PM-13.

As discussed in Section 4.2.2.3.2, the current increase in the Embarrass River chloride load in going from PM-12.2 (upstream of Plant Site) to PM-13 (downstream of Plant Site) provides reasonable evidence that nearly all surface seepage from the northern, northwestern, and western sides of the LTVSMC Tailings Basin is reaching the Embarrass River. It is estimated that this surface seepage is about 2,400 gpm and has an average sulfate concentration of about 230 mg/L, so that the associated sulfate load leaving the Tailings Basin is about 3,000 kg/day. However the plot of sulfate load in the Embarrass River (see Figure 4.2.2-55) indicates that between PM-12.2 and PM-13, the sulfate load increases by only about 200 kg/day. In Section 4.2.2.3.2, it is hypothesized that there is a natural process that sequesters sulfate in wetlands between the Tailings Basin and the Embarrass River and this explains the reduced sulfate load from the Tailings Basin to the Embarrass River. For conservativeness, the GoldSim model was programmed to *not* consider any loss of chemical load in surface flow between the Tailings Basin and the Embarrass River. As consequence, the model would be expected to overestimate sulfate concentrations at PM-13, with the difference being greater for CEC scenario for which there is no capture of the Tailings Basin surface seepage. This effect is illustrated on Figure 5.2.2-51, which uses cumulative probability to compare GoldSim predicted sulfate with measured sulfate at PM-13. The figure shows that GoldSim-predicted sulfate concentrations for both the NorthMet Project Proposed Action and the CEC scenario are greater than measured sulfate at PM-13. In recognition of GoldSim's tendency to overestimate sulfate concentrations at PM-13, evaluation of the NorthMet Project Proposed Action is oriented toward comparing the *difference* between the NorthMet Project Proposed Action and CEC scenario values, rather than focusing on the magnitude of predicted concentrations.

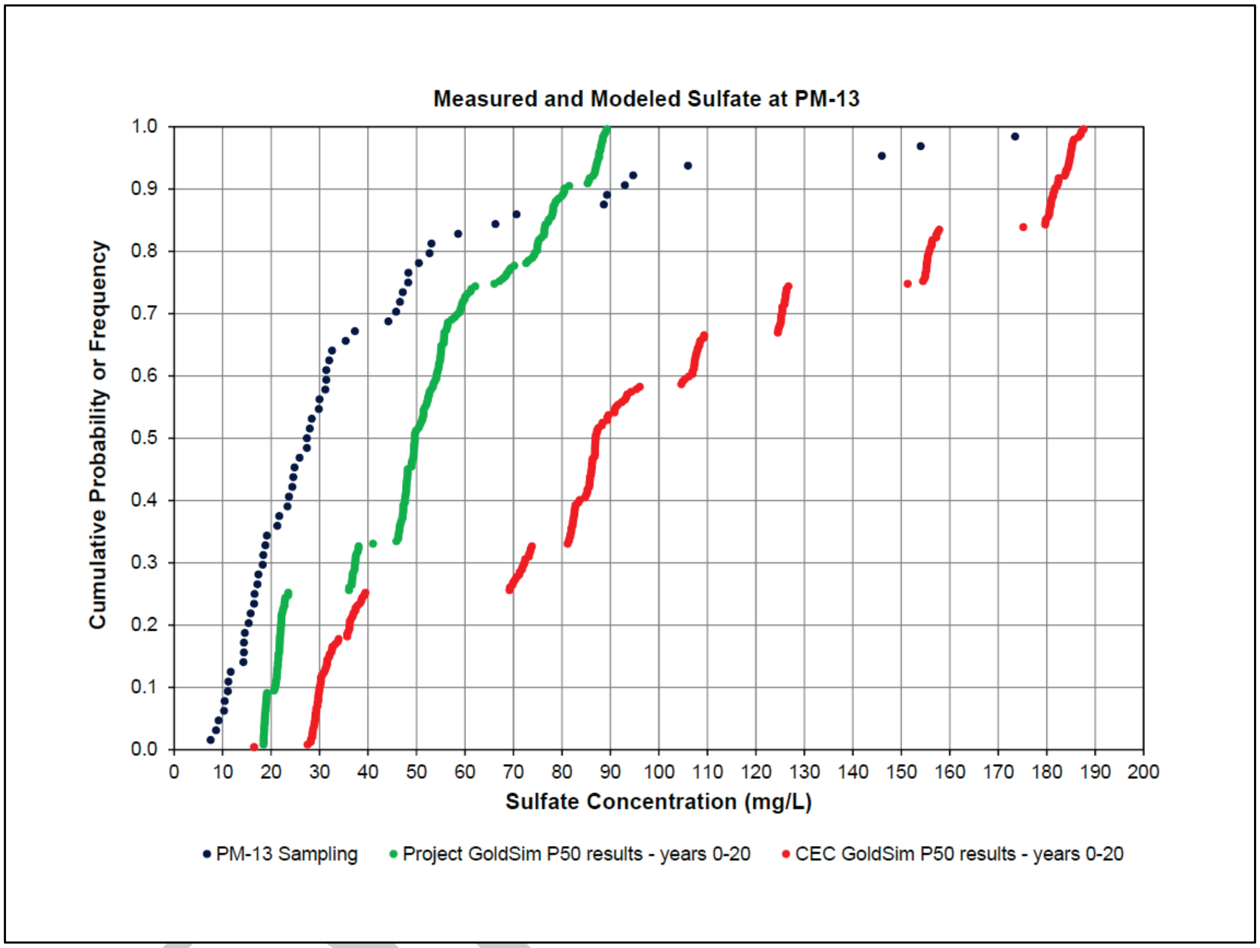


Figure 5.2.2-51 Comparison of Measured and Modeled Sulfate Concentrations at PM-13

Figure 5.2.2-52 shows GoldSim-predicted annual maximum sulfate concentrations at PM-13. For P10, P50, and P90 plots, the model predicts that sulfate at PM-13 would be substantially reduced under the NorthMet Project Proposed Action compared to the CEC scenario. Although the model may overestimate the magnitude of sulfate concentrations, the relative reduction in concentrations at PM-13 is apparent. This result is explained by the engineering controls associated with the NorthMet Project Proposed Action. Currently there is about 2,400 gpm of surface seepage leaving the northern, northwestern, and western sides of the Tailings Basin that contains sulfate concentrations of about 230 mg/L. Under the CEC scenario, all Tailings Basin seepage reaches the Embarrass River and contributing its sulfate load to the Embarrass River. Under the NorthMet Project Proposed Action, nearly all of the surface seepage would be collected by the seepage containment system and sent to the WWTP. To augment the flow loss, at least 80 percent of the captured flow rate would be discharged to the tributaries after treatment has reduced the sulfate concentration to 9 mg/L. The result is that a substantial reduction in sulfate load to the Embarrass River would occur under the NorthMet Project Proposed Action and this explains the lower sulfate concentrations at PM-13 when compared to the CEC scenario.

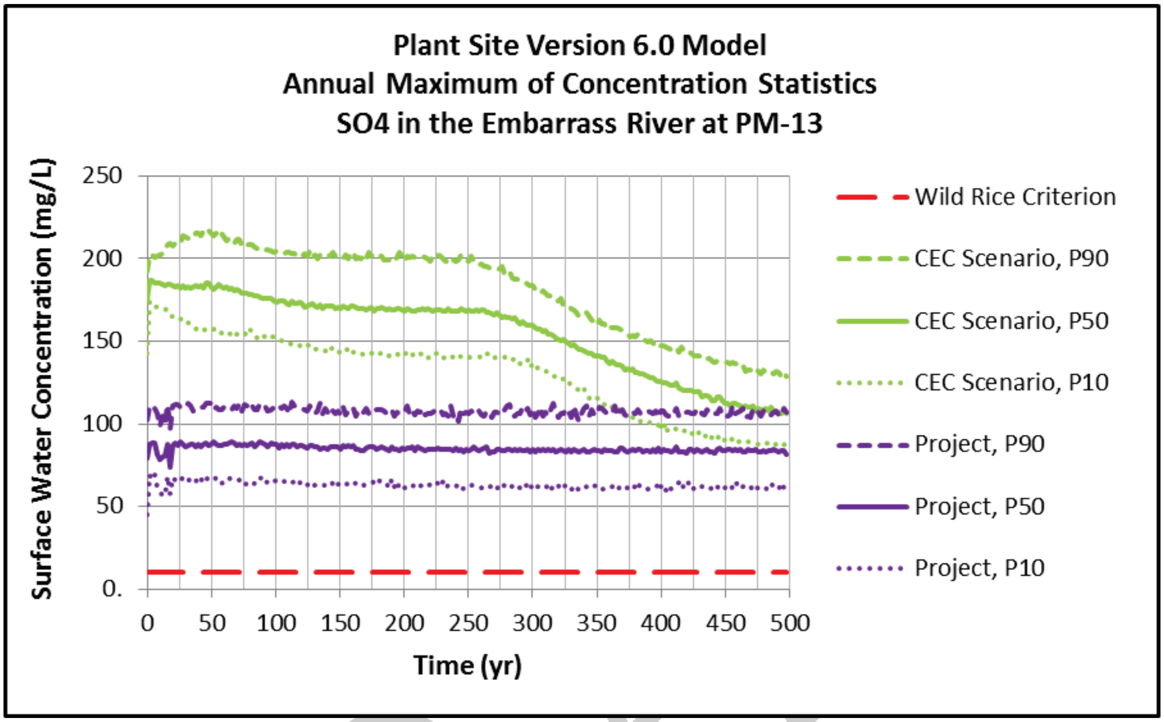
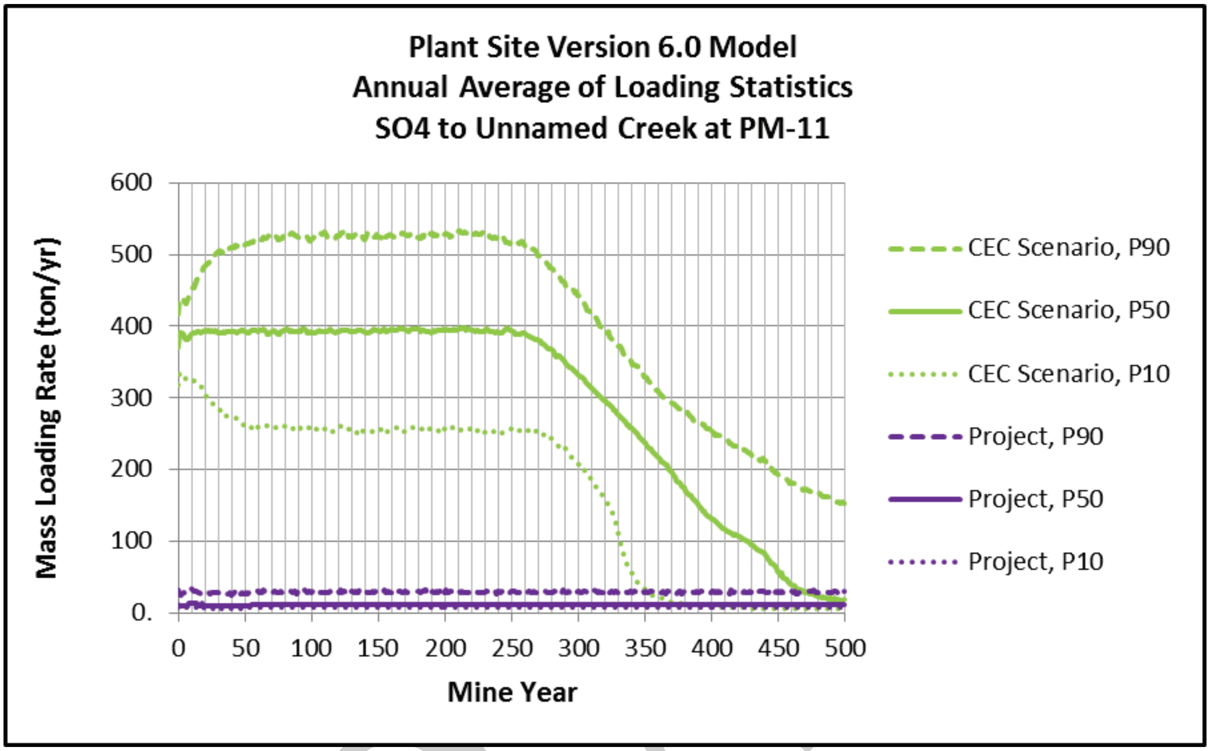


Figure 5.2.2-52 Maximum Annual Sulfate Concentrations at PM-13

The effect of the NorthMet Project Proposed Action on sulfate concentrations in the Embarrass River Watershed is of concern because MPCA has recommended waters within and downstream from Embarrass Lake, the northernmost tip of Wynne Lake, and the segment of the Embarrass River from Sabin Lake to the Highway 135 bridge, as waters used for the production of wild rice (see Figure 5.2.2-1). Given that current sulfate concentrations at PM-13 are almost always higher than the 10 mg/L wild rice sulfate evaluation criterion, the MPCA has developed three supplemental water quality criteria for sulfate at the Plant Site (MPCA 2011d), which are each discussed below.

<u>*Criterion 1: No increase in sulfate-loading from existing conditions would occur at PM-11 (Unnamed Creek), PM-19 (Trimble Creek), and MLC-2 (Mud Lake Creek)*</u>

Figures 5.2.2-53, 5.2.2-54, and 5.2.2-55 show GoldSim-predicted sulfate loading at PM-11, PM-19, and MLC-2, respectively, based on annual maximum values. As shown, the sulfate-loading at these three locations would be reduced under the NorthMet Project Proposed Action compared to the CEC scenario. The decrease is predicted to occur for P10, P50, and P90 concentrations. The model therefore predicts that this criterion would be met under the NorthMet Project Proposed Action.

4084 

4085 *Figure 5.2.2-53 Maximum Annual Sulfate Loading at PM-11*

4086

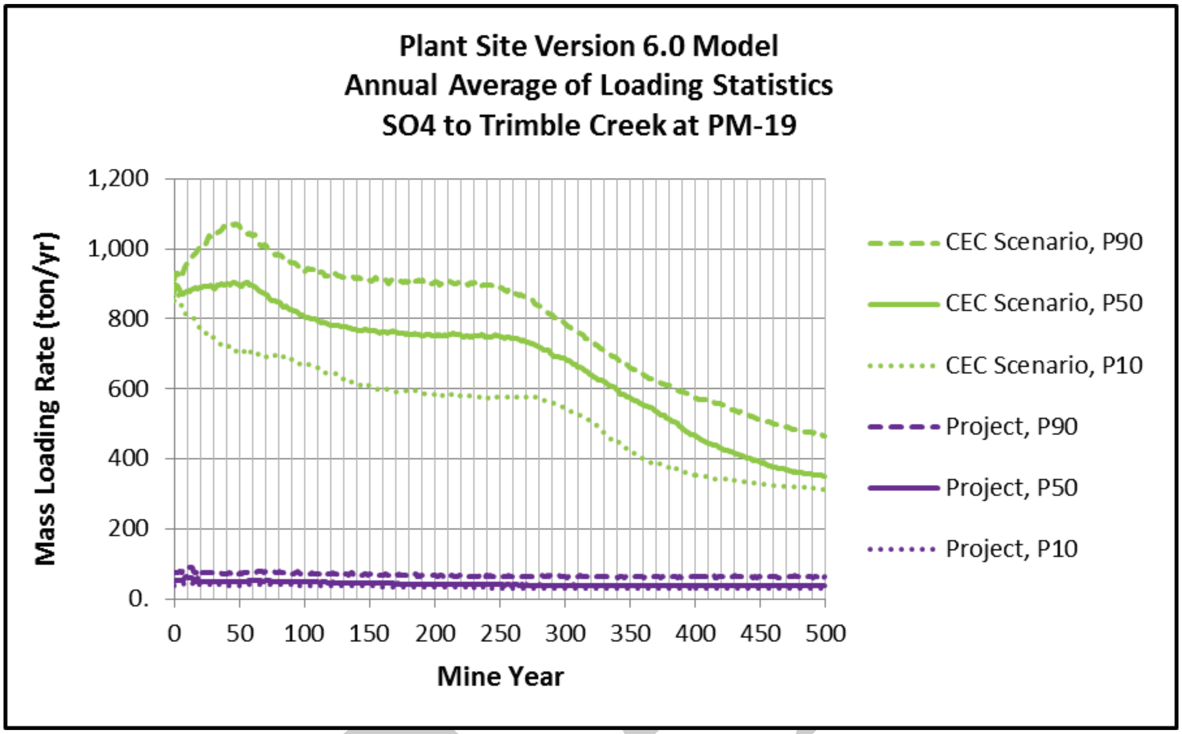


Figure 5.2.2-54 Maximum Annual Sulfate Loading at PM-19

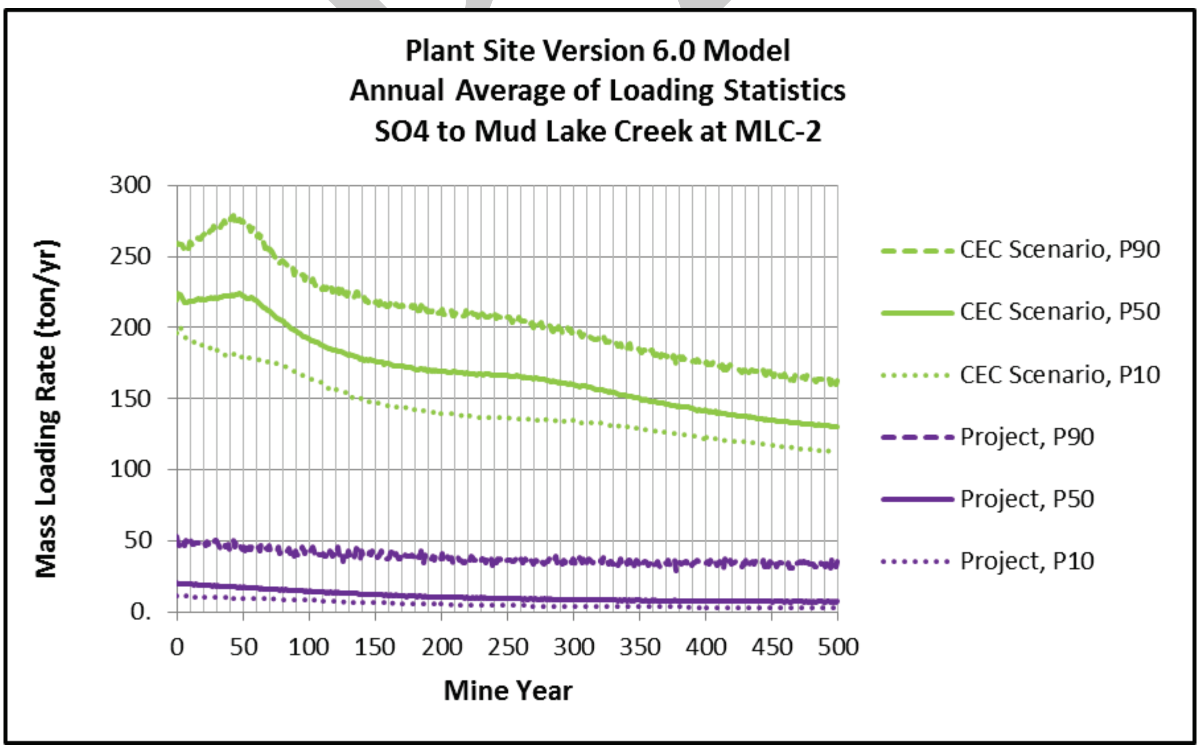


Figure 5.2.2-55 Maximum Annual Sulfate Loading at MLC-2

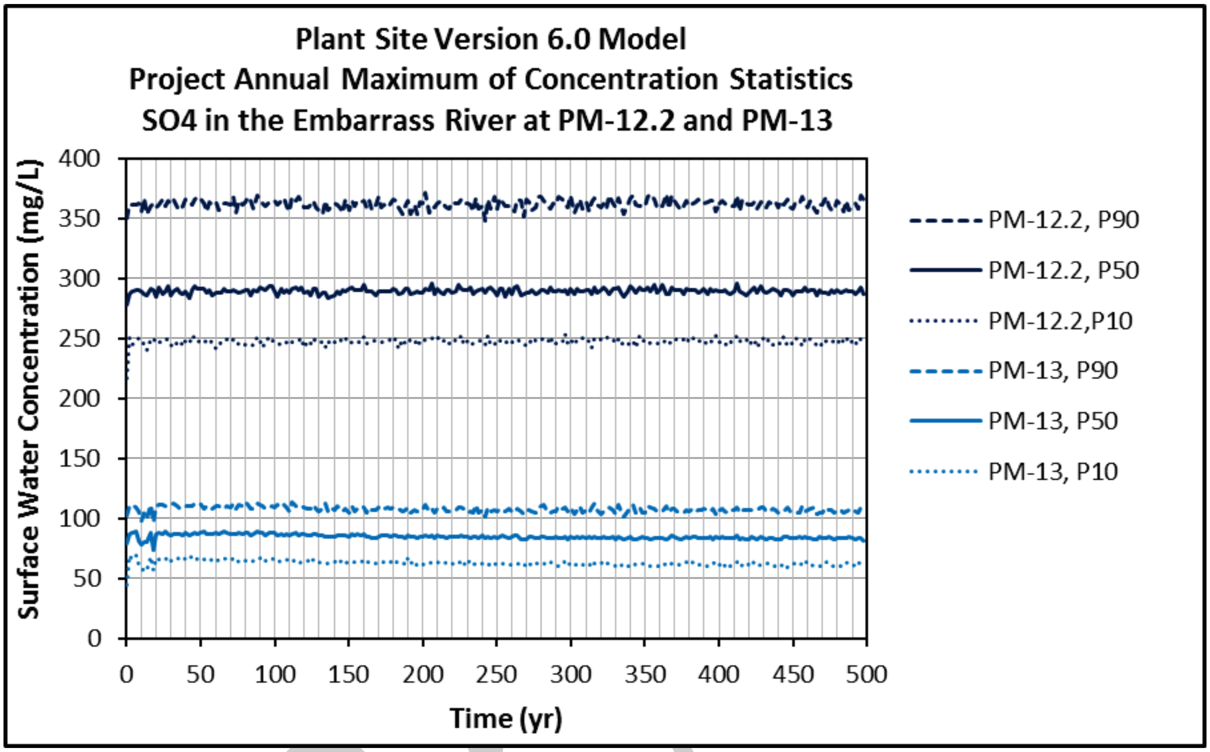


Figure 5.2.2-56 Maximum Annual Sulfate Concentrations at PM-12.2 and PM-13

Criterion 2: The concentration of sulfate in the Embarrass River at PM-13 would decrease from existing condition

Figure 5.2.2-52 shows GoldSim-predicted sulfate at PM-13 for the NorthMet Project Proposed Action and the CEC scenario. For P90, P50, and P10 values, the sulfate concentrations at PM-13 would be reduced under the NorthMet Project Proposed Action. As discussed previously, this concentration reduction under the NorthMet Project Proposed Action would result from the capture of tailings seepage with high sulfate by the seepage containment system and the discharge of most of this water to the Embarrass River with much lower sulfate due to treatment by the WWTP. The model therefore predicts that this criterion would be met under the NorthMet Project Proposed Action.

Criterion 3: No statistically significant increase in sulfate would occur in the Embarrass River from upstream of the facility (e.g., PM-12.2) to downstream of the facility (e.g., PM-13)

Figure 5.2.2-56 compares GoldSim-predicted annual maximum sulfate concentrations at PM-12.2 with concentrations at PM-13. There are no NorthMet Project Proposed Action activities that would affect concentrations at PM-12.2, so this figure serves as a basis for determining downstream sulfate changes for Proposed Action conditions. Figure 5.2.2-56 shows that under the NorthMet Project Proposed Action, sulfate concentrations would substantially decrease in progressing downstream from PM-12.2 to PM-13, so this criterion would be met under the NorthMet Project Proposed Action.

Plant Site Model Sensitivity Analyses

The sensitivity of the GoldSim Model was evaluated for changes to groundwater recharge rates and climate change. The following sections summarize the sensitivity analysis findings for the Plant Site.

Recharge to Groundwater Sensitivity Analysis

A sensitivity analysis was performed to assess to what extend the model predictive simulation results depend on the definition of recharge (to groundwater) used to set up the NorthMet Plant Site water quality model. This analysis showed that changing the distribution used for aquifer recharge from triangular to lognormal and correlating recharge to precipitation in GoldSim model simulations does result in minor changes to 10th percentile, 50th percentile, and 90th percentile of the model calculated groundwater and surface concentrations. However, the changes are minimal. Further, the estimation of the potential to exceed an applicable groundwater and surface water standards is not sensitive to these model input changes (Barr 2015d).

Climate Change Sensitivity Analysis – Plant Site

The potential effects of a climate change upon the predictions of both the GoldSim probabilistic models developed for the Plant Site, the Plant Site NorthMet Project Proposed Action Model and No Action Plant Site NorthMet Project Proposed Action Model, were evaluated by running the "climate change sensitivity analysis". The ranges of precipitation and temperature input parameters were varied following the guidance provided by Co-Lead Agencies (Kellogg 2011). The sensitivity of the model predictions to changes in values of those parameters was quantitatively assessed at the toes of the Tailings Basin and qualitatively assessed at other locations within the model domain. In summary, the Climate Change Sensitivity Analysis Model was set by increasing: (1) the mean annual temperature by 2.0 to 5.2 degrees Celsius, (2) the mean annual precipitation from 28.1 to 29.8 in/yr, and (3) the mean annual open water evaporation by 6.5 percent. The parameter values were linearly increased from mine year 1 to mine year 60 and, then, were kept constant. Such modified model was used to run 200-year predictive simulations, similar to the NorthMet Project Proposed Action Models.

The impacts of the modeled changes upon contaminant concentrations in seepage water at the toes were analyzed for lead, sulfate, copper, and iron. Led concentrations would change most at the west and northwest toes, up to 13 percent. Similarly, the largest increase in sulfate concentrations, up to 15 percent, would occur at the west and northwest toes. The largest increase in copper concentrations, up to 12 percent, would occur, again, at the west and northwest toes. Finally, The largest increase in iron concentrations, up to 15 percent, would also occur at the west and northwest toes.

Seepage at the toes is expected to increase slightly due to the increased infiltration through the Tailings Basin. Climate change is not expected to cause significant changes in groundwater quality. Likewise, surface water quality in the Embarrass River and its tributaries is expected to be minimally affected by the NorthMet Project Proposed Action under climate change conditions. All water leaving the Tailings Basin's footprint would be treated by the WWTP, except for approximately 21 gpm of seepage that is conservatively expected to escape the Containment System. Runoff from the exterior of the East Dam is relatively inert.

It is likely that the amount of water that would need treatment at the WWTP would increase under climate change conditions. This is because the increase in precipitation would be slightly greater than the amount of water lost to increased evaporation (Barr 2015d).

5.2.2.3.4 Mercury

Mercury can be released to surface water or groundwater through mobilization of mercury stored in rock, soil, peat, and vegetation, and can also be deposited to surface water through atmospheric dry deposition and precipitation. Methylmercury, which is an organic form of mercury, accumulates in fish and is toxic to humans and wildlife at concentrations above a toxicity threshold. Current scientific understanding of the factors and mechanisms affecting mercury methylation and bioaccumulation is limited. Mercury concentrations in fish sampled from downstream lakes presently trigger advice to limit fish consumption. An increase in mercury in fish tissue would be counter to statewide efforts to reduce mercury concentrations in fish.

Mercury was not included in the GoldSim model for either the Mine Site or the Plant Site, as insufficient data and unique modeling requirements for mercury dynamics prevented modeling mercury like the other solutes. Regardless, the NorthMet Project Proposed Action would still need to demonstrate that the mercury evaluation criteria would be protected (see Section 5.2.2.1). Details of the overburden management, which includes peat, is included in Section 5.2.2.3.2. Adaptive management has also been identified within the FEIS process that could reduce mercury concentrations if necessary (see Section 5.2.2.3.5). Therefore, a simple mass balance model estimation method was used. This simple estimation method was preferred over a detailed mechanistic model because it incorporated the important input and removal processes for mercury, was very transparent with regard to data inputs, and allowed for easy assessment of the effects of changing parameter values on mercury concentrations. For the Mine Site, this method, in combination with analog data from existing natural and mine pit lakes in the region, was used to assess future mercury concentrations in the West Pit lake and in the overflow water (PolyMet 2015m). A similar mass balance approach was used for the Plant Site to estimate future mercury concentrations released from the Tailings Basin.

The NorthMet Project Proposed Action and project area watershed information used to assess the potential effects on average annual mercury loading and concentrations at the Plant Site and Mine Site (Upper Embarrass River and Upper Partridge River, respectively) were also used in assessing the potential effects from the NorthMet Project Proposed Action on mercury loading in the St. Louis River (Barr 2015f).

This section discusses mercury from only a water-concentration perspective; the potential effects of the NorthMet Project Proposed Action on the bioaccumulation of methylmercury in fish are discussed in Section 5.2.6. Cumulative effects are discussed in Section 6.2.3.3.4 and 6.2.3.5.4.

<u>Direct Release of Mercury to the Partridge River Watershed</u>

The NorthMet waste rock and ore contain trace amounts of mercury. Laboratory analysis of humidity cell leachates from waste rock samples found average total mercury concentrations between 5 and 7 ng/L, with concentrations unrelated to rock type or sulfur content (SRK 2007b). Separate 36-day batch tests using local rainfall (12 ng/L total mercury) found that contact with Duluth Complex rock actually decreased total mercury concentrations to between 1.9 and 3.2 ng/L as a result of adsorption (SRK 2007b). . Therefore, the data suggest that most of the mercury present in rainfall or released by sulfide oxidation is typically adsorbed by other minerals present in the mine waste rock. The primary NorthMet Project Proposed Action-related source of mercury to the Partridge River would be the WWTF discharge.

As discussed previously, there would be no surface water discharges to the Partridge River or its tributaries from the Mine Site until approximately year 52, when the West Pit would be flooded and the overflow would be directed to the WWTF for treatment and discharge. The WWTF discharge would be subject to the Great Lakes Initiative standard for mercury (1.3 ng/L). Mercury concentrations in the West Pit were estimated two ways: using analog data from other natural lakes and mine pit lakes in northeastern Minnesota, and using a mass balance approach.

The West Pit, like seepage/headwater lakes (e.g., lakes with no significant inflowing streams), would receive most of its water from precipitation and direct runoff from the surrounding watershed. Water balance modeling estimates that 70 percent of the West Pit inflow after reclamation would be from precipitation. Therefore, natural seepage/headwater lakes and existing mine pits in the vicinity of the NorthMet Project Proposed Action area can provide an analog for mercury concentrations that would occur in the West Pit at the time of overflow. Of particular significance are the Dunka Pit Lakes. Because the Dunka Pit intersects the Duluth Complex, the mercury concentration data from the Dunka Pit Lakes are considered an important indicator of potential total mercury concentrations for the West Pit at closure. Data from 16 mine pit lakes and five natural headwater/seepage lakes in northeastern Minnesota were evaluated. As Table 5.2.2-49 shows, despite the fact that the primary source of inflow to these lakes/pits was precipitation, which averages about 13 ng/L based on the annual average mercury concentration from the National Atmospheric Deposition Program for the Fernberg Road Monitoring Site (2010-2011); (PolyMet 2015m), only two of the lakes/pits had average total mercury concentrations above the Great Lakes standard of 1.3 ng/L (Pit 2W at 1.61 ng/L and Pit 9S at 1.87 ng/L).

Table 5.2.2-49 Total Mercury Concentration Data from Natural Lakes and Mine Pits in Northeastern Minnesota

Lake/Pit Type	Number of Lakes/Pits	Minimum Mercury Concentration (ng/L)	Average Mercury Concentration (ng/L)	Maximum Mercury Concentration (ng/L)	Number with Avg Concentration >1.3 ng/L
Natural Lakes	5	0.34	0.66	1.73	0
Pit Lakes	16	0.5	0.97	2.55	2

Source: PolyMet 2015m.

A mass balance approach was also used to evaluate potential mercury concentrations in the West Pit. For this evaluation, unless otherwise specified, 'mercury' refers to total mercury. Elemental mercury was not a part of the evaluation process, as no elemental mercury releases are anticipated from mining or processing operations. Mass balance models range from simple spreadsheet-based formats to more complex such as the GoldSim model. An important consideration in the selection of a water quality model is the complexity of the chemical being assessed and the available data, and the consideration that a complex situation may not require a complex water quality model (Loucks et al. 2005). The MPCA's spreadsheet-based model allows reviewers to focus on key inputs and their impact on model behavior and results. Furthermore, the use of a separate spreadsheet model for mercury enabled the specification of assumptions that were specifically conservative for mercury but that were not necessarily conservative for other contaminants, for example the depth of the mixing zone (Barr 2015f).

The mass balance took into consideration average inflows and estimated potential mercury inputs from precipitation, atmospheric dry deposition, groundwater inflow, Category 1 Stockpile drainage, other stormwater runoff within the Mine Site, supplemental water from the Plant Site WWTP, collected seepage from the Tailings Basin, and inflows from the East Pit (see Table 5.2.2-50). The mass balance also took into consideration the loss of mercury via burial (i.e., loss due to settling), evasion/volatilization, and outflow (i.e., pumping to the WWTF for treatment and discharge). Category 1 Stockpile drainage was assumed to be unaltered by the waste rock in the stockpile (i.e., no adsorption of mercury to the waste rock), which is a conservative assumption as there is evidence that waste rock likely adsorbs mercury from precipitation. The mass balance model conservatively assumed that mixing only occurred in the upper 30 ft of the water column, as this would limit the volume of water available to dilute the mercury-loading.

Table 5.2.2-50 Initial and Final Parameter Values for the Mercury Mass Balance

Parameter	Flow in Mine Year 60	Total Mercury Concentration or Flux
Wet and Dry Deposition Precipitation (based on monitoring data) [1]	697 acre-ft/yr[1]	13 ng/L; 9,407 ng/m^2/yr[1]
Atmospheric dry deposition	NA	3,093 ng/m^2/yr[1]
Total wet and dry deposition	NA	12,500 ng/m^2/yr[1]
Contained/Uncontained Category 1 Stockpile drainage	0.3 ac-ft/yr[2]	13 ng/L
Watershed runoff (stormwater runoff from undisturbed or reclaimed/revegetated areas; includes the runoff from the Category 1 Stockpile)	30 ac-ft/yr[2]	4 ng/L[3]
Groundwater Inflow (shallow aquifer)	45 ac-ft/yr[2]	3 ng/L[3]
East Pit flow (from wetland)	248 ac-ft/yr[2]	4 ng/L
Backfilled East Pit flow (groundwater) ("lower pore water seepage")	0 [2] (intermittent contribution; 0.02 to 0.15 ac-ft/yr during pit flooding)	4 ng/L
Treated Water: Mine Site WWTF	0[2] (Up to 588 acre-ft/yr during pit flooding)	8 ng/L
Plant Site Water: Treated water from the WWTP and collected seepage water (untreated) from the Tailings Basin seepage containment systems (supplemental water for pit flooding)	0[2] (Up to 3,500 acre-ft/yr during pit flooding)	1.3 ng/L
West Pit Mercury Losses		
Burial	NA	92% of total load; 12,700 ng/m^2/yr[4]
Evasion/Volatilization (~5% of atmospheric inputs)	NA	5% of atmospheric inputs[5]
Outflows	490 acre-ft/yr[2]	Varies with concentration of West Pit water column

Source: PolyMet 2015m, Table 6-15.

1 Precipitation volume from monitoring stations within 30 miles of the NorthMet Project Proposed Action area based on mean annual precipitation (1981-2010 climate normal); annual average Hg concentration from the National Atmospheric Deposition Program for the Fernberg Road Site (MN18) (2010-2011). Total atmospheric deposition is assumed to equal 12,500 nanograms per square meter per year (ng/m^2/yr) (Swain et al. 1992). Dry deposition is set equal to the difference between total and wet deposition and represents about 25% of total deposition.
2 Flow estimate from GoldSim Modeling results.
3 Estimate of Hg concentration based on NorthMet Project Proposed Action data.
4 Burial rate for mercury is lower (more conservative) than initial estimate according to the burial regression equation discussed in PolyMet 2015m.
5 Volatilization rate is estimated based on the low end of the range of values discussed PolyMet 2015m.

Based on the input values from Table 5.2.2-50 above, the estimated average mercury concentration of the West Pit during flooding (years 20 to 52) would initially be approximately 0.3 ng/L, and after flooding (after year 52) would stabilize at approximately 0.9 ng/L.

It should be noted that the West Pit overflow would be treated by the WWTF using RO or equivalent technology known to remove mercury and would meet water quality targets prior to discharge. Therefore, the actual mercury concentrations in the WWTF effluent discharge are expected to be less than the concentrations predicted for the West Pit lake (i.e., less than 0.9 ng/L), although an effluent mercury concentration of 1.3 ng/L was assumed for purposes of estimating mercury concentrations in the WWTF discharge. Table 5.2.2-51 provides a summary of the initial mass balance results, with the largest input of mercury to the West Pit coming from atmospheric deposition (about 66 percent of total estimated inputs), and the largest loss of mercury attributed to burial (about 92 percent of total mercury inputs).

The Overburden Storage and Laydown Area would not be lined, but would have a compacted soil bottom. Unsaturated overburden and peat would be temporarily stored at the Overburden Storage and Laydown Area until it is utilized for reclamation purposes. Mercury release from decomposed organic material is thought to occur relatively rapidly and dissolved mercury would be transported in solution with precipitation that falls on the Overburden Storage and Laydown Area (PolyMet 2015r). Stormwater runoff from the Overburden Storage and Laydown Area would be considered process water which would be routed to the process water pond and eventually collected and routed to the Tailings Basin for years 1 to 11, where much of the mercury would be sequestered in the tailings through sorption. In years 12 to 20, the Overburden Storage and Laydown Area stormwater runoff would be collected and routed to help flood the East Pit, where most of the remaining mercury would be sequestered with waste rock at depth (e.g., through settling and other chemical processes within the pit). Because peat removal from the areas to be mined would be completed between years 5 to 11, any potential release of mercury from stored peat materials would have occurred or would be ending by the time water is routed from the Overburden Storage and Laydown Area pond to the East Pit beginning in year 12. After year 20, the Overburden Storage and Laydown Area would be closed, reclaimed, and material removed or covered by a geomembrane cover, and therefore would no longer serve as a potential source of mercury. The potential for mercury release from peat decomposition in the Overburden Storage and Laydown Area is included in the mass balance as part of the Process Water input.

The mercury load from the Mine Site would slightly decrease during closure and long-term maintenance, because a portion of the flow that is currently watershed yield (total mercury concentration of 3.6 ng/L) would be captured in the West Pit lake and discharged via the WWTF at a conservatively assumed total mercury concentration of 1.3 ng/L. Flows from the Mine Site in closure and long-term maintenance are not expected to change from existing conditions; therefore, the change in total mercury concentration from 3.6 ng/L to 1.3 ng/L for a portion of the flow from the Mine Site results in reduced loading to the Partridge River (Barr 2015g). Therefore, the NorthMet Project Proposed Action is predicted to result in a net decrease in mercury-loading to the Partridge River from 24.2 to 23.0 grams per year, primarily due to a decrease in natural runoff and a proportional increase in water discharged from the West Pit via the WWTF (with a total mercury concentration of 1.3 ng/L).

Table 5.2.2-51 Summary of Estimated Mercury-Loading (Inputs)[1] and Losses (Outputs) for the West Pit Lake (Mine Year 20 to about Mine Year 52)

Parameters	Annual Average Load of Mercury (nanograms)	Percent of Summed Inputs	Comments
Inputs			
Atmospheric (wet + dry)	1.26E+10	66%	Dry deposition ~30% wet deposition
East Pit wetland overflow	9.03E+08	5%	Includes runoff from the East Pit and watershed to the East Pit
Process water (other than from the East Pit)	1.65E+09	9%	Includes runoff from the Category 1 Stockpile
Groundwater	2.74E+08	1%	Includes groundwater flow from undisturbed portions of the Mine Site + groundwater inflow from the East Pit + contained/ uncontained Category 1 Stockpile drainage
WWTF	1.61E+09	8%	
Pumping from the Plant Site: WWTP and collected seepage from the Tailings Basin	2.12E+09	11%	
SUM	1.91E+10		
Outputs (Losses)			
Evasion/Volatilization	6.30E+08	3%	Loss from the water column
Burial	1.76E+10	92%	
Groundwater	NE		
Overflow	2.58E+07	0.1%	
Removal by RO WWTF	NE		
SUM	1.82E+10		
NET (retention)			
Inputs – Outputs	8.73E+08		Net retention of Hg

Source: PolyMet 2015m, Table 6-16.

NE = Not estimated for this analysis.

[1] Reasonably conservative estimates of mercury concentrations and average annual flow estimates from GoldSim modeling were used to estimate mercury-loading.

Direct Release of Mercury to the Embarrass River Watershed from the Tailings Basin

The Plant Site would receive inputs of mercury from two primary sources: residual trace concentrations in the tailings and process consumables, with some minor contributions from Mine Site process water, which would be pumped to the Tailing Basin pond through year 11 (and possibly through year 20, but is dependent on the NorthMet Project Proposed Action's water balance). As discussed in Section 5.2.2.3.1, all process make up water used for stream augmentation would be treated at the WWTP prior to discharge. Mercury would be released from the Tailings Basin via seepage, discharge from the WWTP, and volatilization from the Tailings Basin pond (this mechanism is discussed in Section 5.2.7, Air Quality). As with the

Mine Site, mercury was not included in the GoldSim model, but a mass balance approach was used to estimate future mercury concentrations.

Several studies have been conducted by state agencies regarding the release of mercury from taconite ore processing and tailings facilities. Berndt (2003) concluded that wet and dry deposition of mercury was the major source of dissolved mercury in taconite tailings pond water, rather than the actual tailings themselves. Further, Berndt found that taconite tailings appear to be a sink for mercury in full-scale actual tailings basins in northern Minnesota, at least similar to other media like soils, as evidenced by lower mercury concentrations in waters seeping from tailings basins (specifically at U.S. Steel's Minntac Mine and Northshore Mining's Northshore Mine) than in either precipitation input or pond water in the tailings basin. The loss of mercury through adsorption to solids in the tailings basin and subsequent burial in the sediments results in an overall permanent retention of mercury within the basin and decreases the mercury load released to receiving waters. Berndt (2003) demonstrates that mercury released to surface waters during taconite processing is insignificant with respect to mercury concentrations found in local precipitation and existing background surface waters. This finding is supported by surface water monitoring around the existing LTVSMC Tailings Basin, which found mercury concentrations in surface water seepage to be consistent with baseline levels (see Table 4.2.2-4), generally averaging less than 2.0 ng/L. The overall average total mercury concentration at two discharge locations at the Tailings Basin (SD-026 and SD-004) over a 9-year period was 1.0 ng/L, indicating relatively low mercury concentrations in the existing LTVSMC Tailings Basin seepage. All monitoring results were well below average concentrations in precipitation, so most mercury appears to be sequestered in the LTVSMC tailings through adsorption (see Table 4.2.2-4).

A mass balance model was developed to aid in estimating potential release of mercury from the Plant Site. All major inputs of mercury were included in the mass balance model. The major outputs of mercury include the hydrometallurgical residue, air emissions from the hydrometallurgical process, the tailings, and the ore concentrate. The vast majority of the mercury is predicted to remain in the concentrate, with only about 8 percent predicted to be sent to the Tailings Basin via the tailings and process water. Process and tailings water samples from a pilot study conducted with NorthMet ore were found to have mercury concentrations of 11.2 and 0.7 ng/L, respectively. Mercury loadings to the Tailings Basin are estimated to be 16.2 pounds per year (lbs/yr), with about 15.8 lbs/yr from solids and about 0.4 lbs/yr from process water. For comparison, this is significantly less than the 610 lbs/yr estimated average mercury-loading to the existing LTVSMC tailings basin during LTVSMC operations.

In 2006, Northeast Technical Services, Inc. (NTS) conducted a bench study using NorthMet tailings to determine the rate of mercury adsorption by the tailings. The study utilized large-volume shake flask tests to evaluate mercury adsorption of tailings over time (PolyMet 2015j). The concentration of dissolved mercury in a treatment flask containing process water and NorthMet tailings decreased from 3.3 ng/L (at time 0) to 0.9 ng/L (at 480 minutes). Although the exact mechanisms behind the adsorption process are not yet clearly understood, the ability of NorthMet tailings to adsorb mercury, in combination with the proven ability of the underlying taconite tailings to adsorb mercury, is expected to result in an overall increase in the adsorption of mercury and subsequent lower concentrations of mercury at the Tailings Basin with the addition of the NorthMet tailings. Although adsorption was not explicitly included in the mass balance model, its effects are observed in the mercury concentrations in runoff from the existing

LTVSMC tailings, and are therefore assumed in the modeled future concentrations in Tailings Basin seepage.

In summary, the Tailings Basin is predicted to receive less loading of mercury (about 2 to 3 percent) and less flow than the existing LTVSMC Tailings Basin historically received, while retaining the adsorption benefits of the LTVSMC tailings, as well as the demonstrated mercury adsorption capability of the NorthMet tailings. For these reasons, it is reasonable to conclude that the seepage from the NorthMet tailings should have similar or lower mercury concentrations as the LTVSMC tailings seepage, which has averaged about 1.0 ng/L. Therefore, the total mercury concentration in seepage from the Tailings Basin is expected to be less than the Great Lakes Initiative standard of 1.3 ng/L.

During long-term maintenance, the Tailings Basin seepage would be captured and pumped to the WWTP for treatment. The WWTP would also receive water from the Tailings Basin pond, as well as stormwater runoff from the basin. The discharge from the WWTP, like the discharge from the WWTF, would be subject to the Great Lakes Initiative standard of 1.3 ng/L. The estimated mercury concentration and flow rate for each of these influent streams is shown in Table 5.2.2-52. As this table shows, the combined influent streams are estimated to have a mercury concentration of 1.3 ng/L prior to treatment.

Table 5.2.2-52 Estimated Mercury Concentration of the Combined Inflows to the Plant Site WWTP

Stream	Flow Rate (gpm)	Mercury Concentration (ng/L)	Total Mercury Flow (ng/yr)
Seepage water	1,635	1.0	3.3E+09
Runoff (interacting with tailings)	290	1.0	5.8E+08
Runoff (not interacting with tailings)	75	3.5	5.3E+08
Tailings Basin pond dewatering	425	2.0	1.7E+09
Combined stream	**2,425**	**1.3**	**6.0E+09**

Source: Table 6-8, PolyMet 2015j.

The WWTP would use a greensand filtration process followed by RO unit or equivalently performing technology that would meet water quality targets. RO treatment or equivalently performing technology that would meet water quality targets are known to remove mercury, particularly when the influent is pre-treated, and this potential additional removal of mercury is not accounted for in mass balance calculations, which adds a level of overestimation to the mass balance results. Any reduction in mercury by the WWTP would reduce discharge concentration; therefore, the total mercury concentration in the WWTP discharge is expected to meet the evaluation criteria of 1.3 ng/L.

The NorthMet Project Proposed Action is predicted to result in a net increase in mercury loadings to the Embarrass River of up to 0.2 grams per year (from 22.3 to 22.5 grams per year), which is about a 1 percent increase. This increase is primarily attributable to:

- The redirection of surface runoff diverted via the drainage swale constructed east of the Tailings Basin East Dam directly to Mud Lake Creek (at an assumed mercury concentration of 3.5 ng/L, versus a seepage concentration of 1.0 ng/L); and
- The Tailings Basin containment systems, which would collect seepage from the Tailings Basin, with an estimated mercury concentration of 1.0 ng/L, and route it to the WWTP,

which would discharge with an assumed mercury concentration of 1.3 ng/L,, which is considered conservative in that the WWTP and the greensand filter are expected to remove some mercury from the effluent.

Enhanced Mercury Methylation

Virtually all dispersal of mercury in the environment (especially atmospheric dispersal) occurs in inorganic form (Fitzgerald and Clarkson 1991), but nearly all of the mercury accumulated in fish tissue (more than 95 percent) is organic methylmercury (Bloom 1992). Thus, methylation is a key step in bioaccumulation and the uptake of mercury by aquatic biota. Methylmercury can be a product of the methylation of inorganic mercury by sulfate-reducing bacteria, a process that can be stimulated by increased sulfate concentrations in aquatic systems where sulfate is limiting (Gilmour et al. 1992; Krabbenhoft et al. 1998), although recent research has shown that numerous other types of bacteria can methylate mercury (Gilmour et al. 2013). Although, as described above, the NorthMet Project Proposed Action is expected to result in a negligible release of inorganic mercury to groundwater or surface waters and is predicted to meet the 1.3 ng/L discharge evaluation criteria, the potential effects of the NorthMet Project Proposed Action on mercury methylation must be evaluated. Bacteria that cause mercury methylation require an anoxic environment, and consequently methylation occurs in sediments rather than in the water column. Therefore, methylation is unlikely to occur in the Partridge River or Embarrass River.

There are several factors that influence mercury methylation, including total available mercury, organic carbon, temperature, micronutrients required by sulfate-reducing bacteria, sulfate loadings (over the range for which sulfate may be a limiting factor for sulfate-reducing bacteria), lack of oxygen, and certain hydrologic conditions. The NorthMet Project Proposed Action is expected to have little or no effect on most of these factors, but the effects on sulfate concentrations and hydrologic conditions warrants further discussion and are discussed below. .

Sulfate Loadings

Research indicates that sulfate-reducing bacteria are the primary mercury methylators in aquatic systems, especially in wetlands (Compeau and Bartha 1985). Biologically available sulfate is believed to be one of several limiting factors for the methylating bacteria (Jeremiason et al. 2006; Watras et al. 2006). Adding sulfate to aquatic systems where sulfate is limiting can therefore stimulate sulfate-reducing bacteria activity, leading to increased mercury methylation as the sulfate is consumed (Gilmour et al. 1992; Harmon et al. 2004; Branfireun et al. 1999; Branfireun et al. 2001). Recent research in northern Minnesota suggests that increased atmospheric sulfate-loading to a peatland can result in increased mercury methylation and export (Jeremiason et al. 2006), but other research suggests that this effect is not linear and diminishes at higher loads where sulfate may no longer be limiting (Mitchell et al. 2008). Heyes et al. (2000) reported a significant positive correlation between methylmercury and sulfate in a poor fen (R2 = 0.765, $p = 0.005$) and in a bog (R2 = 0.865, $p = 0.022$).

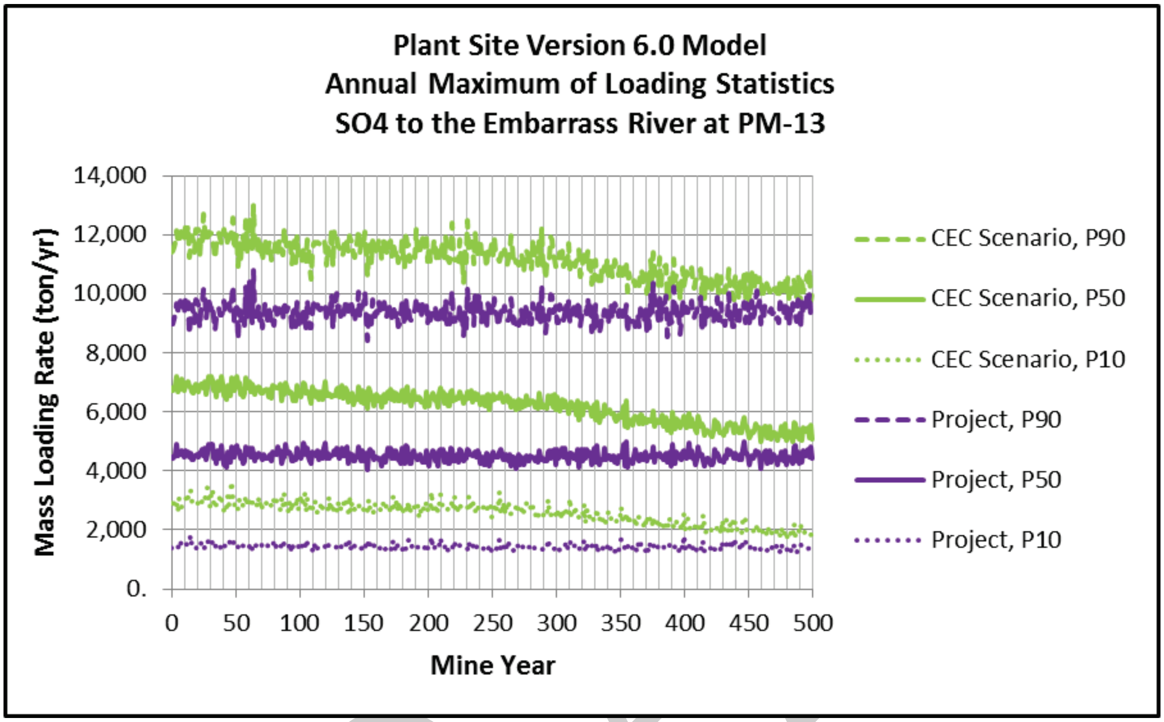
Many studies have shown that wetlands can be sinks for mercury and sources of methylmercury to surrounding watersheds (St. Louis et al. 1996). Galloway and Branfireun (2004) found that wetlands were an important site of sulfate reduction and methylmercury production. Balogh et al. (2004) and Balogh et al. (2006) concluded that increases in methylmercury in several Minnesota rivers during high-flow events was likely the result of methylmercury transport from surrounding wetlands to the main river channel. A recent study by the MDNR found little, if any, correlation between total mercury or methylmercury and sulfate concentrations in northeastern Minnesota streams (Berndt and Bavin 2012a; Berndt and Bavin 2012b; Berndt et al. 2014). Instead, the study found strong correlations between mercury and dissolved organic carbon concentrations and total wetland area. Overall, these studies suggest that most mercury methylation, at least in the St. Louis River Basin, primarily occurs within wetlands rather than in stream channels and the methylmercury is flushed to rivers from wetlands during storm events.

The MPCA and MDNR recognize the important role of sulfate in methylmercury production, as well as the uncertainties regarding site-specific relationships between sulfate discharges and water body impairment. The MPCA has set forth a strategy (MPCA 2006a) for addressing the effects of sulfate on methylmercury production that encompasses technical, policy, and permitting issues. The strategy acknowledges that the technical basis does not exist to establish sulfate concentration limits. The strategy, however, sets forth steps the MPCA can take to improve the technical basis for controlling sulfate discharges and establishes guidance for considering potential sulfate effects during environmental review and NPDES permitting. The strategy focuses on avoiding "discharges," which could include groundwater seepage, to "high-risk" situations. These high-risk areas include wetlands, low-sulfate water (less than 40 mg/L) where sulfate may be a limiting factor in the activity of sulfate-reducing bacteria, and waters that flow to a downstream lake that may stratify, all or most of which apply to the area downstream of the WWTP and the WWTF discharges.

In response to this policy, as well as to comply with sulfate standards that apply to waters recommended as supporting the production of wild rice, PolyMet has proposed several significant changes to the NorthMet Project Proposed Action design from that proposed in the DEIS. These changes would significantly reduce sulfate loadings, and include a surface and groundwater seepage containment system around the Category 1 Stockpile and a WWTF to treat the West Pit overflow at the Mine Site and a containment system around the Tailings Basin and a WWTP to treat tailings seepage at the Plant Site.

As a result of the design changes at the Mine Site, the NorthMet Project Proposed Action is predicted to increase the sulfate load by less than 2 percent in the Partridge River watershed, but maintain the same maximum P90 concentration (19.4 mg/L) as the CEC scenario. Effluent from the WWTF would be discharged at a water quality based effluent limit concentration that protects the sulfate standard for waters used for the production of wild rice (10 mg/L), beginning when the West Pit is predicted to flood around year 55. Sulfate concentrations in this range coupled with the oxygenated hydrologic environment to which the effluent would be discharged would not be expected to promote mercury methylation.

As a result of the design changes at the Plant Site, the NorthMet Project Proposed Action is predicted to significantly decrease sulfate loadings to the wetlands north of the Tailings Basin and to the Embarrass River, primarily because the containment system would capture nearly all Tailings Basin seepage and ultimately route it to the WWTP, which would treat the seepage and discharge the effluent at a target concentration of 10 mg/L as part of the Embarrass River tributary streams flow augmentation. However, as summarized in Section 5.2.2.3.3, the reduction is not sufficient enough to meet the 10 mg/L wild rice sulfate evaluation criterion that applies at PM-13. Nevertheless, the net effect of these engineering controls would be a reduction in sulfate loadings relative to the CEC Scenario model results at PM-13 (see Figure 5.2.2-57).



Source: Barr 2015j.

Figure 5.2.2-57 Range of Annual Sulfate Loading Rates to the Embarrass River at PM-13 – CEC Scenario versus NorthMet Project Proposed Action

Hydrologic Changes and Water Level Fluctuations

Methylation of environmental mercury by sulfate-reducing bacteria is also stimulated by drying and rewetting associated with hydrologic changes and water level fluctuations (Gilmour et al. 2004; Selch et al. 2007). Drying (and subsequent increase in exposure to oxygen) of substrate containing reduced sulfur species (sulfides and organic sulfur) oxidizes those species into sulfate, which is remobilized and available to sulfate-reducing bacteria upon rewetting of the substrate. This mechanism stimulates production of methylmercury in sediments exposed to wetting and drying cycles (Gilmour et al. 2004) and probably accounts for some of the elevated methylmercury concentrations observed in releases from wetlands during high-flow events (Balogh et al. 2006). Thus, hydrologic changes and water level fluctuations can potentially stimulate mercury methylation and enhance bioaccumulation. The effect of the NorthMet Project Proposed Action would decrease with distance downstream, as can be seen at PM-13, where the maximum change in flow would be approximately 3 percent in the annual average flow during operations, with a closure and long-term maintenance decrease of less than 2 percent (PolyMet 2015j).

Mercury Summary

Based on the above analysis, the NorthMet Project Proposed Action would have negligible effects on hydrologic changes or water level fluctuations in the Partridge River and Embarrass River, would maintain relatively low sulfate loadings and concentrations to the Partridge River, would significantly reduce sulfate loadings to the Embarrass River, and would meet the Great Lakes Initiative mercury standard for discharges.

Overall, mercury loadings are predicted to increase slightly in the Embarrass River (1 percent), and decrease in the Partridge River (5 percent). Overall, the changes in total mercury concentrations associated with the NorthMet Project Proposed Action in closure and long-term maintenance at the respective Mine Site and Plant Site are estimated to be too small to distinguish from natural background variability in the Partridge River and the Embarrass River using available laboratory methods (Barr 2015g).

The NorthMet Project Proposed Action and project area watershed information used to assess the potential effects on average annual mercury loading and concentrations at the Plant Site and Mine Site (Upper Embarrass River and Upper Partridge River, respectively) were also used in assessing the potential effects from the NorthMet Project Proposed Action on mercury loading in the St. Louis River. The result would be a net decrease in overall mercury loadings (1.0 grams per year) with no detectable change in mercury concentrations to the St. Louis River as a result of the NorthMet Project Proposed Action (Barr 2015g).

5.2.2.3.5 Proposed and Recommended Mitigation Measures

PolyMet has proposed or agreed to measures to avoid, minimize, or mitigate potential environmental effects. These measures are considered part of the NorthMet Project Proposed Action (see Section 3.2) and include design changes since the DEIS, including fixed engineering controls, PolyMet would be required by its permits to monitor water quality and quantity to refine modeling and to predict future conditions for consideration in permit renewals. In the event that monitoring, coupled with modeling, identifies the potential for water quality exceedances, PolyMet has proposed adaptive engineering controls and contingency mitigation that could be implemented to prevent exceedances of water quality standards. An overview of the evolution of the NorthMet Project Proposed Action with respect to alternatives analysis is provided in Section 3.2.3.3. PolyMet commits to monitoring and management through application of facility management plans that form the NorthMet Project Proposed Action; these plans are listed in Section 3.2.2.

<u>NorthMet Project Proposed Action Design Changes</u>

PolyMet has proposed several significant improvements to the design of the NorthMet Project Proposed Action for this FEIS from the NorthMet Project Proposed Action as described in the DEIS (October 2009), which would avoid or minimize effects on water resources. These are described in Table 3.2-16.

<u>Fixed Engineering Controls</u>

PolyMet has proposed several fixed engineering controls that would decrease effects on water resources from the NorthMet Project Proposed Action. These fixed engineering controls are not expected to be modified during the life of the NorthMet Project Proposed Action and would be included as part of the NorthMet Project Proposed Action's financial assurance package. The fixed engineering controls include the following:

- Ditches, perimeter and pit rim, and sedimentation basins to separate and control stormwater and process waters;

- Pipes, pumps, and lined process water ponds to separate and control stormwater and process waters;
- Geomembrane liners, underdrain systems, sumps, and overflow ponds, for temporary storage of Category 2/3 Category 4 and Ore Surge Pile rock;
- Category 1 Stockpile hydraulic barrier and drain pipe which would collect surface and groundwater seepage that would then be pumped to the WWTF, enabling the capture and treatment of nearly all Category 1 Stockpile seepage;
- Treated Water Pipeline and Central Pumping Station to allow the re-use of water at the processing plant and zero liquid discharge during operations at the Mine Site;
- Haul Roads designed for the collection and separation of stormwater from road surfaces;
- Tailings Basin for the collection and control of NorthMet tailings and re-use of process water;
- Bentonite amended Tailings Basin beaches (during reclamation) and embankment face (during operations) to reduce both water and oxygen intrusion into the tailings during reclamation;
- Tailings Basin containment system to collect, surface and groundwater seepage on the western, northwestern northern, eastern and southern sides of the Tailings Basin and pump it back to the Tailings Basin pond or to the Plant Site WWTP;
- Hydrometallurgical Residue Facility for collection, control, and storage of hydrometallurgical residue and re-use and recycle of process water. This facility would have a double geomembrane liner with a leakage collection system that would return any leachate to the Hydrometallurgical Residue Facility pond;
- Colby Lake pump house, pipeline from Colby Lake to the Plant Site reservoir; and
- Tailings Basin streamflow augmentation system to maintain stream flows within ± 20 percent of existing flows using WWTP effluent.

Adaptive Water Management Plan

Adaptive management is a system of management practices, based on clearly defined outcomes and monitoring requirements, that assesses whether management actions are meeting the desired outcomes, and, if not, prescribes potential actions that would ensure the defined outcomes are met. In the case of the NorthMet Project Proposed Action, PolyMet has developed an Adaptive Water Management Plan (AWMP), which includes adaptive engineering controls and contingency mitigation measures (PolyMet 2015d). Adaptive engineering controls may have their design, operation, or maintenance modified before or after their installation based on measured and modeled water quality during and after operations. Monitoring data in particular are important because not all questions about water management can be answered by GoldSim (i.e., transport time for constituent load in the Category 1 stockpile). Certain model assumptions may not be applicable to all potential project feature modifications. If water quality were better or worse than predicted, adaptive engineering controls would be adjusted accordingly, or contingency mitigation implemented with the approval of regulatory agencies.

Adaptive Engineering Controls

Adaptive engineering controls would be included as part of the permit to mine financial assurance package and would include the following:

- Mine Site WWTF – The WWTF would be upgraded to a RO process or equivalently performing technology that would meet water quality targets during closure and long-term maintenance to manage influent sulfate concentrations. The WWTF is an adaptive engineering control because its operating configuration, process unit requirements and capacity can be modified to treat varying influent streams and discharge requirements. WWTF construction plans include a phased build-out of the capacity to meet the Mine Site's P90 maximum flow requirements (year 14). Therefore, greater capacity could be achieved sooner if necessary. The WWTF processes could be adapted depending on actual water quality conditions encountered during the NorthMet Project Proposed Action phases and estimated by water quality monitoring and model updating. Treatment performance issues that could occur from changes in influent water quality could be addressed by making adjustments to operating conditions (PolyMet 2015d). In addition, the WWTF effluent, which would include calcium carbonate generated from the WWTF re-carbonation/calcite precipitation system, would be used to help flood the East Pit, while also contributing some alkalinity to help maintain near-neutral pH in the pit water. Lime could also be added to the East Pit during waste rock backfilling if additional alkalinity were needed (Adaptive Water Management Plant, v7, Feb 2015).
- Adaptive management would be implemented as necessary based on monitoring for total mercury to determine whether the treated water could be discharged to surface waters, or whether some additional treatment is needed. Adaptive management strategies would include pretreatment modifications such as a chemical scavenger addition ahead of the greensand filter units to obtain additional metals, the use of tighter RO membranes for the primary RO system, treatment of some portion of the Vibratory Shear Enhanced Process (VSEP) permeate by the primary RO system to further remove some dissolved constituents, and addition of polishing treatment units for removal of trace metals (e.g., ion exchange).
- If future modeling, informed by the results of the monitoring, predicted that the NorthMet Project Proposed Action would not protect surface waters, then adaptive mitigation measures could be implemented to decrease NorthMet Project Proposed Action effects on the Partridge River prior to an actual effect occurring (PolyMet 2015d). Possible adaptive measures that could be implemented include the following:
    - Modify the WWTF design to generate cleaner effluent. For example, pilot-testing of the proposed RO unit resulted in average sulfate removal rates of 99.8 percent with average and maximum sulfate concentrations observed in the effluent of 3.7 and 6.9 mg/L, respectively, for the blended (RO and vibratory shear enhanced processing) streams, which is below the 9 mg/L value assumed for modeling purposes during closure (Barr 2013f). Given that the WWTF would have an annual average discharge of approximately 300 gpm, as compared to about 78 gpm from the three groundwater sources of sulfate, a small decrease in the actual sulfate concentration in the WWTF effluent could offset the loading from the three groundwater sources.

   - Increase the WWTF discharge in closure. PolyMet could temporarily increase the volume of the WWTF (which is operating below its actual capacity) effluent discharge during low-flow conditions, which would help further dilute concentrations in the Partridge River.

- Category 1 Stockpile Cover System – PolyMet proposes to install a geomembrane cover system, in lieu of the originally proposed evapotranspiration cover, to reduce the load of the constituents that would reach the West Pit via drainage from the Category 1 Stockpile. Construction of the Category 1 Stockpile cover system would be progressive, starting in year 14 and being fully constructed by the end of year 21. Under the NorthMet Project Proposed Action, the Category 1 Stockpile would be the only permanent waste rock stockpile. Water quality modeling indicates that for many constituents, this stockpile would be the largest source of constituent load to the West Pit. The Category 1 Stockpile cover system would be the primary engineering control that limits constituent loading from the Category 1 Stockpile to the West Pit.

  The design of the Category 1 Stockpile cover system could be adapted up to the point of construction, depending on the actual water quality conditions encountered during the NorthMet Project Proposed Action phases and estimated by water quality monitoring and model updating. Design options, which would need to be approved by the MPCA and MDNR, include:

   - Increased or decreased thickness of the geomembrane material to modify the potential for defects to be created during installation and to modify the life of the geomembrane;
   - Increased or decreased soil cover thickness above the geomembrane material to modify water storage capacity;
   - Increased or decreased soil hydraulic conductivity of the granular drainage layer above the geomembrane to modify lateral drainage capacity;
   - Increased or decreased uninterrupted slope length to modify lateral drainage capacity;
   - Modified soil type and/or thickness below the geomembrane to modify leakage rate through potential geomembrane defects; and/or
   - Including a geosynthetic clay liner below the geomembrane to modify leakage rate through potential geomembrane defects.

  After installation of the cover system, post-installation adjustments, such as modifying vegetation density and erosion of the cover system, could be made if approved by the MPCA and MDNR (PolyMet 2015d).

- Plant Site WWTP – The WWTP would treat process water. A RO treatment plant it proposed or equivalently performing technology that would meet water quality targets. Because the plan for construction of the WWTP envisions a phased build-out of the capacity that would be needed when the maximum flow occurs, variations in quantity can easily be addressed by either accelerating or delaying the installation of the additional equipment that is planned for the expansion of the WWTP.

- Treatment performance issues that could occur from changes in influent water quality can be addressed by making adjustments to operating conditions. At times throughout the year, it is expected that the WWTP would have excess hydraulic capacity, which can be used to

- improve treatment performance, for example by reducing the recovery rates for the membrane separation processes or increasing the hydraulic retention times in the chemical precipitation processes.

- Other examples of how the WWTP can be adapted during the Project to modify treatment performance include:

  – Selection of alternative membranes for either the Reverse Osmosis (RO) or the Vibratory;

  – Shear Enhanced Processing (VSEP) process units to modify the removal efficiencies of some parameters across these systems;

  – Chemical addition to increase metals removal by the WWTP; and

  – Softening pretreatment.

  Adaptive management would be implemented as necessary based on monitoring for total mercury to determine whether the treated water could be discharged to surface waters, or whether some additional treatment is needed. Adaptive management strategies would include pretreatment modifications such as chemical scavenger addition to obtain additional metals; the use of tighter RO membranes for the primary RO system; treatment of some portion of the VSEP permeate by the primary RO system to further remove some dissolved constituents; and addition of polishing treatment units for removal of trace metals (e.g., ion exchange).

- Tailings Basin Pond Bottom Cover – During reclamation, PolyMet proposes to deposit granular or pelletized bentonite into the Tailings Basin pond, which would then settle and form a cover. This cover would reduce the diffusion of oxygen and water percolation into the tailings, thereby reducing oxidation and the resultant production of contaminants. In addition, the seepage through the tailings would be reduced, resulting in less flow being collected in the Tailings Basin surface and groundwater seepage containment system, and then treated.

  The Tailings Basin pond bottom cover thickness or the percent of bentonite in the pellets or grains or both can be changed if monitored water quantity or quality suggested that modifications were needed to meet water resource objectives. This modification can occur before or after installation to modify performance.

  In addition, the bentonite amended layer could be excavated from portions of the pond bottom to modify performance. Any design modifications would need to be approved by the MPCA and MDNR (PolyMet 2015d).

<u>Contingency Mitigation</u>

Contingency mitigation measures are feasible options that could be undertaken should engineering controls (fixed or adaptive) be unable to ensure compliance with applicable water quality standards. These contingency measures were not included in GoldSim modeling, as current model results at the P90 confidence level did not show these measures were needed to meet or not cause or contribute to an exceedance of the evaluation criteria. If monitoring or refined modeling were to indicate that contingency mitigation would be needed, these measures would be employed as appropriate and approved by the MPCA and MDNR. The contingency mitigation measures would not be initially included in the financial assurance package, but, if required in the future, these measures would be added to the financial assurance package. These contingency mitigation measures would address the following situations (PolyMet 2015r; 2015i):

- A pattern of overflows of the process water sumps or ponds developed – In all the process water sumps and ponds, there would be excess capacity designed as a safety factor ranging from approximately 30 to 270 percent of required capacity. Additional capacity could be developed by expanding the pond areas.
- Streams along the railroad corridor between the Mine Site and Plant Site showed degradation in water quality as a result of material spilled from the rail cars – Catchment areas could be developed adjacent to the tracks at stream crossings to minimize the amount of material that reaches the streams.
- Groundwater downgradient of lined infrastructure had compliance issues – Interception wells could collect groundwater flows affected by a leak from one of the liner systems or by the OSLA. Interception wells would only be needed while groundwater was affected by the temporary mine features.
- West Pit water quality was not as expected – This could be addressed by reducing the contaminant load from the West Pit walls or the East Pit using methods such as low-permeability soil barriers or a PRB, adding water with lower concentrations of contaminates to the West Pit by routing additional stormwater to the West Pit, or treating the West Pit either by pumping West Pit water to the WWTF for treatment or treating the West Pit Lake in situ with iron salts, fertilizer, or other methods tailored to the contaminant.
- If East Pit or West Pit groundwater inflows are greater than expected due to faults, use of a grout curtain to control groundwater flow into pits and eventually out of pits when they are filled with water or water and rock would be evaluated (PolyMet 2014l).
- New surface seepage locations emerged as the Tailings Basin was developed – The surface and groundwater seepage containment system or the Tailings Basin south surface seepage management system could be expanded to collect seepage from any new seepage locations.
- Tailings Basin pond water quality was worse than expected – This could be addressed by several methods, including: reducing solute load delivered to the Tailings Basin pond by incorporating additional treatment at the Mine Site WWTF; sending all or a portion of the water from the surface and groundwater seepage containment system and Tailings Basin south surface seepage management systems to the WWTP for treatment before being returned to the Tailings Basin pond; sending pond water to the WWTP for treatment before being returned to the Tailings Basin pond; or treating the Tailings Basin pond in situ with iron salts, fertilizer, or other methods tailored to the constituent of concern.
- Groundwater or surface water downgradient of the Tailings Basin has compliance issues – This could be addressed by several methods, including inspecting the containment system around the Tailings Basin for breaches and repaired or using interception wells to collect groundwater flows affected by a breach, or improving Tailings Basin pond water quality (see above).

Future Transition from Mechanical to Non-Mechanical Treatment Systems

The NorthMet Project Proposed Action would rely upon mechanical treatment to achieve water resource objectives as long as needed; however, the goal would be to transition to non-mechanical treatment—which would be a low-maintenance, low-energy treatment system—to ensure attainment of water resources objectives, including compliance with applicable groundwater and surface water standards, during the closure phase.

State of Minnesota Non-Ferrous Rules allow for maintenance after closure, known as "post-closure maintenance" (*Minnesota Rules* 6132.3200, subp. 2.E.6.). While "closure" is defined in the Rules to mean, "…the process of terminating and completing final steps in reclaiming any specific portion of a mining operation." Post-closure maintenance includes those activities required to "sustain reclamation" after closure (*Minnesota Rules* 6132.0100). Both of these maintenance methods can meet the goals of *Minnesota Rules* 6132.3200, subpart 1. It is important to recognize that the goals in the Non-Ferrous Rules are not requirements.

When mining activities cease, a permittee is required to initiate "closure" of the mine. As part of the closure process, reclamation of the mining area must be completed. If continued maintenance is needed following closure of the mine to sustain the reclamation, the permittee is responsible for "post-closure maintenance." To ensure that reclamation is completed and sustained, the Non-Ferrous Rules require the permittee to provide financial assurance in amounts sufficient to pay for both closure and post-closure maintenance. A permittee cannot be released from its responsibilities, including financial assurance requirements, until there is no longer a need for post-closure maintenance.

The permit to mine would require PolyMet to present a plan for eventual transition from mechanical water treatment to non-mechanical water treatment. PolyMet plans to test non-mechanical water treatment technologies during mine operations and following closure and then transition from mechanical to non-mechanical water treatment technologies as soon as the company can demonstrate that that these technologies would treat water to the required water quality standards. PolyMet estimates that it can transition to non-mechanical water treatment at the Tailings Basin immediately after mine closure and at the Mine Site several decades after mine closure.

Non-mechanical treatment systems, which are described below, would be designed and pilot-tested before being implemented to treat water from the Category 1 Stockpile surface and groundwater seepage containment system, the West Pit Overflow, the Tailings Basin seepage containment system, and the Hydrometallurgical Residue Facility.

Category 1 Stockpile Groundwater Containment Non-mechanical Treatment System

PolyMet proposes to install a Category 1 Stockpile groundwater containment non-mechanical treatment system at the Mine Site to replace the mechanical treatment of the water collected by the containment system during the closure and long-term maintenance phase of the NorthMet Project Proposed Action. The system would likely include two PRBs, which are flow-through treatment systems, for metal precipitation and solids removal. The PRBs would reduce constituent loading through physical, chemical, and/or biological treatment processes including: biochemical reduction of sulfate to sulfide using sulfate-reducing bacteria, sorption to solid-phase surfaces such as iron oxides or organic matter, chemical precipitation to convert dissolved-phase constituents to solid-phase particles, and physical filtering of solid-phase particles. The

PRBs would ideally be located where they could take advantage of gravity flow. The locations would be dependent on the final hydraulic plan for discharge from the Category 1 Stockpile surface and groundwater seepage containment system into the West Pit (PolyMet 2015d).

West Pit Overflow Non-mechanical Treatment System

PolyMet proposes to install a West Pit overflow non-mechanical treatment system at the Mine Site to replace the pumping of West Pit lake water to the WWTF during the closure and long-term maintenance phase of the NorthMet Project Proposed Action. It is expected to be a multi-stage system with a constructed wetland for metal (copper, cobalt, nickel, and lead) precipitation and solids removal, a PSB for metal sorption, and an aeration pond to provide time for water exiting the PSB to re-equilibrate with the atmosphere and to increase the concentration of dissolved oxygen before the water would be discharged. The proposed design and operation of any non-mechanical system at the Mine Site would be adapted as necessary to effectively treat actual flows and to meet all applicable regulatory requirements (PolyMet 2015d).

Tailings Basin Non-mechanical Treatment System

PolyMet proposes to install a Tailings Basin non-mechanical treatment system to replace the mechanical treatment of the water draining through the Tailings Basin and collected in the Tailings Basin seepage containment system and the south seepage management system during the closure and long-term maintenance phase of the NorthMet Project Proposed Action. In closure and long-term maintenance, seepage flow to the east would be less than 1 gpm. Provisions to adaptively manage this low-volume flow from the eastern segment of the containment system would be included in the development of the Non-Mechanical Treatment System. During closure and long-term maintenance, any water collected by the Hydrometallurgical Residue Facility leakage collection system would also be routed to this treatment system. The Tailings Basin non-mechanical treatment system would consist of a constructed wetland for metals precipitation, sulfate load reduction, and solids removal and PSBs for polishing (i.e., additional removal of metals, if needed). It would be constructed by rebuilding the natural wetlands between the Tailings Basin and the containment system as a vertical, upflow constructed wetland system with PSB systems at the outer perimeter within the access road. The total flow for the Tailings Basin non-mechanical treatment system is expected to be 1,200 gpm, which would include flows at the northern, northwestern, western, and southern toes (PolyMet 2015d).

Tailings Basin Pond Overflow Post-mechanical Treatment Options

During the initial portion of the closure and long-term maintenance period, Tailings Basin pond water would be pumped to the WWTP to prevent overflow. A monitoring program would document changes in pond water levels and water quality over time. One goal of the NorthMet Project Proposed Action during closure and long-term maintenance would be to allow overflow of the tailings pond. This could only be done after demonstrating that water in the Tailings pond was stormwater and that it complied with applicable standards. The Tailings Basin closure overflow structure would be embedded into bedrock of the hillside east of Cell 2E during reclamation. This structure would likely be modified to serve as a stormwater overflow, which would allow water discharged to enter the Mud Lake Creek Watershed (PolyMet 2015d).

5.2.2.3.6 Monitoring

Monitoring would be a critical component of the NorthMet Project Proposed Action to better understand impacts and to inform facility operation and maintenance and the selection and implementation of possible adaptive or contingency mitigation measures. The NorthMet Project Proposed Action includes PolyMet's proposed water quality and quantity monitoring plan. Overviews of the water monitoring plans at the Mine Site and Plant Site, with PolyMet proposed monitoring locations and frequencies, are presented in the sections below. The specifics of monitoring—including specific locations, frequencies, and parameters—would be finalized during the permitting process after a detailed evaluation. An NPDES permit would be required for any point source water discharge that adds pollutants to waters of the U.S.

<u>Partridge River Watershed</u>

Water monitoring within the Partridge River Watershed would be used on a continual basis to document compliance with permit conditions, annually validate and update water models, and provide input to optimize operations including any adaptive engineering controls or contingency mitigation measures. Depending on the component (i.e., water flow, elevation, or quality) monitoring frequency would range from continuously to quarterly (PolyMet 2015r). An overview of PolyMet's proposed water monitoring plan within the Partridge River Watershed is in Table 5.2.2-53.

Table 5.2.2-53 Overview of Monitoring Plans within the Partridge River Watershed

Monitoring Plan Component		Purpose	Summary	General Locations
Internal Streams	Pit water	Compare water balance with expected conditions. Define future pumping requirements and evaluate trends in pit water quality.	Continuous flow monitoring and monthly water quality sampling at up to four sumps[1]	Stations installed to monitor flows and water quality from each pit sump
	Stockpile drainage	Compare water balance with expected conditions. Define future pumping requirements, and evaluate trends in stockpile drainage water quality.	Continuous flow monitoring and monthly water quality sampling from up to 12 locations[1]	Stations installed to monitor drainage from each stockpile liner and each stockpile underlain and the two Category 1 Waste Rock Stockpile containment system sumps
	Overburden Storage and Laydown Area runoff	Compare water balance with expected conditions. Define future pumping requirements, and evaluate trends in Overburden Storage and Laydown Area water quality.	Continuous flow monitoring and monthly water quality sampling in the Overburden Storage and Laydown Area pond[1]	Stations installed to monitor flows and water quality from the Overburden Storage and Laydown Area pond

Monitoring Plan Component		Purpose	Summary	General Locations
	Haul road runoff	Compare water balance with expected conditions. Define future pumping requirements, and evaluate trends in haul road water quality.	Continuous flow monitoring and monthly water quality sampling of the haul road ponds[1]	Stations installed to monitor flows and water quality from the haul road ponds
	Rail Transfer Hopper runoff	Compare water balance with expected conditions. Define future pumping requirements, and evaluate trends in Rail Transfer Hopper water quality.	Continuous flow monitoring and monthly water quality sampling of the Rail Transfer Hopper pond[1]	Stations installed to monitor flows and water quality from the Rail Transfer Hopper pond
	WWTF influents and effluents	Optimize the treatment operations and demonstrate acceptable effluent characteristics.	Continuous flow monitoring and monthly water quality sampling of the influent and effluent streams	Inlet and outlet of the WWTF
	Treated Water Pipeline flows	Compare water balance with expected conditions	Flow monitoring and water quality sampling at the inlet and outlet	Inlet and outlet of the Treated Water Pipeline
Stormwater	Stormwater	Evaluate trends in stormwater quality.	Flow monitoring and water quality sampling at pond outlets[1]	Stormwater pond outlets
Groundwater	Surficial aquifer	Evaluate groundwater level and water quality trends in the surficial aquifer.	33 sampling locations sampled approximately April, July, and October	Surficial aquifer monitoring wells installed downgradient of each stockpile and pit
	Bedrock	Evaluate groundwater level and water quality trends in the bedrock.	Number of wells are yet to be determined, with sampling approximately April, July, and October	Bedrock monitoring well locations are to be determined
Wetlands	Wetlands	Evaluate potential effects of mining operations on wetlands and determine if potential indirect impacts from the mining operations have occurred or if additional mitigation is needed.	Number of piezometers and sampling frequency to be determined	Continuation of baseline monitoring program
Surface Water	Partridge River and tributaries	Evaluate trends in surface water quality and flow.	Monthly sampling of flow and water quality at nine sampling locations during non-frozen conditions	Partridge River, Longnose Creek, Wetlegs Creek, Wyman Creek, and West Pit Overflow Creek,

Monitoring Plan Component	Purpose	Summary	General Locations
Colby Lake and Whitewater Reservoir	Evaluate trends in water quality of Colby Lake and water levels for Colby Lake and Whitewater Reservoir.	Water quality and water level sampling at one location for each water body during non-frozen conditions	Colby Lake and Whitewater Reservoir

Source: PolyMet 2015r.

[1] Cumulative flow volume would be measured, with values recorded on a monthly basis. Water quality monitoring would occur during non-frozen conditions.

Proper placement of waste rock and overburden in the appropriate stockpile and for ultimate disposal would be important to achieve the NorthMet Project Proposed Action's predicted water quality. PolyMet has developed a Rock and Overburden Management Plan for monitoring and testing of waste rock during mine operations. The USEPA, MDNR, and MPCA have agreed that they will review this Plan and include requirements for waste rock testing and monitoring to ensure it is properly categorized and managed during permitting.

The MDNR would require a Spilled Ore Plan as part of the Permit to Mine for monitoring the extent of spillage and identifying appropriate mitigation measures.

The Co-Lead Agencies recommend a robust monitoring program during all phases of mining to provide evidence of the presence or absence of hydrologically significant faults. If identified, mitigation can be employed to minimize flow through the faults.

Embarrass River Watershed

Water monitoring within the Embarrass River Watershed would be used on a continual basis to document compliance with permit conditions, annually validate and update water models, and provide input to optimize operations of adaptive engineering controls. Depending on the component (i.e., water flow, elevation, or quality) monitoring is proposed to occur continuously, monthly, or three times a year in the first month of non-freezing quarters (PolyMet 2015i). An overview of PolyMet's proposed water monitoring plan at the Plant Site is in Table 5.2.2-54.

Table 5.2.2-54 Overview of Monitoring Plans for the Embarrass River Watershed

Monitoring Plan Component		Purpose	Summary	General Locations
Internal Process Water Streams	Tailings Basin pond	Monitor pond water levels and trends in Tailings Basin pond water characteristics over time	Daily water level (WL) monitoring and water quality (WQ) monitoring	WL monitoring location TBD; WQ monitoring at pond barge
	Tailings Basin seepage	Evaluate seepage rate and trends in water quality characteristics over time	Continuous flow monitoring and monthly WQ samples from seepage collection systems	Groundwater containment system lift stations and Tailings Basin south surface seepage management system pump station
	Hydrometallurgical Residue Facility pond	Monitor water level to prevent overtopping the Hydrometallurgical Residue Facility dam and monitor water quality trends over time	Daily WL monitoring and monthly WQ monitoring.	WL monitoring location TBD; WQ monitoring at pond barge
	Hydrometallurgical Residue Facility leachate	Evaluate leachate quantity and characteristics over time	Continuous flow monitoring and monthly monitoring of leachate quality	Underdrain
	Continued existing waste streams	Continue existing WQ monitoring requirements as appropriate	Quarterly monitoring of flow and WQ during non-frozen conditions (April, July, and October)	Seep into Cell 1E
Stormwater	Stormwater	Monitor stormwater quality and quantity	Monthly (during non-frozen conditions, April through October) flow rate and WQ monitoring	Stormwater control features
Surface Discharges	WWTP	Demonstrate acceptable effluent characteristics	Continuous flow monitoring of WWTP effluent, and monthly WQ monitoring and monthly total flow monitoring at discharge locations	WWTP effluent
Surface Water	Embarrass River and tributaries	Evaluate trends in surface water quality and flow	Monthly sampling of flow and water quality	Embarrass River, Mud Lake Creek, Trimble Creek, and Unnamed Creek
	Second Creek	Evaluate trends in surface water quality and flow	Monthly sampling of flow and water quality	Second Creek downstream of seepage barrier
	Colby Lake intake	Evaluate water quantity use over	Continuous flow monitoring at intake,	Colby Lake intake

Monitoring Plan Component		Purpose	Summary	General Locations
		time for plant use		
Groundwater	General	Evaluate groundwater quality and water level trends over time	Monitoring wells sampled during non-frozen conditions (April, July, and October)	Existing monitoring wells installed around the Tailings Basin
Wetlands	Wetlands	Evaluate potential effects of processing plant operations on wetlands and determine if the potential indirect impacts from these operations have occurred or if additional mitigation is needed	Number of piezometers and sampling frequency yet to be determined	Continuation of the baseline monitoring program

Source: PolyMet 2015i.

WQ = Water Quality; WL = Water Level

Piezometers or other measurement devices would be installed on opposite sides of the containment system to monitor head differential to verify that hydraulic gradient have been reversed which would show that the containment system is achieving complete capture. Additionally, permit(s) would require a robust monitoring program during all phases of mining to provide evidence of the presence or absence of hydrologically significant faults. If identified, mitigation would be employed to minimize flow through the faults.

5.2.2.4 NorthMet Project No Action Alternative

Under the NorthMet Project No Action Alternative, the NorthMet Project Proposed Action would not occur and, therefore, the environmental effects associated with the NorthMet Project Proposed Action, as described in Section 5.2.2, would not occur. Although under the No Action Alternative, the NorthMet Project Proposed Action, including the proposed Tailings Basin seepage collection and water treatment engineering controls, would not occur, the No Action Alternative would not be static. Under the No Action Alternative, water quality would continue to be maintained by generally effective existing natural ecosystem functions. Under the NorthMet Project Proposed Action, these functions would be provided by the WWTP or WWTF (or alternative, if developed) and this reflects a substantial shift in how water quality is maintained.

In the Partridge River Watershed, there are actions occurring as part of the Cliffs Erie Consent Decree that would be expected to result in improvements to the water quality of Second Creek and the Lower Partridge River, but there are also other proposals for mining and mineral processing, and mitigative actions under other existing water quality permits, that could also affect the water quality of these waterbodies, but which cannot be predicted at this time.

In the Embarrass River Watershed, it is anticipated that the water quality of the existing LTVSMC Tailings Basin seepage would improve over time as a result of natural attenuation and/or possible additional mitigation measures at some point in the future pursuant to new permit requirements or other state or federal remediation requirements. Other actions are underway to improve the water quality of the Area 5NW Pit overflow, which contributes a high sulfate load to the Embarrass River. At this time, the exact nature, timing, and effectiveness of these measures are unknown and, therefore, not quantifiable in this FEIS, but it is reasonable to expect that water quality within the Embarrass River could improve over time, absent other unforeseen activities that could affect water quality. In addition, climate change would be likely to affect the hydrology and, indirectly, the water quality, of the NorthMet Project Proposed Action area as the result of predicted increases in mean annual temperature and mean annual precipitation.

Therefore, there are several factors that could dynamically affect the hydrology and water quality of the Partridge and Embarrass River watersheds in the future, but in ways that cannot be quantified with any reasonable level of confidence at this time. It should be noted that PolyMet did analyze the effects of climate change on water quality and quantity estimates for the NorthMet Project Proposed Action by conducting a sensitivity analysis. As described in Section 5.2.2.3, the GoldSim model was used to evaluate the CEC scenario for comparison with the NorthMet Project Proposed Action. The CEC scenario represents future conditions without the NorthMet Project Proposed Action, including all proposed facilities, but is not synonymous with the No Action Alternative because it does not account for other foreseeable changes within the NorthMet Project area.

5.2.3 Wetlands

This section describes the potential environmental consequences of the NorthMet Proposed Action to wetland resources, including the potential direct and indirect effects. Discussions are also included on actions taken to avoid or mitigate wetland impacts, proposed wetland mitigation options, and wetland monitoring plans.

Summary

The NorthMet Project Proposed Action would result in direct impacts and indirect effects on wetland resources at the Mine Site, along the Transportation and Utility Corridor, at the Plant Site, and around the Mine Site (Area 1) and north of the Plant Site (Area 2). This section describes these effects within each of these areas and provides a summary of the effects over the operational life of the facility.

Direct wetland impacts would result from mining-related activities involving filling, excavation, a combination of filling and excavation, and installation of a containment system within the wetland boundary, and therefore these wetlands would be permanently lost. The NorthMet Project Proposed Action would directly affect 913.8 acres of wetlands located within the NorthMet Project area. The Mine Site would be subject to the majority of the direct wetland impacts. The direct wetland impacts within the entire NorthMet Project area would occur in the following wetland types: coniferous bog (56 percent), shrub swamp (12 percent), coniferous swamp (9 percent), shallow marsh (8 percent), deep marsh (8 percent), sedge/wet meadow (4 percent), hardwood swamp (1 percent), and open bog (1 percent). The majority of the direct impacts would occur as a result of a combination of filling and excavation (65 percent).

Wetlands directly impacted within the Mine Site would result in a combined effect area of 758.2 acres. These direct wetland impacts would be caused by fill (10 percent), excavation (12 percent), or a combination of fill and excavation (78 percent). The Transportation and Utility Corridor would directly affect 7.2 acres of wetlands, all of which would be directly filled. Approximately 148.4 acres of wetlands within the Plant Site would be directly impacted. These wetlands impacts would be caused by fill (12 percent), excavation (31 percent), excavation and fill (less than 1 percent), and the containment system (58 percent).

Compensatory mitigation is required for the 913.8 acres of wetlands that would be directly impacted. In addition, compensatory mitigation for the 26.9 acres of wetland fragmentation would be provided up front. The overall wetland mitigation strategy for the NorthMet Project Proposed Action is to compensate for unavoidable wetland impacts in-place, in-kind where possible and in-advance of impacts when feasible in order to replace lost wetland functions. Off-wetland mitigation projects would be implemented to fulfill the requirements for compensatory mitigation. PolyMet's current mitigation proposal includes the following:

- Off-site mitigation including:
  - Aitkin Site – 808.3 acres of wetland restoration and 83.2 acres of upland buffer;
  - Hinckley Site – 286.2 acres of wetland restoration and 91.2 acres of upland buffer; and
  - Zim Site – 508.2 acres of wetland restoration and preservation and 22.7 acres of upland buffer.

USACE St. Paul wetland compensatory mitigation replacement ratios are based on three factors: in-place versus out-of-place, in-kind versus out-of-kind, and in-advance versus concurrent. The 2009 USACE St. Paul District's policy states a base compensation ratio of 1.5:1, and a minimum of 1:1, with a provision for a case-by-case determination of higher ratios to account for factors including difficult-to-replace, rare and/or exceptional wetlands/aquatic resources. Therefore, per the 2009 policy, the District Engineer may determine that a higher compensation ratio of 2:1 (or higher) would be required to offset losses of wetlands that would be difficult to replace and/or provide an exceptional level of functions. The USACE St. Paul District has not made a final determination of the compensation ratios that would be required for the NorthMet Project Proposed Action. The final decision on compensatory mitigation ratios would be determined at the time of the DA permit decision pursuant to Section 404 of the CWA based on current District guidance. PolyMet would ultimately need to satisfy both the federal and state mitigation requirements. The number of mitigation credits to be earned by replacement wetlands would be determined during permitting by the appropriate agencies reviewing the wetland mitigation plan. This would be based on the extent to which the sites meet the target goals established during permitting. These include, among other things, restoration of wetland appropriate hydrology and the establishment of a target plant community or type. The NorthMet Project Proposed Action is estimated to directly affect 913.8 acres. Depending on the location, type, and timing of compensatory mitigation, the minimum required amount of replacement wetlands for direct impacts could range from 913.8 acres up to 1,827.6 acres (i.e., 1:1 up to 2:1 compensation ratios). In addition, compensatory mitigation for the 26.9 acres of wetland fragmentation would also be provided up front.

The USACE has concluded that the mitigation sites selected and the wetland credits generated at the three mitigation sites would be acceptable for use in compensating for direct wetland losses. The USACE has not made a final decision on the mitigation ratios that would be required to compensate for direct wetland impacts; if fully successful, it is likely these three mitigation sites would generate sufficient credits to compensate for the 940.7 acres of wetlands directly impacted. In the event that not all of the credits generated by these sites are utilized to compensate for direct wetland impacts, any excess credits could be used to compensate for indirect losses (USACE 2015a). The current proposed mitigation presented below shows that PolyMet could have an excess of mitigation credits from the three mitigation sites if the mitigation sites are successful and meet the performance standards. However, it is understood that mitigation sites sometimes are not fully successful; contingency plans (discussed below) would be developed for the NorthMet Project Proposed Action and approved during permitting. The USACE encourages the development of mitigation for foreseeable indirect effects, which the current proposed mitigation plan appears to achieve.

Financial assurances for the direct wetland impact mitigation would be required until success of the mitigation sites can be assured. While this wetland mitigation would be expected to be approved and constructed in advance of any authorized wetland impacts, it is unclear whether these sites would be well enough established for financial assurances to be waived. The USACE would also consider the application of financial assurances for potential indirect wetland effects and monitoring. Both the USACE and state would require consideration of financial assurances during the permitting process.

Off-site wetland compensation of 1,602.7 acres could provide 1,513.3 wetland mitigation credits. In addition, a total of 197.1 acres of upland buffer areas are proposed to be established with native vegetation around the wetland restoration areas. In accordance with USACE guidelines, credit for the upland buffer areas would be at a 4:1 ratio, resulting in an additional 49.3 credits. The total off-site mitigation could provide 1,562.5 wetland mitigation credits. Compensatory ratios determined in permitting may vary from these assumptions. The determination of final mitigation credits required to offset the impacts of the proposed NorthMet Project Proposed Action would be determined during permitting.

Finally, post-closure establishment of 101.8 acres of wetland on-site would likely occur during reclamation of the Mine Site; this establishment is not included in the mitigation credits discussed above as credit is not being requested at this time. The generation of wetland credits in these areas has the potential to be used on a contingency basis, but compensatory credit would not be considered at this time for a variety of reasons including the fact that any restoration efforts would not occur for many years.

Potential indirect wetland effects from the NorthMet Project Proposed Action would result from one or more of the following six factors: 1) wetland fragmentation, 2) changes in wetland hydrology resulting from changes in watershed area, 3) changes in wetland hydrology due to groundwater drawdown resulting from open pit mine dewatering, 4) changes in wetland hydrology from groundwater drawdown resulting from operation of the Plant Site, including groundwater seepage containment, 5) changes in stream flow near the Mine Site and Plant Site, as well as associated effects on wetlands abutting the streams, and 6) changes in wetland water quality related to atmospheric deposition of dust and rail car spillage associated with Mine Site and Plant Site operations. The change in wetland hydrology from groundwater drawdown at the Mine Site was assessed by two different methodologies; therefore, total indirect wetland effects were provided based on both approaches. The NorthMet Project Proposed Action could indirectly affect up to either 7,694.2 acres of wetlands located within and around the NorthMet Project area, based on the method of wetlands crossing analog impact zones, or up to 6,568.8 acres of wetlands located within and around the NorthMet Project area, based on the method of wetlands within analog impact zones (PolyMet 2015b).

Regardless of the method used, wetland mitigation for potential indirect wetland effects would be determined by the agencies during permitting. If the NorthMet Project Proposed Action were to be permitted, wetland monitoring for hydrology and vegetation would be conducted to identify if future indirect effects to wetlands would occur. Wetland hydrology and vegetation would be monitored, and additional monitoring locations may be considered during permitting. A component of the monitoring plan would be based on those wetlands that would have a high likelihood of indirect effects as a result of groundwater drawdown. If the monitoring were to determine that indirect wetland effects had occurred, additional compensation could be required if determined necessary by the permitting agencies. In the event that the required wetland monitoring identified additional indirect effects, permit conditions would likely include a plan for adaptive management practices to be implemented, such as expanded monitoring and hydrologic controls. Additionally, compensatory mitigation may be required if additional impacts are identified during annual reporting. Permit conditions would likely include an adaptive management plan to account for any additional impacts that may be identified in the annual monitoring and reporting.

5.2.3.1 Methodology and Evaluation Criteria

Wetland effects for the NorthMet Project Proposed Action include direct, indirect, and cumulative effects. As previously mentioned, a Wetland IAP Workgroup was formed, and based on this workgroup, effects were assessed using agency-prescribed methods as presented in the Wetland Analysis Work Plan (PolyMet 2011b) and using the wetland types and acreages identified in the report *NorthMet Project Wetland Data Package* Version 7 (PolyMet 2015b). Methods used to evaluate direct impacts and indirect effects are described below; cumulative effects are described in Chapter 6.

5.2.3.1.1 Direct Wetland Impacts Methodology and Evaluation Criteria

Direct wetland impacts for the NorthMet Project Proposed Action were determined through a GIS analysis of the areas that would be directly disturbed by mining features and operations, such as mine pits, stockpiles, and access roads. The area of analysis for the direct impacts included the Mine Site, Transportation and Utility Corridor, and Plant Site.

Direct impacts would result from mining-related activities such as filling or excavation of wetlands, and therefore, these wetlands would be permanently lost. Wetlands within the NorthMet Project area were identified using the Eggers and Reed (1997, 2014) community classification system, as described in Section 4.2.3. The analysis for the direct wetland impacts included identification of wetland type, total wetland acreage, total acres of direct effect, type of direct effect (i.e., fill, excavation, etc.), and the quality of each wetland to be impacted by the NorthMet Project Proposed Action.

5.2.3.1.2 Potential Indirect Wetland Effects Methodology and Evaluation Criteria

Wetlands that are not filled or excavated, but have a reduced function or value, would be considered indirectly affected. The most likely types of indirect effect on the functions and values of remaining wetlands at the Mine Site include wetland fragmentation from NorthMet Project area elements such as open pits, stockpiles, and haul roads; and indirect hydrological effects that may result in a conversion of one wetland type to another or the conversion of a wetland to an upland. Other indirect effects could result from changes in wetland watershed areas (during operation and post-closure); groundwater drawdown resulting from open pit mine dewatering; groundwater drawdown resulting from operation of the Tailings Basin, including groundwater seepage containment system; changes in streamflow near the Mine Site and Tailings Basin and associated effects on wetlands abutting the streams (during operation and post-closure); and changes in wetland water quality related to atmospheric deposition of dust and rail car spillage associated with the Mine Site and the Tailings Basin operations.

Potential indirect wetland effects from drawdown were estimated using the analog method. Various models, some of which were associated with impact analysis of other environmental resources such as air, groundwater, and surface water that affect wetland resources were also used in estimating potential indirect wetland effects.

Each analysis was completed using the same set of wetlands that were not directly impacted; therefore, there are wetlands that may be potentially indirectly affected by more than one type of assessed source. The potential indirect wetland affects for each wetland cannot be summed across the analysis as this would likely result in double-counting of wetland acres. The results of the analyses and assessments identify areas to be monitored for wetland effects.

Wetland acreage by wetland type was calculated using GIS analysis with 500-ft radius increments beginning at the mine pits and continuing out to a total radius of 10,000 ft (for a total of 20 increments); and 500-ft radius increments beginning at the Plant Site and continuing out to the Embarrass River. The area of analysis for the indirect effects extended beyond the NorthMet Project area component boundaries and included Area 1 and Area 2, as identified in Section 4.2.3. The analysis did not include wetlands identified as directly impacted. Additionally, wetlands in the Northshore Mine and areas directly north of the Northshore Mine have been excluded from the evaluation (PolyMet 2011b).

Noise and dust effects on wildlife that utilize the wetland habitat are discussed in Section 5.2.5 (Wildlife Section).

Additional description of the specific methods used to assess individual indirect effects is provided below.

The indirect effects analyses performed for the EIS were not performed to characterize impacts but were done to inform where monitoring should take place for those areas that were identified as having a potential for indirect wetland effects. The Co-lead Agencies agree that multiple factors can affect whether a wetland would experience indirect effects due to a project. This FEIS quantitatively assessed all potential indirect wetland effects. Indirect wetland effects from the NorthMet Project Proposed Action were assessed as a result from one of the following six factors: 1) wetland fragmentation; 2) changes in wetland hydrology from changes in watershed area; 3) changes in wetland hydrology from groundwater drawdown resulting from open pit mine dewatering; 4) changes in wetland hydrology from groundwater drawdown resulting from operation of the Plant Site, including groundwater seepage containment; 5) changes in stream flow near the Mine Site and Plant Site, as well as associated effects on wetlands abutting the streams; and 6) change in wetland water quality related to atmospheric deposition of dust and rail car spillage associated with Mine Site and Plant Site operations. The methodology and criteria used for assessing potential indirect wetland effects are described in detail below. The monitoring and mitigation for potential indirect effects would be determined during permitting. Section 5.2.3.3 of this FEIS includes a detailed discussion on the monitoring and mitigation plan for the indirect wetland effects. The proposed wetland impact, avoidance, minimization, mitigation and monitoring plan presented in this FEIS would be reviewed, modified as required, and approved during permitting; therefore, this information could change during permitting.

While the Co-lead Agencies believe that the analog method used in the SDEIS to assess potential indirect effects from mine dewatering is adequate, this FEIS has been updated with a more conservative approach to address concerns raised by the Bands. Section 5.2.3.2.2 of this FEIS has been updated to make a more conservative assumption of the potential indirect effects for all bog communities within the zero to 1,000-ft analog zone such that all bogs are reclassified from the “no effect” category to “low likelihood” category of wetland hydrology effects. The complex mixes of bedrock, surficial deposits, and wetland soils at the Mine Site impede the ability to reasonably model and accurately assess the potential effect of pit dewatering on wetlands. In light of this modeling limitation, wetlands were divided into zones based on distance from the open pit. The closer a wetland was to the pit during dewatering, the greater the water table drawdown would be and the greater potential there would be for hydrologic effects on overlying wetlands. These impact assessment methodologies are presented below and in Section 5.2.2.3.2.

The Co-lead Agencies are not relying solely on the potential impact zones determined in the analog method for this FEIS, but would be monitoring wetlands for potential indirect effects. In the event that the required wetland monitoring identifies additional indirect effects, permit conditions would likely include a plan for adaptive management practices to be implemented. Additional compensatory mitigation would be required if indirect wetland impacts were identified during monitoring and annual reporting.

When an agency is evaluating reasonably foreseeable significant adverse effects on the human environment in an EIS and there is incomplete or unavailable information because the overall costs of obtaining it are exorbitant or the means to obtain it are not known, NEPA directs the agency to 1) make it clear that such information is lacking, 2) discuss the relevance of the lacking information, and 3) discuss any information relevant to evaluation the future impacts. In these cases, NEPA also directs the agency to evaluate these impacts based upon theoretical approaches or research methods generally accepted in the scientific community provided that the analysis of the impacts is supported by credible scientific evidence, is not based on pure conjecture, and is within the rule of reason.

The Co-lead Agencies believe this is the case for evaluating indirect wetland effects. The Co-lead Agencies have thoroughly considered throughout the development of the EIS and through the Wetland IAP Working Group how to assess potential indirect wetland effects. As a result, strengths and weaknesses of the approach used, as well as other suggested approaches, have been carefully considered. The Co-lead Agencies ultimately decided that the use of the analog method and the 20 percent metric described in this section as factors considered in identifying potential indirect effects to wetlands is a credible and reasonable approach consistent with the requirements of NEPA.

<u>Potential Indirect Wetland Effects Resulting from Wetland Fragmentation</u>

For each wetland that would not be directly impacted at the Mine Site, along the Transportation and Utility Corridor, or at the Plant Site, an estimate of indirect wetland effects (wetland acres by wetland type, and type of effect) from wetland fragmentation by NorthMet Project area features (e.g., open pits, stockpiles, haul roads) was determined based on an analysis of the various factors that may contribute to fragmentation. A wetland may be fragmented as the result of direct impacts that may split a wetland resource area into multiple parts. These fragmented parts could potentially be isolated from other wetlands and would no longer have any adjacent upland watershed area, which could result in the loss of functions in the wetland fragments. While a wetland may be fragmented by direct impacts, this does not necessarily mean the remaining fragmented part of the wetland resource area would be affected. These fragmented parts therefore required further evaluation to determine if these areas would remain viable and/or would retain its functions (PolyMet 2015b; PolyMet 2015j).

The evaluation (PolyMet 2015b; PolyMet 2015j) to determine if a wetland resources area would remain viable included the following criteria: change in the size of remaining wetland, wetland type, source of hydrology, direction of flow in the area, location in the current watershed, location in the future watershed, and connectivity to other wetlands. The criteria used are described below:

- **Size of Remaining Wetland:** Wetland fragments that were identified using GIS as having less than about 0.5 acres in size were determined too small to retain their functions. These wetlands were determined for the analysis to be considered fragmented.
- **Wetland Type:** The wetland types for the wetland fragments that were greater than 0.5 acres in size were reviewed to determine if they were bogs versus non-bogs. Ombrotrophic bogs that would become fragmented were not identified as indirectly impacted by fragmentation because they would maintain their functions because their sole source of hydrology is precipitation (see below). Minerotrophic bogs and small non-bog wetlands that were fragmented were further evaluated to determine their hydrologic sustainability.
- **Source of Hydrology:** Wetlands were further subclassified as ombrotrophic (solely precipitation-fed) or somewhat minerotrophic (receives surface and/or groundwater inputs). The hydrology of ombrotrophic bogs is solely supported by precipitation; therefore, these wetlands are not dependent on the watershed size to maintain their functions and were not identified as indirectly impacted by fragmentation. The hydrology of minerotrophic bogs and non-bog wetlands is primarily supported by shallow groundwater systems that are connected within different scales: wetland watershed, local (e.g., Mine Site) watershed, or regional watershed. Therefore, these minerotrophic bogs and non-bog wetlands were further evaluated because they are considered to be dependent on their watershed size to maintain their functions, and their watersheds would be altered due to construction of project infrastructure.
- **Direction of Flow in the Area:** The Mine Site is located in the Upper Partridge River watershed, and water on the Mine Site eventually drains to the Partridge River. Under this criterion, PolyMet evaluated the locations of the minerotrophic bogs and non-bog wetlands relative to the sub-watersheds on each side of the Mine Site groundwater divide, which is generally located from southwest to northeast near the northern boundary of the Mine Site. Under existing conditions, water in the northernmost area of the Mine Site generally drains (flows) north and water in the southern area of the Mine Site generally drains (flows) south. There are several sub-watersheds on each side of the divide. Based on the location of predicted wetland fragments on the Mine Site, their locations within the sub-watersheds in relation to direct impacts within that same sub-watershed and the direction of flow were noted. A wetland is more likely to retain its function if the fragment that remains is located in the upper portion of its sub-watershed than in the lower portion. Ultimately, if the area of the wetland's watershed is modified, it could result in a change to the equivalent flow (expressed as ac-ft/yr per acre of wetland), a measure of hydrologic support.
- **Determination of the Wetland's Current Watershed:** The current watersheds for ombrotrophic bog wetlands were not analyzed because they are not dependent on watershed area for their hydrology as they are precipitation-fed. The current (existing) conditions include the wetlands and watersheds, which represent the existing and relatively undisturbed conditions in the Mine Site area. The watersheds for the minerotrophic bogs and non-bog wetlands are the land areas that contribute surface water to the wetlands (upland areas and wetland areas). For each minerotrophic bog and non-bog wetland in the analysis, GIS was used to determine the acreage of its watershed area. The location of each minerotrophic bog and non-bog wetland in its current (existing) watershed was compared with its location in the future watershed.

- **Location of the Minerotrophic Bog and Non-bog Wetland Fragment in the Wetland's Future Watershed:** During operations, some watershed areas would be directly impacted by the NorthMet Project Proposed Action and would no longer be considered as tributary areas to the minerotrophic bogs and non-bog wetlands. Using the same methodology as in the previous criteria, for each minerotrophic bog and non-bog wetland in the analysis, GIS was used to determine the acreage of upland area and wetland area within its watershed area. As a result, the amount of water potentially contributed by the watershed to support the hydrology of the remaining wetland may also change (increase or decrease). If the wetland fragments had a change in equivalent yield of ±20 percent, the minerotrophic bogs and non-bog wetlands were further determined to have a potential for indirect impacts. Depending on the results of the other criteria, the minerotrophic bog and non-bog wetland fragments were either considered to be indirectly affected or included as a monitoring location in the wetland hydrology monitoring plan.
- **Connectivity to Other Wetlands:** Each wetland fragment was evaluated based on its location, adjacency to upland, and adjacent infrastructure characteristics to determine if it would be expected to maintain its functions. Some of the wetland fragments as a result being divided by Mine Site infrastructure would become isolated from other wetlands; therefore, no longer located within or adjacent to an intact, relatively undisturbed upland. These wetland fragments were not expected to maintain their functions. However, other wetland fragments would still be hydrologically connected to wetlands and would be located within or adjacent to an intact, relatively undisturbed upland. For example, these fragmented wetlands would be located in the vicinity of the haul roads on the Mine Site. Construction of the haul roads would require excavation and fill with blasted rock that would allow groundwater connectivity for wetlands on either side of the haul road.

Potential Indirect Wetland Effects Resulting from a Change in Watershed Area

For each wetland that would not be directly impacted, but would have NorthMet Project area elements affect its watershed, an estimate of the change in watershed area (acreage and percent gain or loss) was calculated for the following conditions: pre-NorthMet Project Proposed Action, during operation when the maximum amount of watershed has been removed, and at closure and long-term maintenance. For those non-directly affected wetlands that would have changed watershed areas (during operation and post-closure), an estimate of indirect wetland effects (wetland acres by wetland type and type of indirect effect) was calculated.

Potential Indirect Wetland Effects Resulting from Changes in Hydrology Due to Drawdown at the Mine Site

An estimate of indirect wetland effects (wetland acres by wetland type, and type of indirect effect) due to groundwater drawdown from open pit mine dewatering was determined using an analog model in which the degree of effect was correlated to the distance from the open pit mine (PolyMet 2011b). The analog approach was based on similar mine settings (e.g., within the glacial till in the region) and consisted of well data from the Canisteo Pit, which is the only mine pit within the Mesabi Iron Range that has an associated water balance study with well data that could be used to assess potential drawdown effects. In addition, two wells near Kinney were also used for the evaluation. Please refer to Section 5.2.2.3.2 for more information on the analog approach. The closer a wetland was to the pit where dewatering would occur, the greater the water table drawdown would be and the greater the potential for hydrologic effects on overlying wetlands. Wetlands were divided into zones based on distance from the open pit. The use of the impact zones may overestimate indirect effects on wetlands. The analog distances, referenced to the pit edge, were as follows:

1. 0 to 1,000 ft;
2. greater than 1,000 to 2,000 ft;
3. greater than 2,000 to 3,500 ft; and
4. greater than 3,500 to 10,000 ft (within Area 1).

The following is a discussion of the justification for the use of the analog data based upon comparisons of the existing regional and site-specific geologic data (e.g., bedrock faults, bedrock joint systems, bedrock topography, surficial deposits hydraulic conductivities), site-specific engineering controls (e.g., Category 1 Stockpile surface and groundwater seepage containment system), and the geologic settings of the analog information sites and the Mine Site (PolyMet 2011b; PolyMet 2015b). Analog data were used instead of a model such as MODFLOW since MODFLOW could not practically be used to estimate potential indirect wetland effects, due to complex mixes of bedrock, surficial deposits, and wetland soils at the Mine Site and therefore could not be used to accurately assess the potential effect of pit dewatering on wetlands (PolyMet 2015b).

The Mine Site contains localized heterogeneous vertical and horizontal hydraulic conductivities within each soil unit, which also makes the MODFLOW model less effective. Hydraulic conductivities between the different deposits range from 0.00026 to 31 ft/day (PolyMet 2015b). Because there is such a wide range in hydraulic conductivity within the natural geologic formations at the Mine Site, each model layer would contain widely variable hydraulic conductivities. Thus, it was not feasible to model the expected effects of mine dewatering on wetlands in a meaningful way. Prior to conducting the analysis to identify indirect wetland effects resulting from changes in hydrology, bog wetlands within and surrounding the Mine Site were reclassified as either ombrotrophic or somewhat minerotrophic. This distinction is important because ombrotrophic bogs would be less likely to be affected by groundwater drawdowns associated with proposed mining operations, whereas more minerotrophic bogs would have a higher likelihood of being affected (Eggers 2011a, 2015).

A discussion of potential indirect wetland hydrology drawdown effects at the Mine Site, including conversion to other wetland community types, a change in vegetation without a change in community type, conversion to uplands, or other effects is provided below in Section 5.2.3.2.2. These effects were categorized by applying the Eggers and Reed (1997, 2014) wetland classification system to each wetland type based on wetland sensitivity class tables for falling groundwater tables that were developed for a previously proposed mine project in Wisconsin (PolyMet 2015b).

<u>Potential Indirect Wetland Effects Resulting from Changes in Hydrology at the Plant Site</u>

Potential indirect wetland effects from hydrological changes were evaluated based on estimates of groundwater upwelling and resulting surface water flow in wetlands and/or groundwater drawdown near the water containment system that would surround the Plant Site. An estimate of potential indirect wetland effects (wetland acres by wetland type, and type of effect) from hydrologic changes resulting from the containment system was determined as follows:

1. The amount of Plant Site groundwater seepage water that would bypass the containment system and emerge in surface water features, including wetlands, downgradient of the Tailings Basin was quantified. The quantity of seepage evading the containment system was confirmed using MODFLOW and incorporated into the GoldSim model as a deterministic value.
2. All wetlands (type, acreage) within the surficial aquifer groundwater flowpaths downgradient of the Plant Site were identified within the boundaries used in the water quality modeling (as shown in the Groundwater IAP Summary document [MDNR et al. 2011]).
3. Using the wetlands identified in step 2, wetlands were categorized into minerotrophic (groundwater-fed) and ombrotrophic (precipitation-fed) wetlands using guidance in the Corps Memorandum (CEMVP-OP-R) *Distinguishing Between Bogs That Are Entirely Precipitation Driven Versus Those with Some Degree of Mineral Inputs from Groundwater and/or Surface Water Runoff* (Eggers 2011b) and evaluating the potential for indirect effects resulting from construction of the water containment system.

A discussion regarding potential indirect wetland hydrology effects at the Plant Site, including conversion to other wetland community types, a change in vegetation without a change in community type, conversion to uplands, or other effects is provided below in Section 5.2.3.2.4. These effects were categorized by applying the Eggers and Reed (1997, 2014) wetland classification system to each wetland type based on the wetland sensitivity class tables for rising groundwater tables that were developed for a previously proposed mine project in Wisconsin (PolyMet 2015b).

Potential Indirect Effects on Wetlands Abutting the Partridge River and Four Creeks

An estimate of potential indirect wetland effects (wetland acres by wetland type and type of effect) was determined for wetlands abutting the following:

- the Partridge River, as a result of changes in river flow resulting from the NorthMet Project Proposed Action (during operation and post-closure); and
- the three creeks north and west of the Plant Site (Trimble Creek, Mud Lake Creek, and Unnamed Creek) and Second Creek south of the Plant Site, as a result of changes in streamflow resulting from operation of the Plant Site and containment system.

Changes in river and creek flow were estimated using mass balance techniques.

Potential Indirect Wetland Effects Resulting from Water Quality Changes

A screening analysis for depositional effects was conducted that estimated potential annual deposition of dust, metals, and sulfur to wetlands within and adjacent to the Mine Site and Plant Site from fugitive dust through air dispersion/deposition modeling (AERMOD). Emission rates and particle size distributions were based on total particulate matter. The estimated deposition from fugitive dust emissions was used to identify wetlands that have the potential for water quality changes (e.g., potential for water chemistry changes related to sulfide dust deposition). The estimated deposition from fugitive dust emissions was used to identify a threshold for a negative effect on vegetation. The estimated inputs of the dust, metals, and sulfur to wetlands were evaluated for significance to potential changes in water quality. The receptors of interest were the wetlands that were not identified as directly impacted.

Leakage from stockpiles at the Mine Site was evaluated to determine if wetlands would be impacted. The amount of stockpile leakage water that would potentially discharge to surface waters and wetlands downgradient of the stockpiles was based on the water quality modeling (see Section 5.2.2). Wetlands within the surficial aquifer groundwater flowpaths from mine features were identified and then further characterized into minerotrophic and ombrotrophic wetlands per Eggers 2011a. Wetlands were then evaluated to determine the potential for indirect effects based on potential water quality changes from the mine features.

Tailings Basin groundwater seepage at the Plant Site was evaluated to determine if wetlands would be impacted. The chemistry from the Tailings Basin groundwater seepage based on the water quality modeling (see Section 5.2.2) was determined. Wetlands within the downgradient zone were identified and then further characterized into minerotrophic and ombrotrophic wetlands (Eggers 2011a). Wetlands were then evaluated to determine the potential for indirect effects based on potential water quality changes from the Tailings Basin.

Wetlands within and adjacent to the Transportation and Utility Corridor were assessed to determine if indirect wetland effects would occur to wetlands as a result of water quality changes. The following was evaluated: the potential release of dust from railcars transporting ore from the Mine Site to the Plant Site, use of Dunka Road, and product shipping at the Plant Site.

5.2.3.2 NorthMet Project Proposed Action

The NorthMet Project Proposed Action would result in both direct and indirect effects. This section describes effects within the NorthMet Project area and provides a summary of wetland effects. Estimates of both direct and indirect wetland effects have changed during the EIS process as the result of refined analysis and changes in project design. The effects identified in this FEIS are based on the most current information available and may differ from those identified in prior reports. Avoidance, minimization, mitigation, and monitoring measures for the NorthMet Project Proposed Action are discussed in Section 5.2.3.3.

5.2.3.2.1 Mine Site and Transportation and Utility Corridor Direct Wetland Impacts

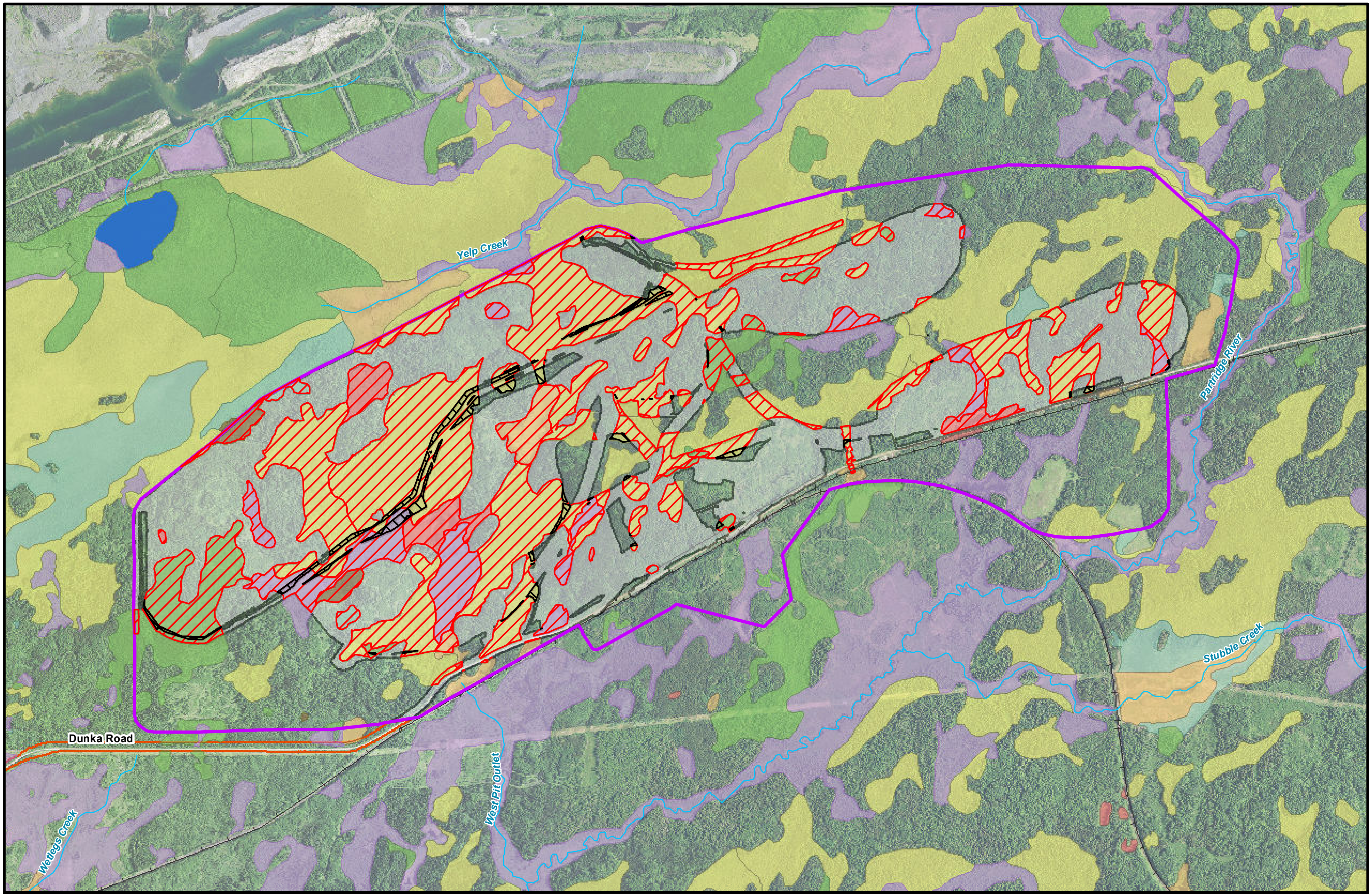
Direct wetland impacts would result from the following Mite Site and Transportation and Utility Corridor components: construction and/or installation of the mine pits, Category 1 Stockpile, Category 2/3 Stockpile, Category 4 Stockpile, Overburden Storage and Laydown Area, haul roads, rail transfer loadout, WWTF, perimeter dike, culverts, groundwater discharge pipe, surface and groundwater seepage containment system, stormwater collection ditches and ponds, CPS, process water pipes and ponds, Treated Water Pipeline, transmission lines, and Dunka Road upgrades. The Mine Site features would result in 758.2 acres of directly impacted wetlands (see Figure 5.2.3-1). Table 5.2.3-1 summarizes the directly impacted wetlands within the Mine Site by community type while Table 5.2.3-2 identifies the activity that causes the impacts expected at the Mine Site. Three wetland types comprise 89 percent of the expected wetland impacts in the Mine Site, including 508.3 acres of coniferous bog (67 percent), 97.8 acres of shrub swamp (13 percent), and 70.3 acres of coniferous swamp (9 percent). Direct impacts would be caused by fill (10 percent), excavation (12 percent), or a combination of fill and excavation (78 percent). The majority of the wetlands (99 percent) that would be directly impacted wetlands are rated high quality, while 1 percent are rated as moderate quality (PolyMet 2015b).

Table 5.2.3-1 Total Projected Direct Wetland Impacts at the Mine Site and the Transportation and Utility Corridor

	Directly Impacted Wetlands at Mine Site			Directly Impacted Wetlands at Transportation and Utility Corridor		
Eggers and Reed Class[1]	**Acres**	**%**	**No.**	**Acres**	**%**	**No.**
Coniferous bog	508.3	67	22	0.9	12	2
Coniferous swamp	70.3	9	7	1.6	22	7
Deep marsh	0.1	<1	1	0.0	0	0
Hardwood swamp	12.5	2	2	0.0	0	0
Open bog	7.6	1	4	0.0	0	0
Open Water (includes shallow, open water, and lakes)	0.0	0	0	0.0	0	0
Sedge/wet meadow	38.2	5	5	0.0	0	0
Shallow marsh	23.4	3	6	0.6	8	3
Shrub swamp (includes alder thicket and shrub-carr)	97.8	13	12	4.1	57	13
Total Direct Impacts	758.2	100	59	7.2	100	25

Source: PolyMet 2015b.

[1] Eggers and Reed 1997, 2014.



Mine Site
Transportation and Utility Corridor
Directly Impacted Wetland
Proposed Disturbed Area
Stream/River
Fragmented Wetland

Eggers & Reed Wetland Types

Coniferous Bog
Coniferous Swamp
Hardwood Swamp
Deep Marsh & Shallow Marsh
Open Bog
Sedge Meadow & Wet Meadow
Shrub Swamps (Alder Thicket & Shrub-Carr)
Shallow, Open Water & Lake

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N W E S

0 500 1,000 2,000 3,000 Feet

Figure 5.2.3-1

Mine Site Direct Wetland Impacts and Fragmentation

NorthMet Mining Project and Land Exchange PFEIS

Minnesota

June 2015

472 -Page Intentionally Left Blank-

Table 5.2.3-2 Type of Projected Direct Wetland Impacts at the Mine Site and the Transportation and Utility Corridor

Type of Effect	Directly Impacted Wetlands at Mine Site			Directly Impacted Wetlands at Transportation and Utility Corridor		
	Acres	**%**	**No.**	**Acres**	**%**	**No.**
Fill	77.3	10	23	7.2	100	25
Excavation	87.9	12	14	0.0	0	0
Fill and Excavation	593.0	78	22	0.0	0	0
Total Direct Impacts	758.2	100	59	7.2	100	25

Source: PolyMet 2015b.

PolyMet proposes to minimize wetland impacts by placing waste rock back into the East Pit and Central Pit after year 11, thereby reducing the need for additional surface stockpile areas that would otherwise affect wetlands. In addition, PolyMet proposes to combine the saturated overburden and temporary stockpiles, and leave only unsaturated overburden and peat in the Overburden Storage and Laydown Area. By doing so, the footprint of these stockpiles would be reduced, resulting in fewer direct wetland impacts.

In approximately year 52, flooding to the West Pit would be complete. Discharge from the West Pit would be pumped to the WWTF for treatment. The WWTF would then be upgraded to include RO treatment to achieve a 9 mg/L sulfate effluent, which would then be discharged into a wetland and finally through the West Pit Outlet Creek to the Partridge River. The direct impacts on this wetland have been included within the wetland effect direct totals in Table 5.2.3-1.

Construction activities within the Transportation and Utility Corridor would affect 7.2 acres of wetlands, all of which would be filled. Table 5.2.3-1 summarizes the directly impacted wetlands within the Transportation and Utility Corridor by community type while Table 5.2.3-2 identifies the activity that causes the impacts expected within the Transportation and Utility Corridor. The wetland types that would be directly impacted include shrub swamps (57 percent), coniferous swamps (22 percent), coniferous bogs (12 percent), and shallow marshes (8 percent) (see Figure 5.2.3-2). All of the wetlands to be directly impacted are rated as high quality. The rail spur was designed to avoid wetlands to the extent possible within the requirements for rail construction based on a portion of the spur being located on an existing rail alignment.

5.2.3.2.2 Mine Site and Transportation and Utility Corridor Indirect Wetland Effects

The potential indirect wetland effects were assessed by identifying wetlands in Area 1 within 500-ft increments beginning at the edge of the mine pits and extending to a maximum distance of 10,000 ft (see Figure 5.2.3-3) (PolyMet 2015b). The area of evaluation for the Mine Site potential indirect wetlands effects included only wetlands within Area 1 where wetland type information had been developed and does not include the directly impacted wetlands.

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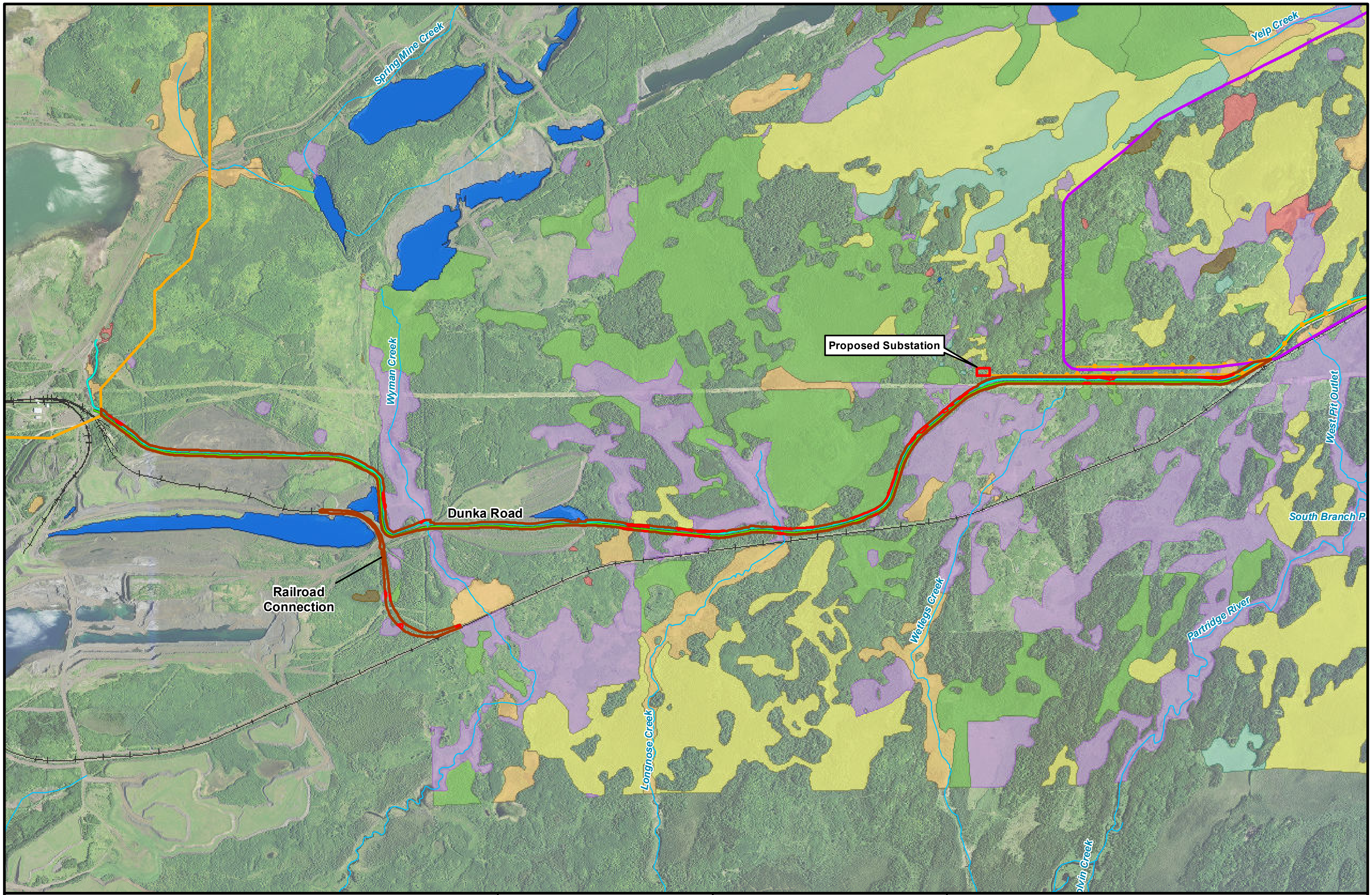

Transportation and Utility Corridor
Directly Affected Wetland
Proposed Transmission Line
Treated Water Pipeline
Dunka Road
Mine Site
Plant Site
Existing Railroad
Stream/River

Eggers & Reed Wetland Types

Coniferous Bog
Coniferous Swamp
Deep Marsh & Shallow Marsh
Hardwood Swamp
Open Bog
Sedge Meadow & Wet Meadow
Shrub Swamps (Alder Thicket & Shrub-Carr)
Shallow, Open Water & Lake

Minnesota Department of Natural Resources

US Army Corps of Engineers
St. Paul District

Forest Service

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N S W E

0 1,000 2,000 4,000
Feet

Figure 5.2.3-2

Transportation and Utility Corridor Wetlands and Direct Wetland Impacts

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Minnesota

June 2015

505

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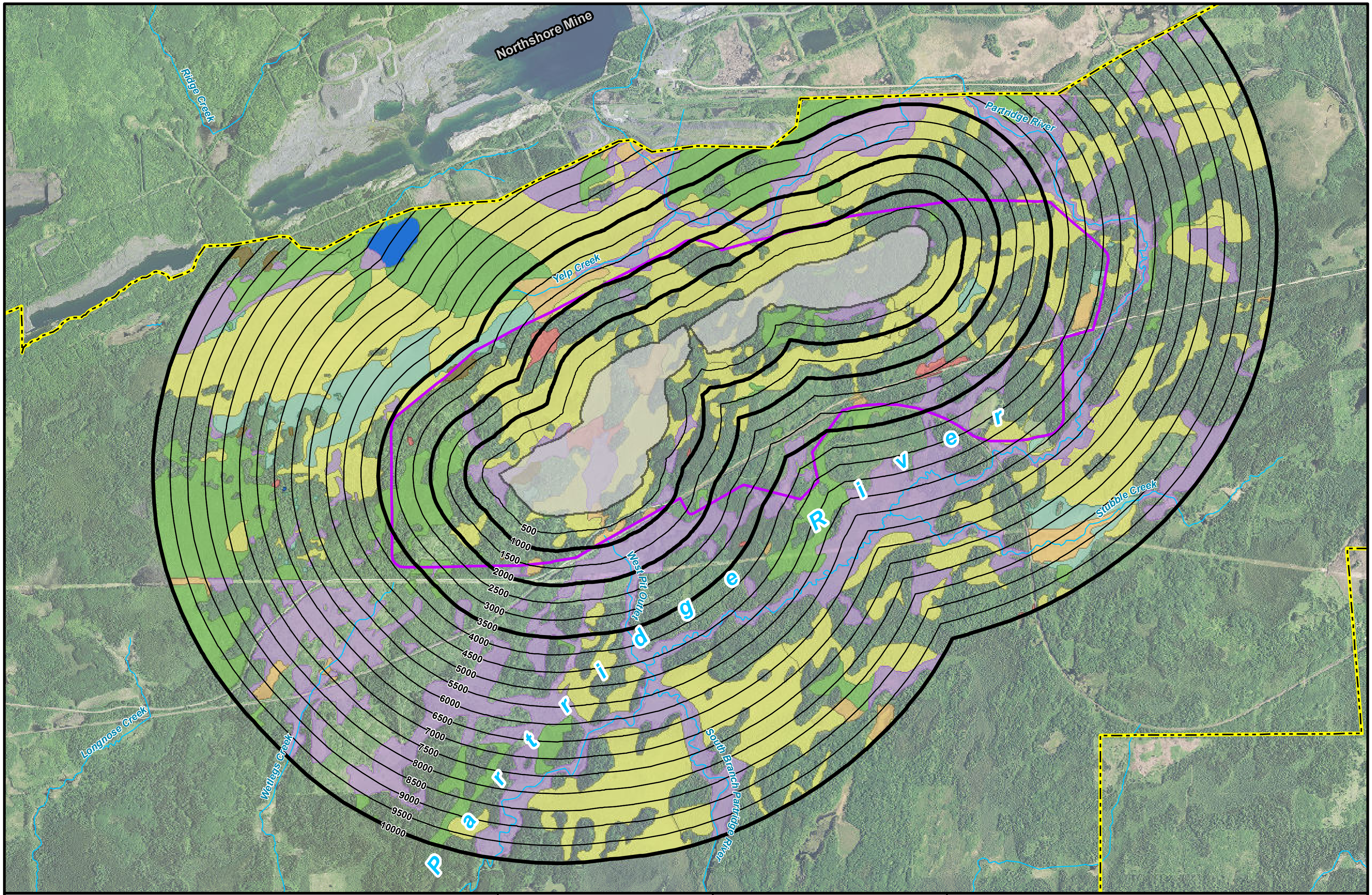

Mine Site
500 ft Increments
Area 1
Mine Pit
Stream/River

Eggers & Reed Wetland Types

- Coniferous Bog
- Coniferous Swamp
- Open bog
- Deep Marsh & Shallow Marsh
- Hardwood Swamp
- Sedge Meadow & Wet Meadow
- Shrub Swamps (Alder Thicket & Shrub-Carr)
- Shallow, Open Water & Lake

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N S W E

0 0.25 0.5 1 Miles

Figure 5.2.3-3

Wetlands within 500 ft Increments at the Mine Site

NorthMet Mining Project and Land Exchange PFEIS

Minnesota

June 2015

507

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Wetland Fragmentation

Construction of the Mine Site features (e.g., open pits, stockpiles, haul roads, etc.) would result in 26.4 acres of wetland fragments (see Figure 5.2.3-1). Wetlands were determined to be fragmented and their associated remaining acreage included as a potential indirect wetland effect if they were small remnants of a directly impacted wetland located between Mine Site features (e.g., in the area between the Category 1 Stockpile and the West Pit or along Dunka Road or the Railroad Connection Corridor) and their functions were lost. The majority of the wetland fragments in the Mine Site would consist of coniferous bog (79 percent), alder thickets (14 percent), coniferous swamp (7 percent), and sedge/wet meadow (less than 1 percent). In addition, a 0.01 acre alder thicket would become fragmented just outside of the Transportation and Utility Corridor near Dunka Road but within Area 1 (PolyMet 2015b). No wetlands would become fragmented along the Railroad Corridor. The wetland fragments that are expected to maintain their functions would be included in the wetland hydrology and vegetation monitoring plan that would be developed and implemented for the NorthMet Project Proposed Action.

Changes in Hydrology Due to Change in Watershed Area

The potential for indirect effects to wetland acreage due to change in watershed area was assessed by evaluating the change in watershed area per acre of wetland (PolyMet 2015b). Watersheds were defined for each wetland within the Mine Site boundary, as well as wetlands outside the Mine Site with a watershed area that may be affected by NorthMet Project area features. Wetland and watershed areas were determined for the following conditions: existing conditions, during operations when the maximum amount of watershed has been removed (i.e., maximum NorthMet Project Proposed Action extent), and at closure and long-term maintenance.

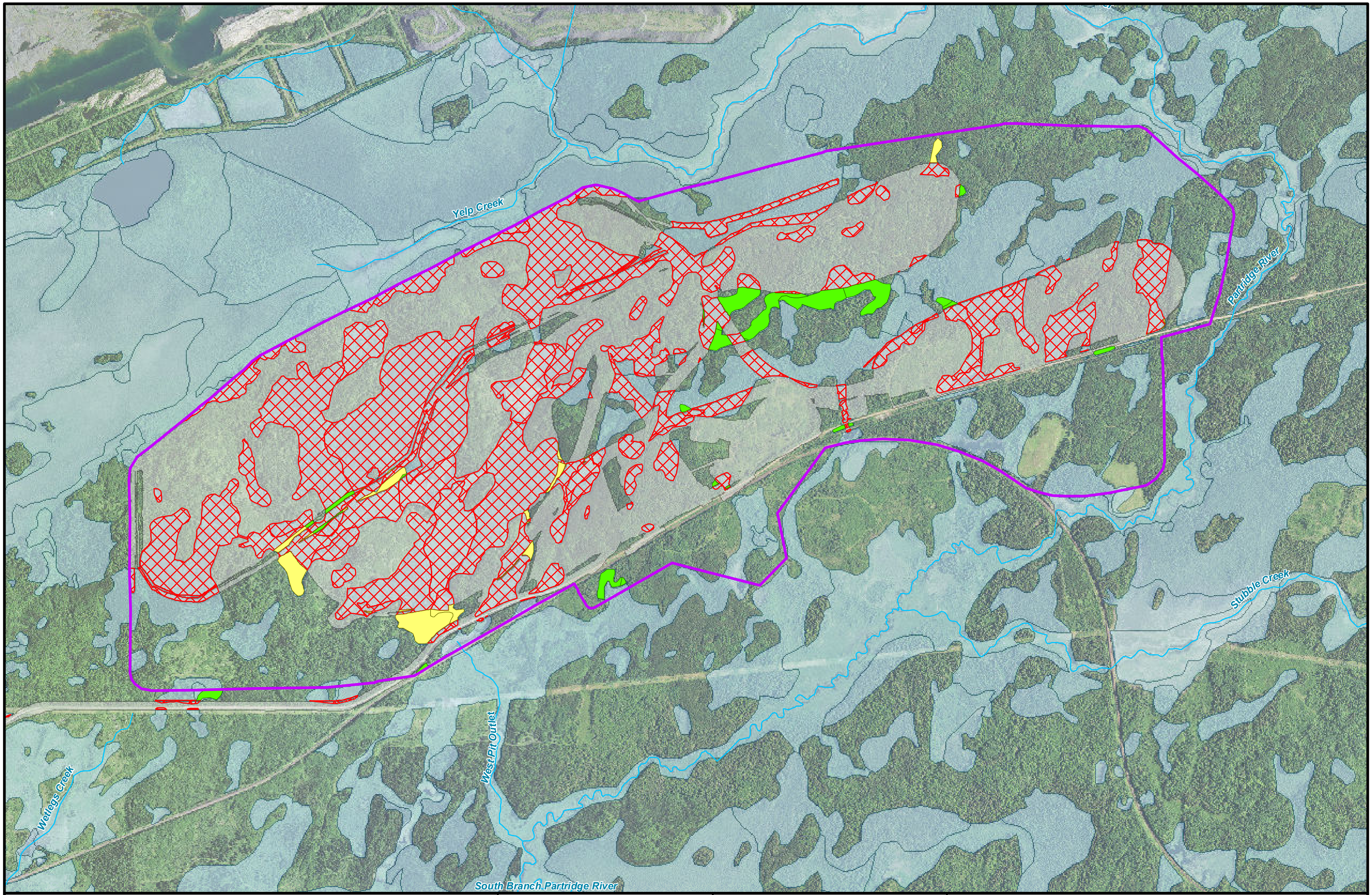
The analysis was completed by first defining the watershed area (i.e., the sum of upland area and wetland area). For each wetland in the Mine Site, GIS was used to determine the upland area (acres) and wetland area (acres) within each watershed area (acres). Using these acreages, the percentage of a wetland within its watershed was calculated. In addition, the tributary acres per wetland acre were determined as a proportion of the watershed area to wetland area; the equivalent watershed yield (acre-feet per year) was determined for the existing, maximum operational extent, and closure and long-term maintenance conditions (the average net precipitation rate is 11.77 inches per year); and the change in the equivalent yield (inches per year) estimated over the life of the NorthMet Project Proposed Action was evaluated relative to existing conditions equivalent yield to calculate the maximum percent change in yield (PolyMet 2011b; PolyMet 2015b).

The existing conditions include wetlands that represent the existing and relatively undisturbed conditions at the Mine Site. The analysis included wetlands and associated watersheds that are partially or completely within the Mine Site boundary. There are a total of 3,325 acres of wetlands within 6,287 acres of watershed, which results in approximately 53 percent of the analysis area covered by wetlands (PolyMet 2015b).

During operations, some wetlands and watershed areas may be directly impacted by the NorthMet Project Proposed Action and would no longer be considered as a tributary area to the wetland. Consequently, the amount of water potentially contributed by the watershed to support the hydrology of the remaining wetlands may also change.

There would be 20 wetlands, potentially indirectly affected, displaying an increase or decrease of greater than 20 percent equivalent yield. Ombrotrophic coniferous bogs and open bogs were not included in the total wetland acreage because their hydrology is solely supported by precipitation and may contain groundwater flowpaths. The hydrology of the ombrotrophic bogs is not dependent on the size of the watershed. There would be 35 acres (11 wetlands) that would have the potential to experience an increase in yield per wetland acre of greater than 20 percent, and 15 acres (9 wetlands) that would likely experience a decrease in yield per wetland acre in excess of 20 percent (see Figure 5.2.3-4). The 49.4 acres of potentially indirectly affected wetland types include alder thickets (52 percent), coniferous swamp (34 percent), minerotrophic coniferous bog (8 percent), shallow marsh (6 percent), and sedge/wet meadow (less than 1 percent) (PolyMet 2015b).

During reclamation, a portion of the wetlands and wetland watersheds within the Mine Site would be restored to the existing condition.



Mine Site

Disturbed Area

Directly Affected Wetland

Stream/River

Wetlands

Potential Indirect Wetland Effects

Decrease in Yield per Wetland Acre of Greater Than 20%

Increase in Yield per Wetland Acre of Greater Than 20%

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N W E S

0 500 1,000 2,000 3,000 Feet

Figure 5.2.3-4

Wetlands Potentially Indirectly Affected by Change in Watershed Area

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Minnesota

June 2015

564

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Changes in Wetland Hydrology Due to Surficial Aquifer Drawdown

The geologic and hydrogeologic settings of the Mine Site and the analog sites are fairly similar with a thin veneer of heterogeneous surficial deposits underlain by fractured bedrock. The hydraulic conductivities of the surficial deposits and bedrock are lower at the Mine Site than at the analog sites, and so it is expected that the wetland impact zones would likely overestimate the extent of potential wetland effects. Because of the thin, discontinuous nature of the surficial deposits at the Mine Site, drawdown effects are expected to be more localized at the Mine Site than at the analog sites. Additionally, the numerous bedrock outcrops present at the Mine Site are expected to act as barriers to flow in the unconsolidated aquifer, thereby limiting the area of influence of the mine pits. Whereas, the analog sites have fewer or no bedrock outcrops compared to the Mine Site. Last, the presence of the Partridge River approximately 4,000 to 6,000 ft south (downstream) of the mine pits is likely to act as a natural barrier to the expansion of the cone of depression within the surficial aquifer from 3,500 to 10,000 ft from the pit (PolyMet 2015b).

Open and coniferous bog wetlands within and surrounding the Mine Site were subcategorized as either ombrotrophic (hydrology and mineral inputs solely from direct precipitation) or minerotrophic (some degree of mineral inputs from groundwater and/or surface water runoff) to determine if the bogs would be affected by groundwater drawdown. Due to the potential connection to groundwater flowpaths, ombrotrophic bogs would have a low likelihood of being affected by groundwater drawdowns associated with proposed mining operations. Similarly, more minerotrophic bogs would have also had a low likelihood of being affected (Eggers 2015a). Using a conservative approach for the analysis (i.e., one that errs on the side of estimating greater wetland impacts), all bog communities within 0-1,000 ft from the edge of the mine pits were categorized as Low Likelihood of wetland hydrology impact (PolyMet 2015b).

The potential indirect wetland effect from surficial aquifer drawdown was based on the analog impact zone with the greater potential drawdown (zone closer to the open pit mine) for wetlands that lie on both sides of the analog distance boundary. Wetlands were identified within four analog impact zones (0-1,000 ft, >1,000-2,000 ft, >2,000-3,500 ft, and >3,500-10,000 ft) from the edge of the mine pits within Area 1 (see Figure 5.2.3-5).

The change in wetland hydrology from groundwater drawdown at the Mines Site was assessed by two different methodologies; therefore, total potential indirect wetland effects were provided based on both approaches. The two approaches are as follows:

- **Wetlands Crossing Analog Zones**: Wetlands that were located within multiple analog impact zones were included in the analog impact zone closest to the edge of the mine pits. The likelihood of wetland hydrology impact was categorized as High, Medium, Low, and No Impact for each analog impact zones.
- **Wetlands within Analog Zones**: Wetlands that were located within multiple analog impact zones were split along zone edges and acreages were calculated by zone. As a result, the acreage for wetlands crossing zone edges was split among multiple zones, rather than included in the analog impact zone that was closest to the edge of the mine pits. The likelihood of wetland hydrology impact was categorized as High, Medium, Low, and No Impact for each analog impact zones.

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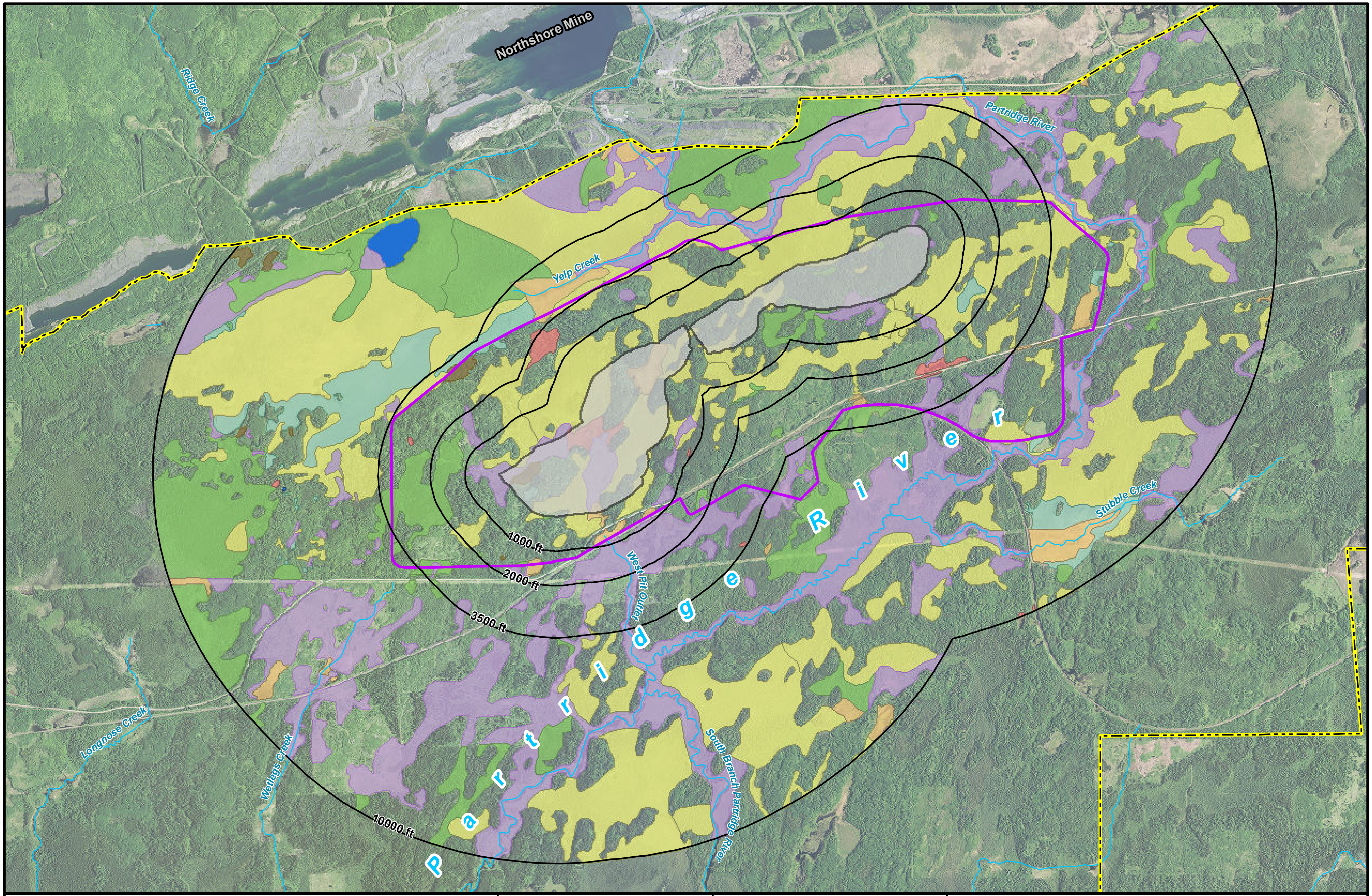

Mine Site
Analog Zones (feet)
Area 1
Mine Pit
Stream/River

Eggers & Reed Wetland Types

- Coniferous Bog
- Coniferous Swamp
- Open bog
- Deep Marsh & Shallow Marsh
- Hardwood Swamp
- Sedge Meadow & Wet Meadow
- Shrub Swamps (Alder Thicket & Shrub-Carr)
- Shallow, Open Water & Lake

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N W E S

0 0.25 0.5 1 Miles

Figure 5.2.3-5
Wetlands Located within the Four Analog Zones at the Mine Site
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June 2015

609

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Based on the wetlands crossing analog zones analysis approach, there would be 1,328.0 acres of wetlands in the 0-1,000 ft zone, 618.6 acres in the >1,000-2,000 ft zone, 1,162.0 acres of wetlands in the >2,000-3,500 ft zone, and 2,718.3 acres of wetlands in the >3,500-10,000 ft zone beyond the edge of the pits (see Table 5.2.3-3; Figures 5.2.3-6 through 5.2.3-10) (PolyMet 2015b).

Table 5.2.3-3 Wetlands Crossing Analog Impact Zones Resulting from Potential Changes in Hydrology

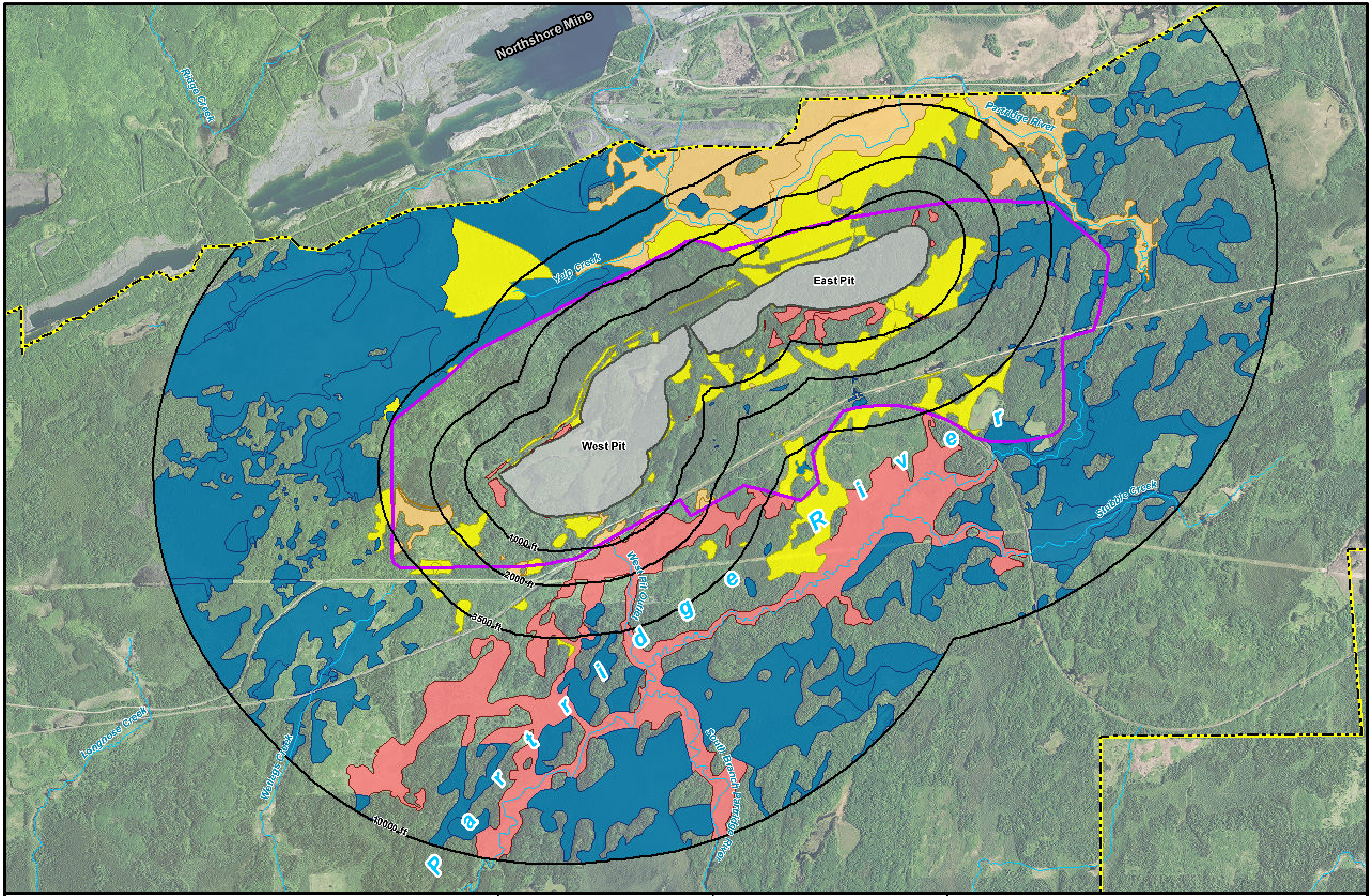
Likelihood of Wetland Hydrology Effect Based on Wetland Type for Each Analog Distance	Wetland Area (acres) within each Analog Increement				
	0-1,000 ft	1,000-2,000 ft	2,000-3,500 ft	3,500-10,000 ft	Eggers and Reed Wetland Community
0 – 1,000 ft					
High Likelihood	866.9	-	-	-	Coniferous swamp, sedge meadow, and alder thicket
Moderate Likelihood	8.3	-	-	-	Deep marsh and shallow marsh
Low Likelihood	452.8	-	-	-	Minerotrophic and ombrotrophic coniferous bog
No Effect	-	-	-	-	No wetland types
1,000 – 2,000 ft					
Moderate Likelihood	-	522.4	-	-	Coniferous swamp, hardwood swamp, shrub-carr, and alder thicket
Low Likelihood	-	4.1	-	-	Shallow marsh
No Effect	-	92.1	-	-	Minerotrophic and ombrotrophic coniferous bog and open bog
2,000 – 3,500 ft					
Low Likelihood	-	-	293.1	-	Coniferous swamp, hardwood swamp, sedge/wet meadow, shrub-carr, and alder thicket
No Effect	-	-	868.9	-	Minerotrophic and ombrotrophic coniferous bog and open bog and shallow marsh
3,500 – 10,000 ft					
No Effect	-	-	-	2,718.3	All wetland types
Total Acres of Wetland	**1,328.0**	**618.6**	**1,162.0**	**2,718.3**	

Source: PolyMet 2015b

Under this methodology approach, the likelihood of wetland hydrology effects would be as follows: no effect on 3,679.3 acres of wetlands (63 percent); low likelihood to 750.0 acres of wetlands (13 percent); moderate likelihood to 530.7 acres of wetlands (9 percent); and high likelihood to 866.9 acres of wetlands (15 percent) (see Table 5.2.3-3). Within 0-10,000 ft from the edge of the mine pits, wetland types with a high likelihood of wetland hydrology effects include shrub swamps (847.8 acres), coniferous swamp (18.9 acres), and sedge/wet meadow (less than 1 acre); with a moderate likelihood include shrub swamp (327.2 acres), coniferous swamp (194.9 acres), deep marsh (4.9 acres), shallow marsh (3.4 acres), and hardwood swamp (less than 1 acre); and with a low likelihood include coniferous bog (452.8 acres) coniferous swamp (222.7 acres), shrub swamps (67.8 acres), shallow marsh (4.1 acres), sedge/wet meadow (1.7 acres), and hardwood swamp (less than 1 acre) (PolyMet 2015b).

The wetlands categorized as high likelihood are dominated by one alder thicket (823.7 acres) that has approximately 4 acres (less than 1 percent) within the 0-1,000 ft analog impact zone. The remainder of this wetland (more than 99 percent) is located more than 1,000 ft away from the edge of the mine pits and extends out to the edge of Area 1 (see Figure 5.2.3-6).

Based on the analog data, hydrologic effects to peat wetlands would only be observed to occur within 1,000 ft from the edge of the mine pits. Therefore, wetlands were categorized within the analog impact zones using an alternate method to determine the likelihood of wetland hydrology effects as described below.



Mine Site
Mine Pit
Analog Zones (feet)
Area 1
Stream/River

Likelihood of Wetland Hydrology Effect
High Likelihood
Moderate Likelihood
Low Likelihood
No Effect

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N W E S

0 0.25 0.5 1 Miles

Figure 5.2.3-6
Wetlands Crossing Analog
Zones - 0-10,000 ft of Edge of Mine Pits
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June 2015

638

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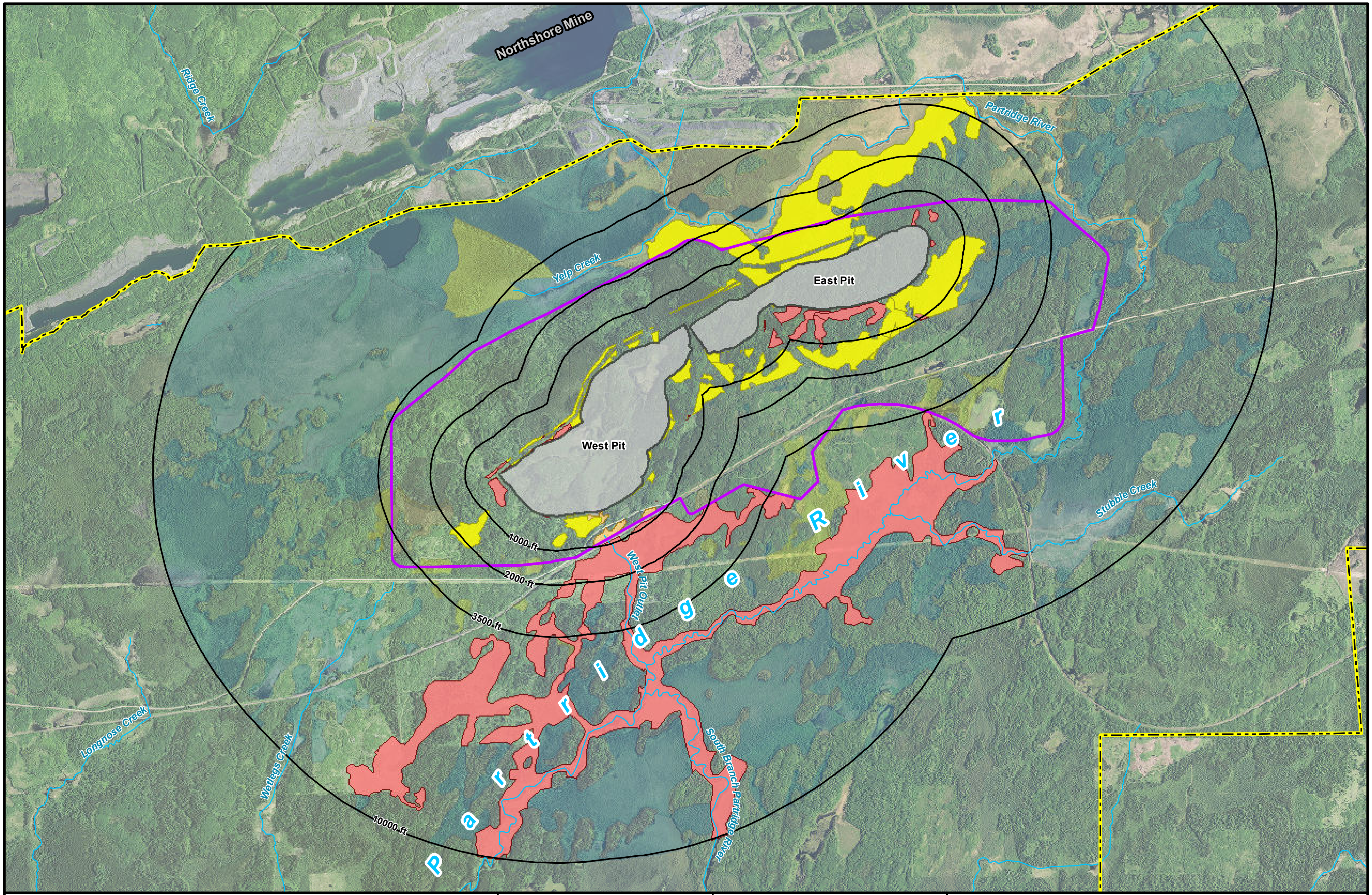

Mine Site
Mine Pit
Analog Zones (feet)
Area 1
Stream/River

Likelihood of Wetland Hydrology Effect
High Likelihood
Moderate Likelihood
Low Likelihood
No Effect

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N W E S

0 0.25 0.5 1 Miles

Figure 5.2.3-7
Wetlands Crossing Analog Zones - 0-1,000 ft of Edge of Mine Pits
NorthMet Mining Project and Land Exchange PFEIS
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June 2015

640

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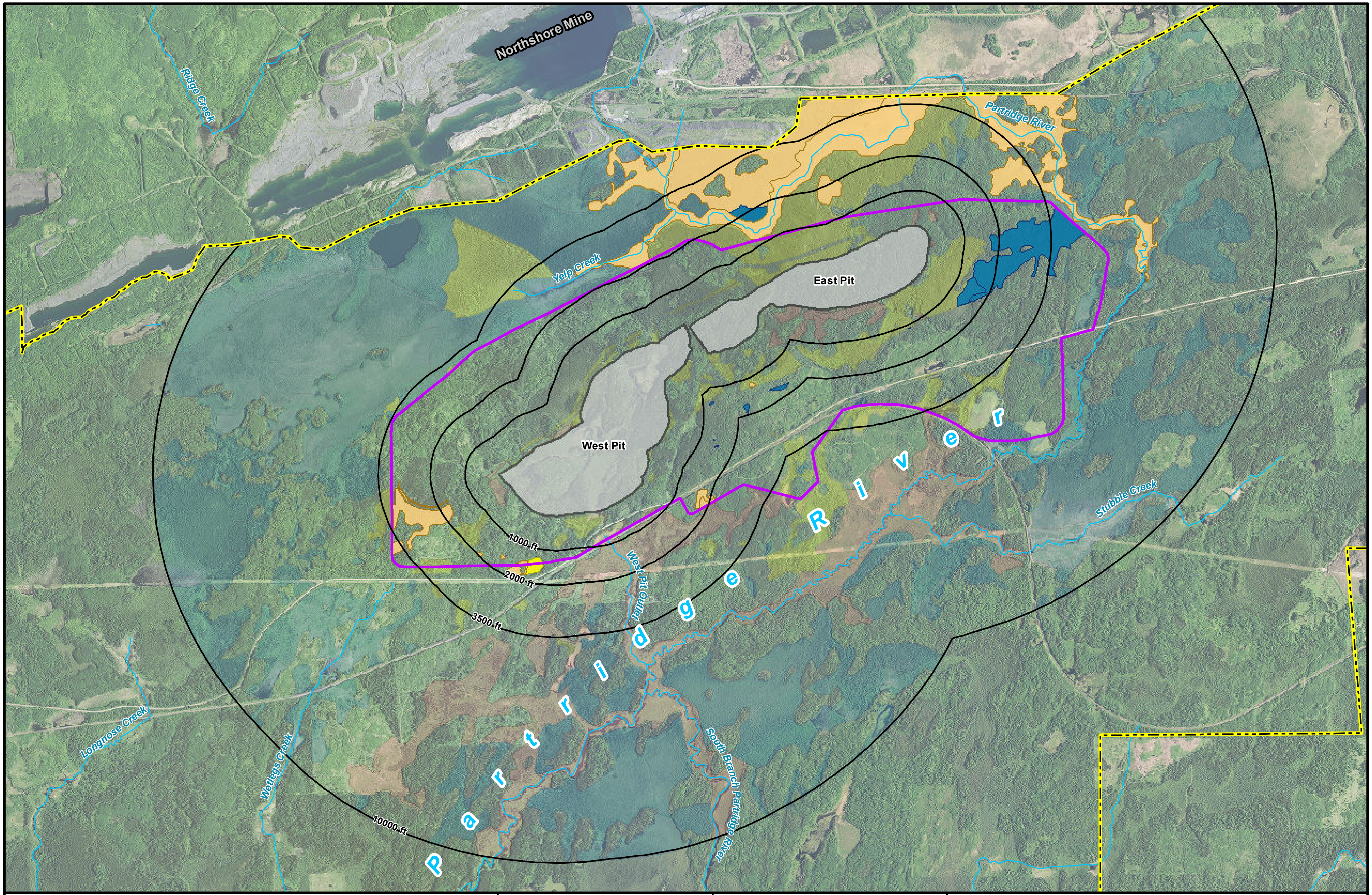

Mine Site
Mine Pit
Analog Zones (feet)
Area 1
Stream/River

Likelihood of Wetland Hydrology Effect
High Likelihood
Moderate Likelihood
Low Likelihood
No Effect

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0 0.25 0.5 1 Miles

Figure 5.2.3-8
Wetlands Crossing Analog Zones - >1,000-2,000 ft of Edge of Mine Pits
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642

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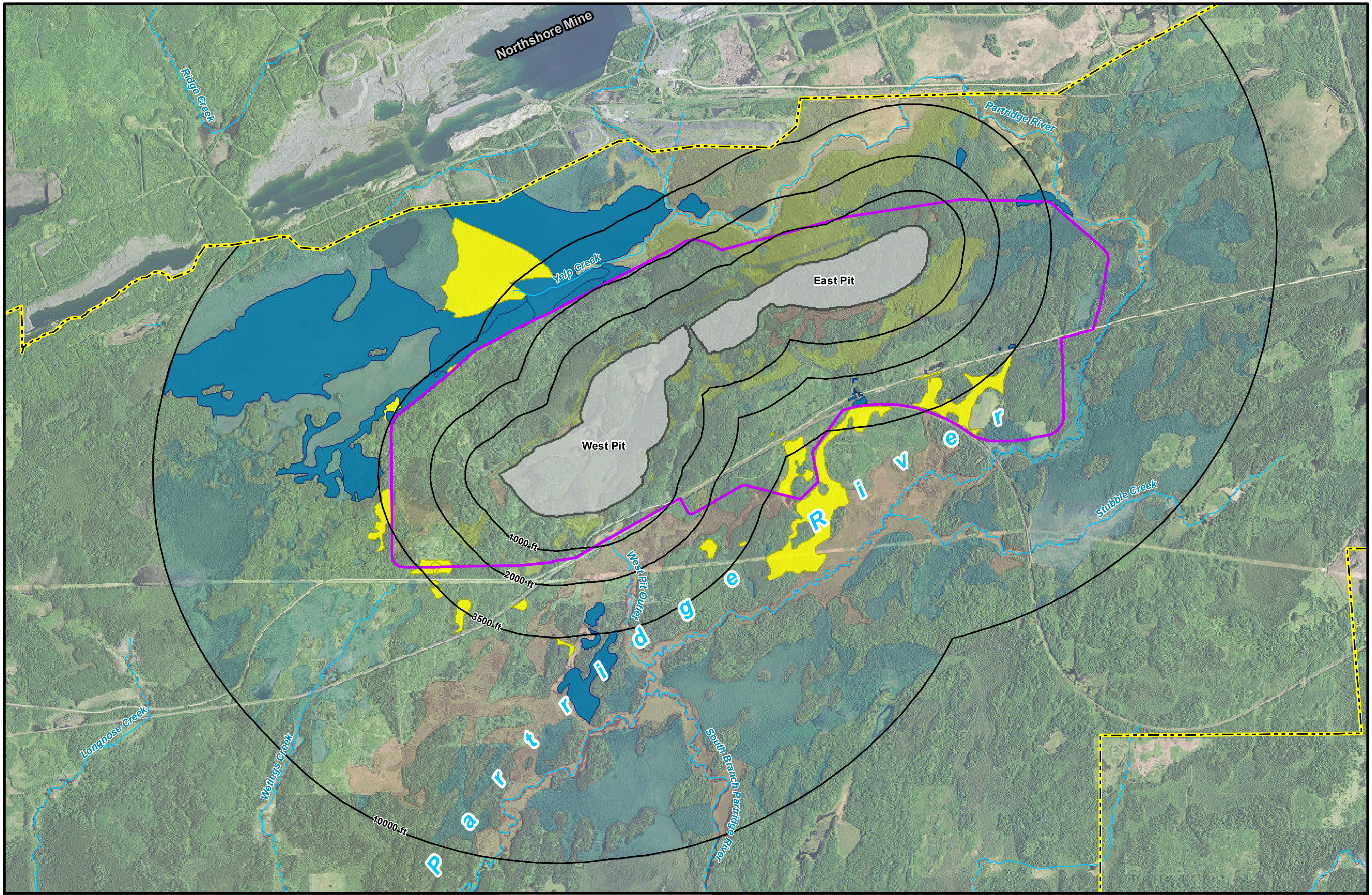

Mine Site
Mine Pit
Analog Zones (feet)
Area 1
Stream/River

Likelihood of Wetland Hydrology Effect
High Likelihood
Moderate Likelihood
Low Likelihood
No Effect

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N W E S

0 0.25 0.5 1 Miles

Figure 5.2.3-9
Wetlands Crossing Analog Zones - >2,000-3,500 ft of Edge of Mine Pits
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June 2015

644

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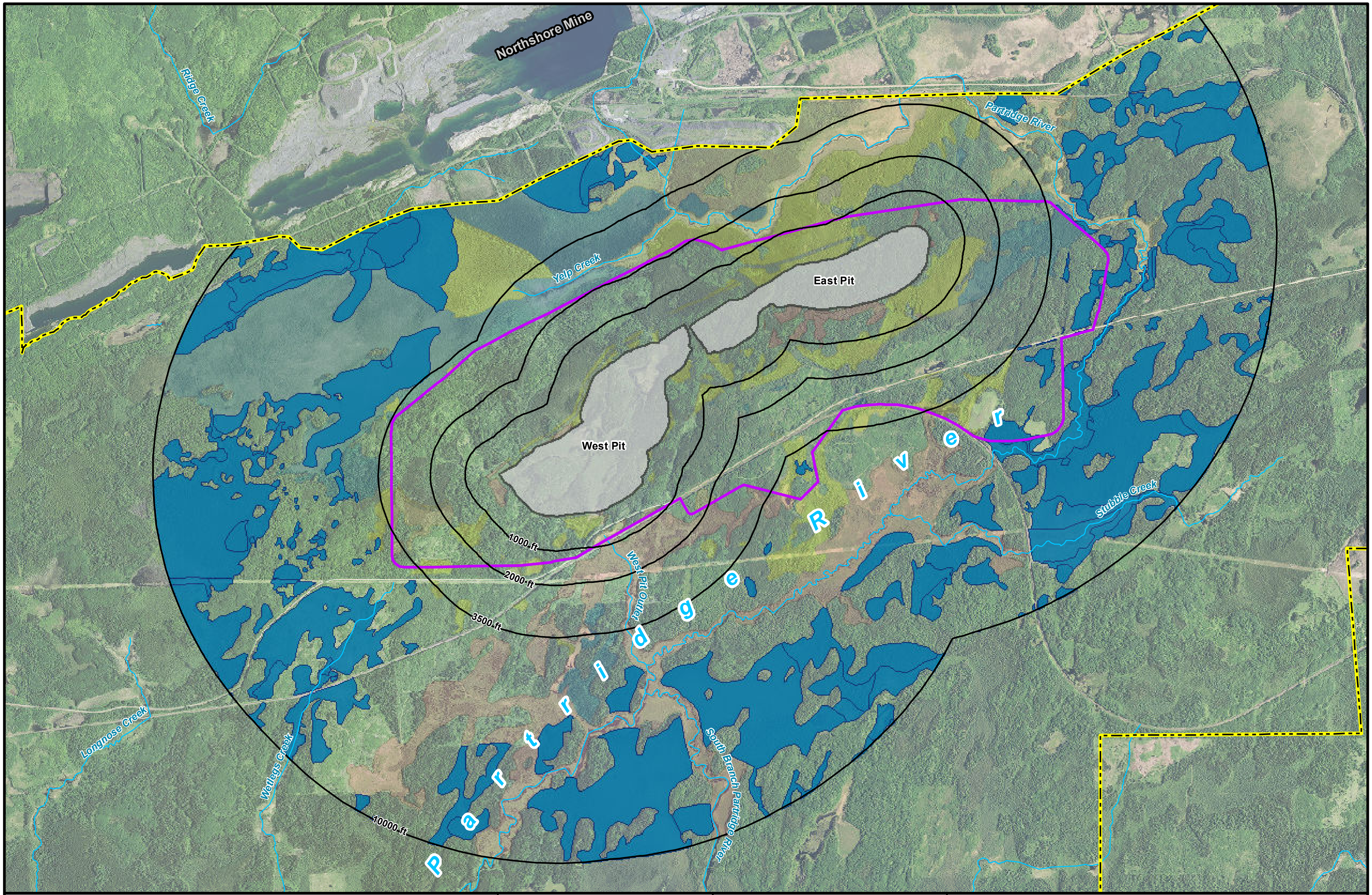

Mine Site
Mine Pit
Analog Zones (feet)
Area 1
Stream/River

Likelihood of Wetland Hydrology Effect

High Likelihood
Moderate Likelihood
Low Likelihood
No Effect

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0 0.25 0.5 1 Miles

Figure 5.2.3-10
Wetlands Crossing Analog Zones - >3,500-10,000 ft of Edge of Mine Pits
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

646

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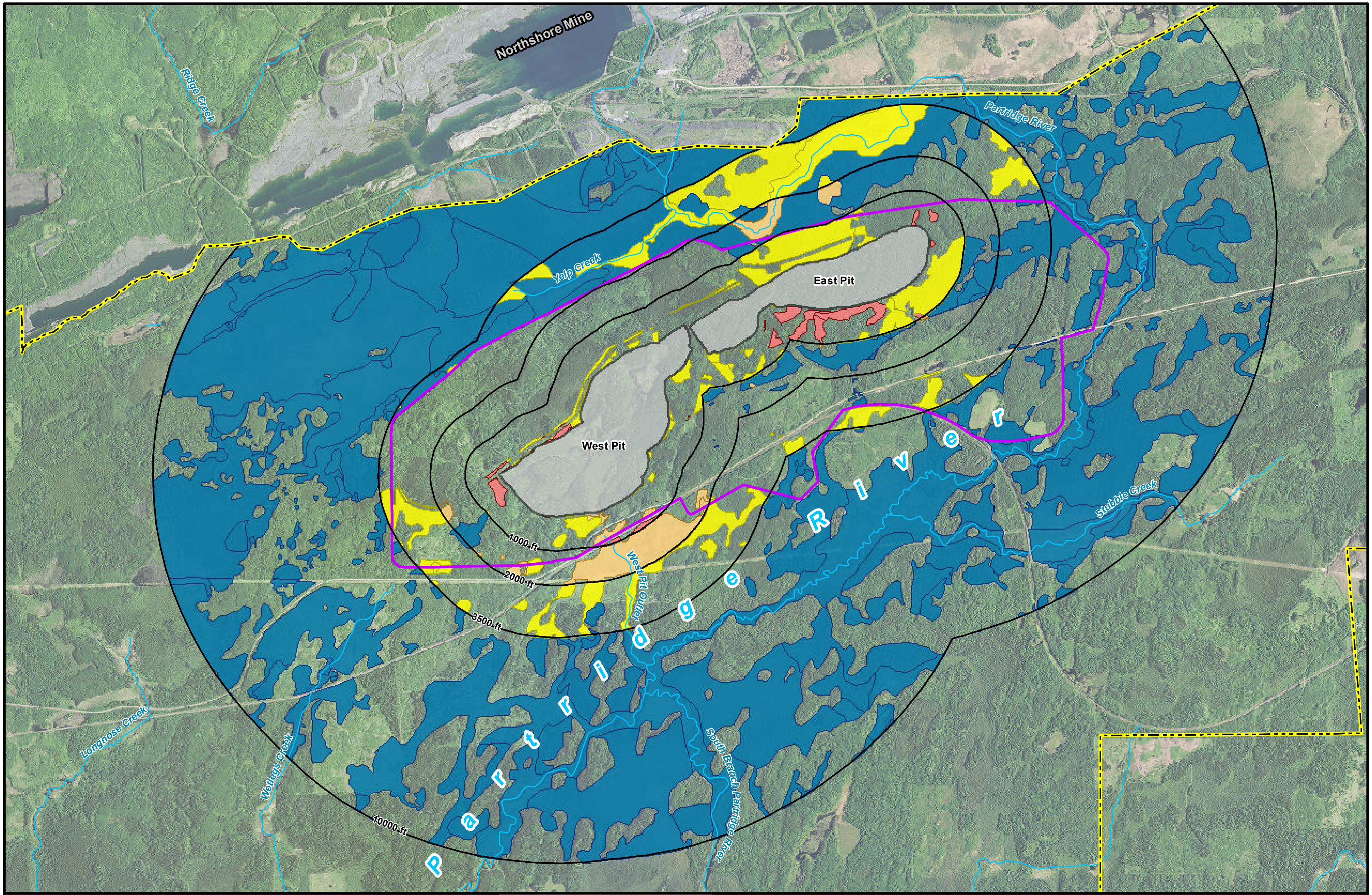
For the method approach of wetlands within analog zones, wetlands that were located within multiple analog impact zones were split along zone edges, and acreages were calculated by zone. The acreage of each wetland type located within these impact zones is summarized in Table 5.2.3-4 and locations are shown in Figures 5.2.3-11 through 5.2.3-15. Using this analysis approach, there would be 233.5 acres of wetlands in the 0-1,000 ft zone, 311.0 acres in the >1,000-2,000 ft zone, 718.0 acres of wetlands in the >2,000-3,500 ft zone, and 4,564.4 acres of wetlands in the >3,500-10,000 ft zone (PolyMet 2015b).

Table 5.2.3-4 Wetlands Within Analog Impact Zones Resulting from Potential Changes in Hydrology

Likelihood of Wetland Hydrology Effect Based on Wetland Type for Each Analog Distance	Wetland Area (acres) within each Analog Increment				
	0-1,000 ft	**1,000-2,000 ft**	**2,000-3,500 ft**	**3,500-10,000 ft**	**Eggers and Reed Wetland Community**
0 – 1,000 ft					
High Likelihood	46.4	-	-	-	Coniferous swamp, sedge meadow, and alder thicket
Moderate Likelihood	8.3	-	-	-	Deep marsh and shallow marsh
Low Likelihood	178.8	-	-	-	Minerotrophic and ombrotrophic coniferous bog
No Effect	-	-	-	-	No wetland types
1,000 – 2,000 ft					
Moderate Likelihood	-	110.8	-	-	Coniferous swamp, hardwood swamp, shrub-carr, and alder thicket
Low Likelihood	-	4.1	-	-	Shallow marsh
No Effect	-	196.1	-	-	Minerotrophic and ombrotrophic coniferous bog and open bog
2,000 – 3,500 ft					
Low Likelihood	-	-	385.0	-	Coniferous swamp, hardwood swamp, sedge/wet meadow, shrub-carr, and alder thicket
No Effect	-	-	333.0	-	Shallow marsh and minerotrophic and ombrotrophic coniferous bog and open bog
3,500 – 10,000 ft					
No Effect	-	-	-	4,564.4	All wetland types
Total Acres of Wetland	**233.5**	**311.0**	**718.0**	**4,564.4**	

Source: PolyMet 2015b.

Under this methodology approach, the likelihood of wetland hydrology effects would be as follows: no effect on 5,093.5 acres of wetlands (87 percent); low likelihood to 567.9 acres of wetlands (10 percent); moderate likelihood to 119.1 acres of wetlands (2 percent); and high likelihood to 46.4 acres of wetlands (less than 1 percent) (see Table 5.2.3-4). Within 0-10,000 ft from the edge of the mine pits, wetland types with a high likelihood of wetland hydrology effects include shrub swamps (27.5 acres), coniferous swamp (18.8 acres), and sedge/wet meadows (less than 1 acre); those with a moderate likelihood include shrub swamp (96.0 acres), coniferous swamp (14.4 acres), deep marsh (4.9 acres), shallow marsh (3.4 acres), and hardwood swamp (less than 1 acre); and those with low likelihood include shrub swamp (247.1 acres), coniferous swamp (135.3 acres), coniferous bog (178.8 acres), shallow marsh (4.1 acres), sedge/wet meadow (1.7 acres), and hardwood swamp (less than 1 acre) (PolyMet 2015b).



Mine Site
Mine Pit
Analog Zones (feet)
Area 1
Stream/River

Likelihood of Wetland Hydrology Effect

High Likelihood
Moderate Likelihood
Low Likelihood
No Effect

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N W E S

0 0.25 0.5 1 Miles

Figure 5.2.3-11
Wetlands within Analog Zones - 0-10,000 ft of Edge of Mine Pits
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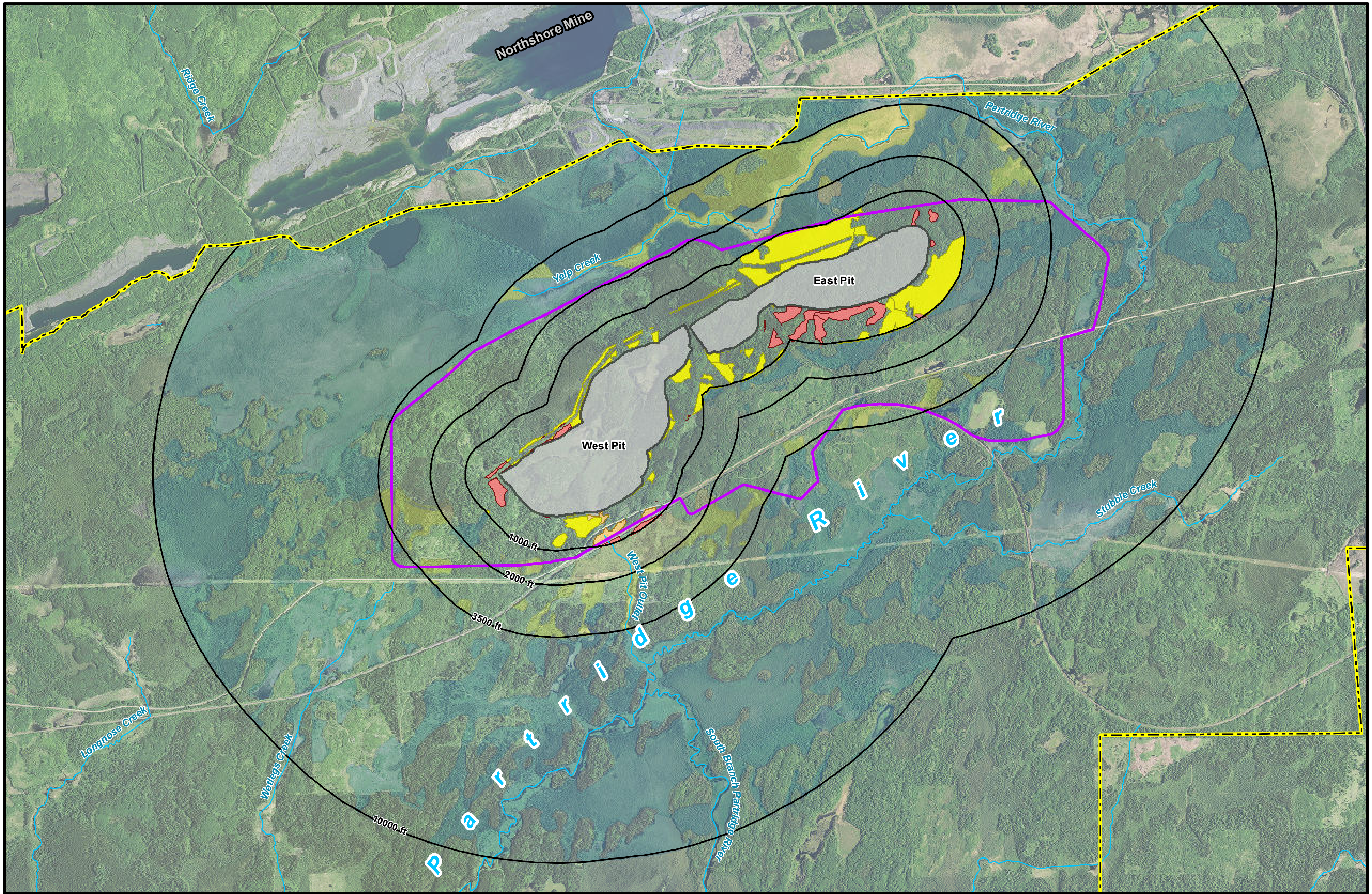
669 -Page Intentionally Left Blank-



Mine Site
Mine Pit
Analog Zones (feet)
Area 1
Stream/River

Likelihood of Wetland Hydrology Effect
High Likelihood
Moderate Likelihood
Low Likelihood
No Effect

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0 0.25 0.5 1 Miles

Figure 5.2.3-12
Wetlands within Analog Zones - 0-1,000 ft of Edge of Mine Pits
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Minnesota

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671

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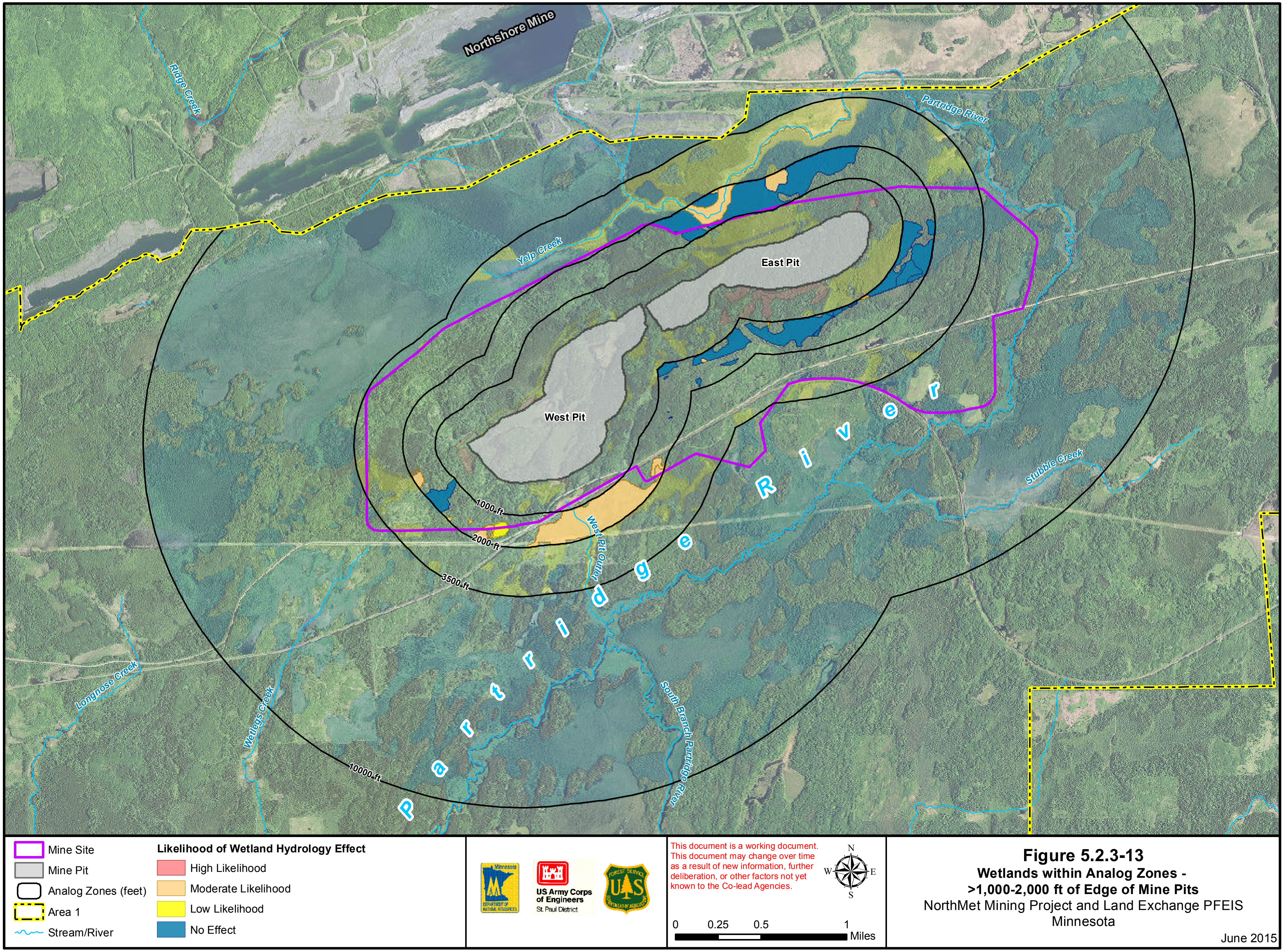

Figure 5.2.3-13
Wetlands within Analog Zones - >1,000-2,000 ft of Edge of Mine Pits
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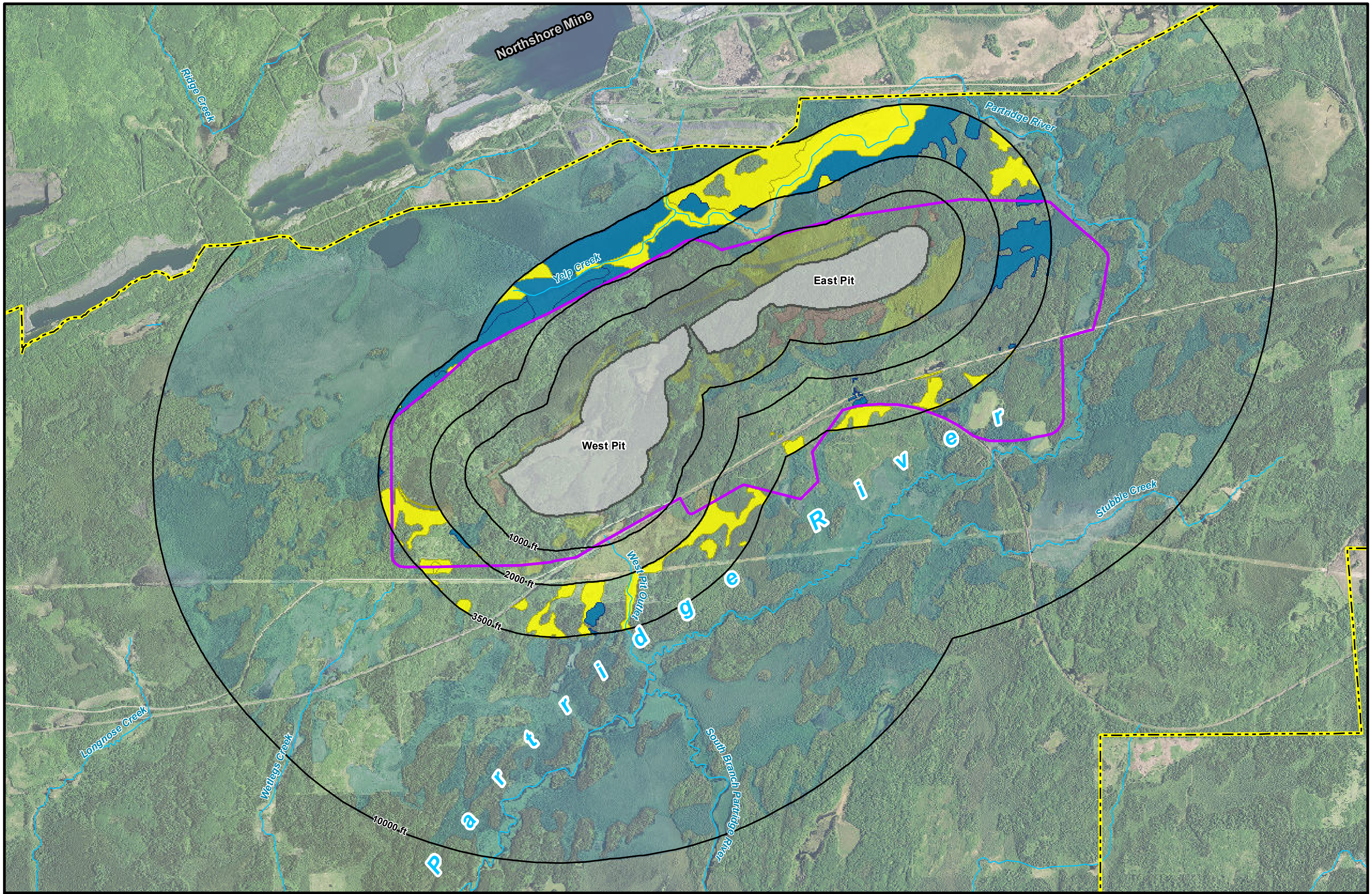
673 -Page Intentionally Left Blank-



Mine Site
Mine Pit
Analog Zones (feet)
Area 1
Stream/River

Likelihood of Wetland Hydrology Effect

High Likelihood
Moderate Likelihood
Low Likelihood
No Effect

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N W E S

0 0.25 0.5 1 Miles

Figure 5.2.3-14
Wetlands within Analog Zones - >2,000-3,500 ft of Edge of Mine Pits
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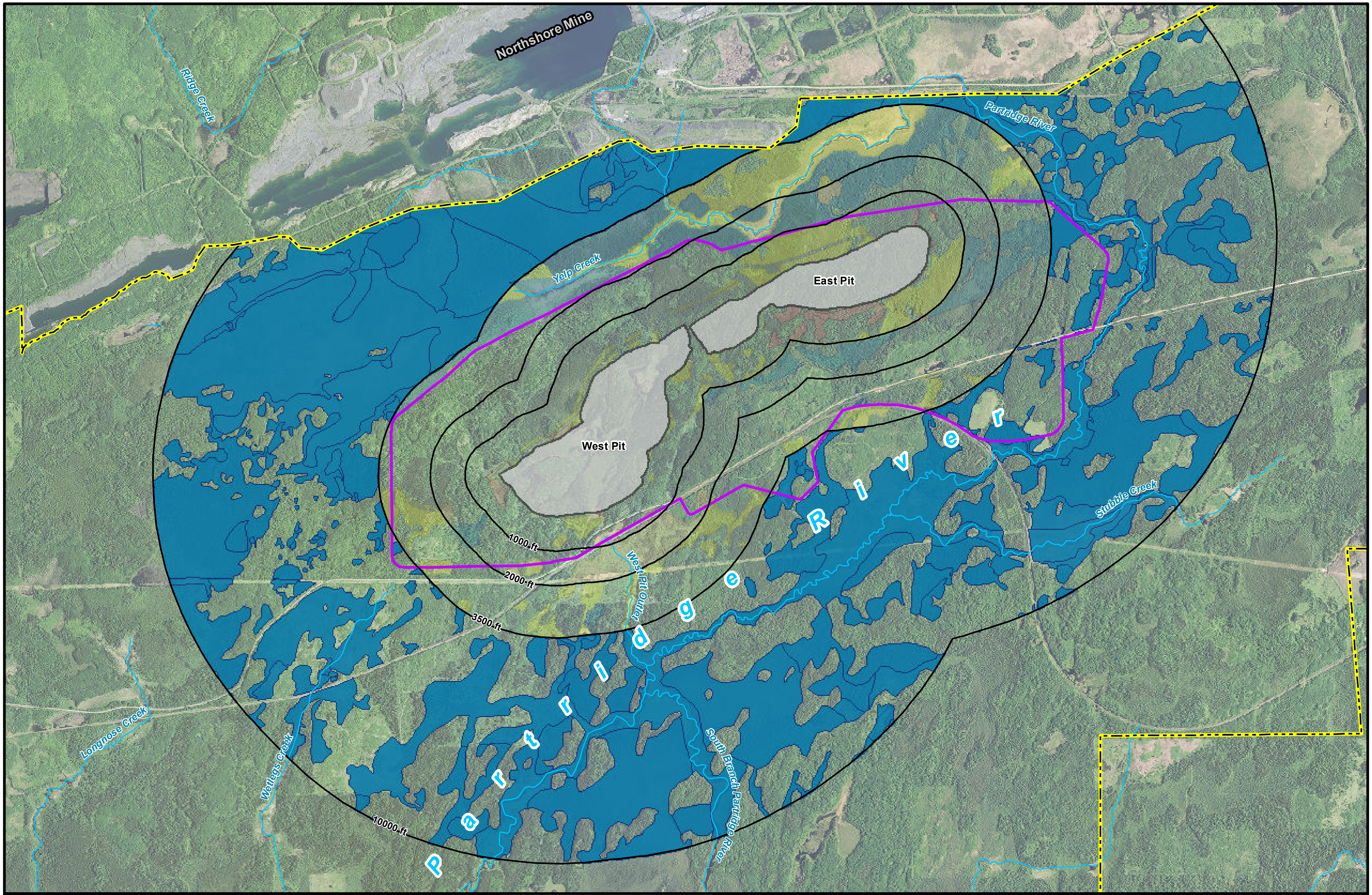
675 -Page Intentionally Left Blank-



Mine Site
Mine Pit
Analog Zones (feet)
Area 1
Stream/River

Likelihood of Wetland Hydrology Effect
High Likelihood
Moderate Likelihood
Low Likelihood
No Effect

Minnesota DEPARTMENT OF NATURAL RESOURCES
US Army Corps of Engineers
St. Paul District
FOREST SERVICE U.S. DEPARTMENT OF AGRICULTURE

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N S E W

0 0.25 0.5 1 Miles

Figure 5.2.3-15
Wetlands within Analog Zones - >3,500-10,000 ft of Edge of Mine Pits
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June 2015

677 -Page Intentionally Left Blank-

The potential indirect wetland hydrology drawdown effects on each wetland type were assessed based on the wetland sensitivity class tables for falling groundwater tables found in the Crandon mine project document titled *Wetland Impact Assessment Technical Memorandum – Appendix B*. The following provides a general discussion regarding potential indirect wetland effects that could occur based on hypothetical hydrologic drawdown levels using the hydrologic wetland sensitivity method. The potential indirect wetland effects that could occur include: conversion to other wetland community types, a change in vegetation without a change in community type, conversion to uplands, or other effects.

Three categories of hydrologic wetland sensitivity, each with associated groundwater drawdown levels for each wetland community type, were created for the hypothetical hydrologic drawdown wetland sensitivity assessment (PolyMet 2015b).

- None-to-Slight: Water level changes in which effect on the community would be slight to none with the potential for slight changes in abundance of various species but no change in species present. Monitoring or mitigation not anticipated.
- Moderate: Water level changes that may have a moderate effect on the wetland community with the potential for the loss and addition of some species. Monitoring recommended with mitigation based on monitoring results.
- Severe: Water level changes expected to result in severe effects on the community with the potential for considerable loss of characteristic plant species and invasion by other species, conversion of wetland type or conversion to upland. Monitoring should be conducted and mitigation may be required. According to the hydrologic wetland sensitivity method, wetlands in which groundwater is not the principal source of water and in which mitigation of surface water is planned (e.g., streamflow augmentation) should be excluded from this category.

The hydrologic wetland sensitivity method estimated how wetland communities would respond to groundwater drawdown by assuming that they would change to drier native plant communities or variants of the original community. No data or research was utilized from actual wetlands responding to groundwater drawdown; therefore, this analysis and related data can only be used as an initial estimate of what changes could be expected should groundwater levels actually fall as a result of the NorthMet Project Proposed Action. Monitoring of hydrology and vegetation within potentially affected wetlands represents the best method for documenting actual community changes resulting from hydrology changes, understanding complex hydrologic conditions, and identifying potential future indirect effects related from mine features.

The preliminary information developed for the hydrologic wetland sensitivity method was utilized to estimate what type of wetland effects might occur at the Mine Site assuming various, theoretical groundwater drawdown levels. Table 5.2.3-5 provides a summary of the estimated wetland community changes using the groundwater drawdown thresholds for each wetland type based on the hydrologic wetland sensitivity method.

Table 5.2.3-5 Potential Wetland Community Changes Due to Drawdown

Impact Sensitivity Category	**None**		**Moderate**		**Severe**	
Community Type	**Water Level Drawdown (ft)**	**Potential Effect**	**Water Level Drawdown (ft)**	**Potential Effect**	**Water Level Drawdown (ft)**	**Potential Effect**
Ombrotrophic Coniferous and Open bog	<0.75	None	0.75-2	Minor changes in vegetation; Increased tree growth	>2	Possible conversion of wetland type
Minerotrophic Coniferous and Open bog	<0.5	None	0.5-2	Change in vegetation; Increased tree growth	>2	Possible conversion of wetland type
Shallow marsh[1]	<1	None	1-3	Conversion of type	>3	Conversion of wetland type
Deep marsh[1]	<2	None	2-4	Conversion of type	>4	Conversion of wetland type
Shallow, open water[1]	<2	None	2-4	Conversion of type	>4	Conversion of wetland type
Conifer swamp	<1	None	1-2	Minor changes in vegetation; Increased tree growth	>2	Change in vegetation
Hardwood swamp	<2	None	2-4	Change in vegetation; Increased tree growth	>4	Conversion of wetland type; possible conversion to upland
Alder thicket	<1	None	1-4	Change in vegetation; Increased shrub growth	>4	Conversion of wetland type; increased shrub growth
Shrub-carr	<0.5	None	0.5-3	Change in vegetation; Increased shrub growth	>3	Conversion of wetland type
Sedge/wet meadow	<0.5	None	0.5-3	Change in vegetation; Conversion of type	>3	Conversion to upland

Source: PolyMet 2015b.

[1] Shallow marsh, deep marsh, and shallow open water communities were not evaluated in the hydrologic wetland sensitivity method as described in the Wetland Work Plan, but were estimated based on best professional judgment (PolyMet 2015b).

For minor groundwater drawdown (ranging from 0.5 to 2 ft), no substantial wetland community changes were identified. For the moderate sensitivity category (water level changes ranging from 0.5 to 4 ft), some changes to vegetation would be possible in all wetland communities with marshes, open water, and meadows, potentially resulting in conversion of wetland type, and there could be increased shrub or tree growth in shrub or forested wetlands. For the severe sensitivity category, nearly all wetland community types would be estimated to convert to other wetland types with a few wetlands estimated to convert to upland, including sedge/wet meadows and possibly hardwood swamps (PolyMet 2015b). Monitoring to document effects to wetlands would be recommended for all potential effects in the moderate and severe categories.

Groundwater modeling cannot reasonably estimate potential indirect wetland effects; therefore, analog impact zones can provide a reasonable estimate of the extent of potential indirect wetland effects resulting from hydrologic effects. In addition, the evaluation of theoretical groundwater drawdown levels can help estimate what types of potential indirect wetland effects might occur. However, wetland hydrology is a complex mix of precipitation, surface runoff, and in some cases, groundwater. The response of complex natural systems to human disturbances can only be estimated. Therefore, monitoring of wetland hydrology and vegetation communities would occur to document the extent and magnitude of wetland responses (potential indirect effects) to human disturbances. The monitoring plan, developed as part of the federal and state permitting process, would be based on those wetlands that have a high likelihood of indirect effects as a result of groundwater drawdown. The requirements of the monitoring plan would be determined during the permitting process. Permit conditions would likely include an adaptive management plan to account for any additional effects that may be identified in the annual monitoring and reporting.

Wetlands Abutting the Partridge River

There are 1,478.5 acres of wetlands abutting the Partridge River within Area 1 (see Figure 4.2.3-2) are presented in Table 5.2.3-6.

Table 5.2.3-6 Wetlands Abutting the Partridge River

Eggers and Reed Class[1]	**Wetland Size (acres)**	**Wetland Size (percent)**
Coniferous bog	193.0	13
Shallow marsh	12.1	1
Shrub swamp (including alder thicket or shrub-carr)	1,273.5	86
Total Acres of Wetlands	1,478.5	100

Source: PolyMet 2015b.

[1] Eggers and Reed 1997.

The XP-SWMM model identified that the changes in average annual flow (and therefore stage) of the Partridge River would be within the naturally occurring annual variation for the Partridge River. Thus, no potential indirect wetland effects were identified for the wetlands abutting the Partridge River (PolyMet 2015b).

Water Quality Changes

The screening analysis for depositional effects conducted to estimate potential annual deposition of dust, metals, and sulfur to wetlands within and adjacent to the Mine Site was performed using AERMOD. The estimated deposition from fugitive dust emissions was used to identify wetlands that have the potential for water quality changes. The estimated deposition from fugitive dust emissions was used to identify a threshold for a negative effect on vegetation. Below is a summary of the assessment from the *NorthMet Project Wetlands Data Package* (PolyMet 2015b).

Receptors

The receptors of interest for this analysis were the wetlands that were not directly affected. The respective initial receptor grids for the Mine Site were set up with near-field receptor spacing of 250 meters (within the ambient air boundary and out to 1,000 meters beyond the ambient air boundary) and far-field receptor spacing of 1,000 meters (from 1 km out to 5 km from the ambient air boundary).

Dust Deposition and Speciation to Individual Metals and Sulfur

For the dust emission sources identified for assessing potential metals and sulfur deposition at the Mine Site, the highest estimated dust deposition rate for each receptor node was then speciated to the respective metal and sulfur deposition rates based on the contribution of the sources to a receptor node and the metal and sulfur composition identified for each contributing source (e.g., ore and waste rock at the Mine Site). The estimated metal or sulfur deposition for each contributing dust source at a receptor node was then summed to provide a "total" deposition rate for each respective metal and for sulfur at that receptor location. Dust deposition rates were speciated for arsenic, cadmium, chromium, lead, manganese, nickel, and selenium. Copper and vanadium were also included. For each receptor node, the post-processing of the dust deposition rate by source contribution was then summed to provide a "total" metal deposition rate and a "total" sulfur deposition rate.

Sulfur associated with fugitive dust is part of the mineral matrix of the rock particles (sulfide). Therefore, weathering of the particles must occur before any of the sulfur would be released to soil, soil water, or surface water. Mercury was not considered as part of the evaluation of dust deposition at the Mine Site because the concentration of mercury in the rock to be mined is very low and would not be considered environmentally significant in this medium (PolyMet 2015b). Potential mercury air emissions from ore processing (i.e., potential emissions from the autoclave) were evaluated for potential local deposition impacts (see Section 5.2.7).

Estimates of Rural Background Deposition

For dust, an annual effects-level deposition rate of 365 grams per square meter per year ($g/m^2/yr$) was compared to modeled annual dust deposition rates. This deposition rate is a potential effects threshold for photosynthesis (i.e., potential for reduced photosynthesis due to "dusting" of the plant surface). However, for this analysis, the vegetative surface area of the wetlands was not calculated or included in the analysis. The modeled dust deposition rate was assumed to be applied to the land surface area which is a smaller area than the vegetative surface area. Vegetative surface area can be up to 13 times greater than the land surface area. By only assessing dust deposition to the land surface area instead of the vegetative surface area, it is likely the ratio of modeled deposition rate to the effects level was being overestimated. In other words, the modeled deposition rate is not being spread over the larger surface area of the vegetation, which would reduce the effective deposition rate. Because this application did not include the deposition of dust to the vegetative surface area, it is likely that the areas identified to exceed the effects threshold of 365 $g/m^2/yr$ have been overestimated.

For metals, background deposition is based on the data from *Atmospheric Deposition of Trace Metals at Three sites near the Great Lakes* (Sweet et al. 1997), which indicated that precipitation was under-collected by 45 to 70 percent when sample volumes were compared to corresponding rain gage amounts. Because wet deposition was considered to be underestimated, the wet deposition component was adjusted upward by a factor of 1.6.

Total background sulfur deposition included both wet and dry deposition, which was calculated to be 0.16 g/m^2/yr. The estimated background deposition used in the analysis for metals and sulfur was from data collected at sites characterized as open areas in rural settings that were reasonably distant from industrial sources and population centers. For forested areas, dry deposition may be underestimated. Vegetation can effectively scavenge fine particles and aerosols from the atmosphere and this interception can result in dry deposition being 50 percent or more of the total deposition. A monitoring site in Ely (Fernberg Road), dry deposition was assumed to be 22 percent of total deposition. Therefore, it is likely that the background sulfur deposition estimated for this analysis may be low due to an underestimation of dry deposition; however, no adjustments were made to the background sulfur deposition estimated for this analysis.

Significance Levels for Estimating the Potential Effects for Identifying Future Monitoring

For dust, metals, and sulfur, the following general categories were used for assessing the significance of a modeled deposition rate at a receptor node:

- Less than 100 percent of background: no potential for effects expected.
- Greater than 100 percent of the background value: potential for effects, include in future wetland monitoring.

These are general categories of potential for effects. Since this was a screening analysis to identify wetlands for potential inclusion in the monitoring program, there was some flexibility in identifying a potential level of deposition that suggested a potential for effect and would then trigger a requirement for monitoring. Another consideration for selecting a deposition rate that was a high percent of the background rates was the likely overestimation of modeled deposition and the underestimation of background deposition.

Adding to the conservatism in the modeling of particulate metals, this screening analysis used a maximum dust deposition from a range of possible modeled values and a high-end metal or sulfur concentration for each source contributing to that receptor node to derive a maximum potential metal or sulfur deposition for a receptor node.

Using a maximum concentration for each contributing emission source to speciate a metal or sulfur deposition from a maximum modeled dust deposition rate for each receptor node overestimates individual metal or sulfur deposition. Also adding to the conservatism of this analysis is the underestimation of background deposition because the ratio of the NorthMet Project Proposed Action-related deposition is compared to the background deposition. If background deposition is underestimated, that would indicate that estimated NorthMet Project Proposed Action-related deposition at more receptor nodes would be higher than background and further increase the area for potential future monitoring. The underestimation of background metal deposition (i.e., wet deposition due to under-collection of precipitation) was identified by Sweet et al. (1997). In addition to the underestimation of background metal deposition, background wet sulfate deposition may be underestimated, as well, because the National Atmospheric Deposition Program data for the Fernberg Road monitoring site indicated rainfall in the last 3 years was about 22 percent below the annual average. If sulfate deposition from 2007 and 2008 was used (both years approximately normal for precipitation amount), a background sulfur deposition rate of 0.23 $g/m^2/yr$ was calculated—about 44 percent higher than the background deposition used in the screening analysis. If the higher estimate of background sulfur deposition was used in the screening analysis, a smaller number of receptor nodes would have been identified to have modeled sulfur deposition that was more than 100 percent of background deposition and the area for potential monitoring would be smaller than that identified. Also, it was found that for forested areas, dry deposition may be systematically underestimated due to sample collection and analysis methodology. It is possible that the background sulfur deposition estimated for this analysis may be low due to an underestimate of dry deposition.

Given the potential for overestimation of modeled deposition and underestimation of background deposition, and balancing the conservatism when their respective results are combined in this analysis, it seems reasonable to select the wetlands estimated to receive greater than 100 percent of background deposition (a potential doubling of the background deposition) for consideration in potential future monitoring (PolyMet 2015b).

Fugitive Dust/Metals and Sulfide Dust Emissions

At the Mine Site, dust deposition was concentrated relatively close to the ore loading area near the southern portion of the ambient air boundary. All receptors have model-estimated dust deposition of 25 percent or less of the effects-level background of 365 $g/m^2/yr$) (see Figure 5.2.3-16). The model-estimated dust deposition is largely constrained to within the ambient air boundary at the Mine Site, and the model-estimated dust deposition would be 50 percent or less of the effects-level background dust deposition.

The highest model-estimated metal and sulfur depositions at the Mine Site were in two defined areas, which include the ore loading area and at the east end of the Category 2/3 Stockpile (see Figure 5.2.3-17). All of the receptor nodes with the highest model-estimated deposition rates (deposition rates greater than 100 percent background) were located within the ambient air boundary.

Of the 19,914 acres of wetlands identified within the Mine Site receptor grid, deposition modeling results indicated that 234 acres of wetlands could be potentially indirectly affected (modeled metal deposition rates greater than 100 percent of background). Of the 234 acres of wetlands, 228 acres (97 percent) would be located within the Mine Site ambient air boundary (PolyMet 2015b). The 234 acres of wetlands would be included in any future monitoring to be conducted for the NorthMet Project Proposed Action.

The deposition modeling results for dust, metals, and sulfur would likely not have an adverse effect on wetlands; however, the modeling only indicated those areas that had deposition rates greater than 100 percent of background deposition. These specific wetlands areas would be identified for consideration in any future monitoring to be conducted for the NorthMet Project Proposed Action.

The initial assessment provided a discussion on conservatism, including a discussion that the estimated sulfur deposition was as particle-bound sulfur, with the sulfur being inherent to the mineral matrix of the dust and not readily available for dissolution in soils or surface waters. A supplemental assessment has been conducted to provide for a worst-case scenario in that all of the sulfur in fugitive dust converts to sulfate and would mix with surface water in a wetland

(Barr 2015f). A summary of the supplemental assessment evaluation of sulfur from stack emissions is included in Section 5.2.7.2.6, while the fugitive dust evaluation is presented herein.

Based on a conservative assumption that all sulfur in fugitive dust converts to sulfate and mixes with surface water in wetlands, a potential incremental increase in sulfate was calculated as 4.2 mg/L. When the potential incremental sulfate concentration is mixed with annual precipitation, the sulfate value was calculated as 1.7 mg/L. Because the sulfur is inherent to the mineral matrix of the dust particles, it is likely that less than 100 percent of the sulfur would be weathered from the particles and be available to go into solution if deposited to soils or water. While this potential incremental change may warrant future monitoring, it would not be expected to have an effect on methylmercury concentrations in surface water based on available data that indicate a relative insensitivity of wetlands to additional sulfate (Barr 2015f).

Although the actual potential for deposition of fugitive dust to wetlands, and the potential release of sulfur in that dust, is uncertain, any adverse effects on wetlands are unlikely. The fugitive dust control plan for both the Mine Site and the Plant Site (including the Tailings Basin) would minimize such deposition, and the sulfur from any rock dust particles that would be deposited may not be released or only released slowly through weathering. Using a conservative assumption that all sulfur in the deposited dust is both released and transformed to sulfate, no significant increase in methylmercury concentrations would be expected (Barr 2015f). Additional information relating to mercury methylation is provided in Section 5.2.2.3.4. A discussion of mercury deposition and bioaccumulation in fish and the assessment of the cumulative effects is provided in Section 6.2.6.3.3.

Mine to Plant Site Railroad Corridor – Ore Spillage

The potential release of dust from railcars transporting ore from the Mine Site to the Plant Site was addressed in the May 6, 2011, Air IAP Summary Memo (PolyMet 2015b):

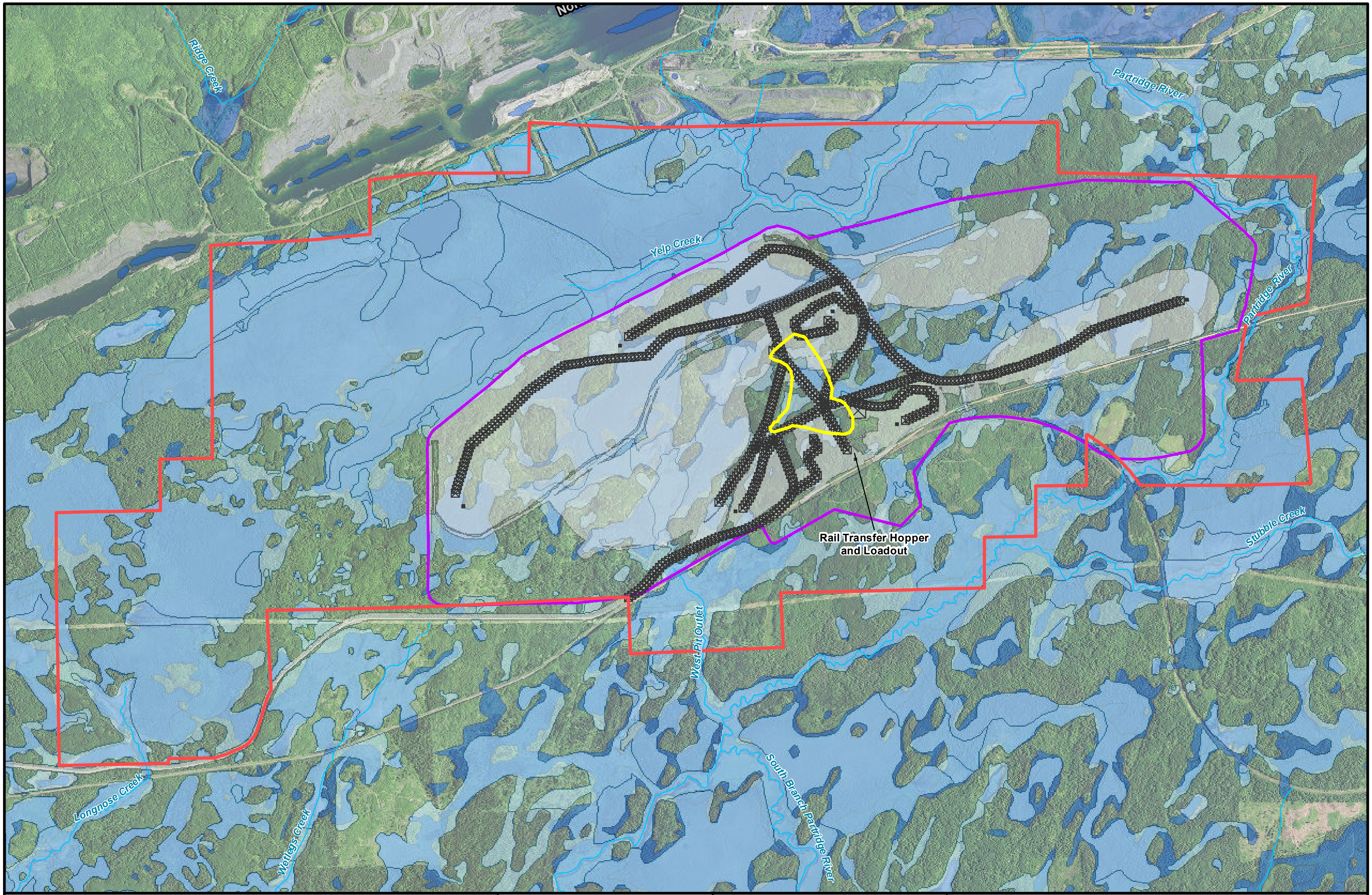
> The air IAP group concluded that there would be minimal air impacts from any dust generated from ore hauled in the railcars due to the coarse nature of the ore.

Based on this conclusion, air modeling of potential release of dust from railcars was not performed because the potential wetland effects would not be significant.

The air IAP group concluded that any dust generated from ore hauled in railcars would be coarse in nature (i.e., relatively large particles). These larger particles would tend to deposit near the railcar and not be dispersed to any great extent. An estimate of the spillage of ore fines along the rail corridor is provided in Section 8.4.3 of the Waste Characterization Data Package (PolyMet 2015q). Assuming that all spillage of the coarse material would occur in a 2-meter-wide strip on both sides of the centerline of the railway (total width equals 4 meters) over the entire haul distance after loading (approximately 8 miles or 13,000 meters), results in approximately 0.11 kilograms per square meter (kg/m^2) of ore fines annually or 2.14 kg/m^2 for the 20-year NorthMet Project Proposed Action. This equates to 0.002 inch of depth annually or 0.05 inches for the 20-year NorthMet Project Proposed Action. However, as described in Section 3.2.2.2.4, PolyMet has committed to refurbish the rail cars to minimize the gaps along hinges and joint areas to reduce potential ore spillage. Based upon the rail car modification evaluation performed by PolyMet (2014a), the ore spillage may be reduced by up to 97 percent which would proportionally reduce the dilution needed to meet surface water standards (PolyMet 2015b).

For most contaminant constituents, the contact water leaving the spillage strip has been estimated to have a greater than 90 percent likelihood of complying with surface water standards at all times. Constituents that have the potential to exceed surface water standards at the edge of the 2-meter spillage strip include aluminum, cobalt, copper, and nickel. Aluminum concentrations are often above the surface water standard in the background runoff, and it is not possible to achieve a less than 10 percent likelihood of exceeding the standard in the mixed water (PolyMet 2015b). For cobalt, copper, and nickel the estimated area (square meters per meter of railroad track on each side) necessary to provide sufficient dilution for 90 percent probability of compliance is 2.5, 675, and 30 square meters per meter of railroad track on each side, respectively. Therefore, the limiting area required to provide sufficient dilution water for all constituents has been estimated at 675 square meters per meter of track (one-sided). Please refer to 5.2.2.3.2 for more information on ore spillage. Approximately 542.7 acres of wetlands along the railroad corridor could be potentially indirectly affected by the NorthMet Project Proposed Action.

Wetlands that have contributing watersheds that include no segments of the railway (e.g., many of the wetlands uphill to the north of the rail corridor) were identified as having no potential indirect effects from rail spillage. Wetlands immediately abutting the railway and whose watersheds included the rail centerline were identified as potentially being affected, although the effects may not extend to the full area of the wetland. Wetlands that have contributing watersheds, which include natural areas that are larger than 675 square meters per meter of track (one-sided) in the contributing watershed, were identified as having no potential indirect effects.



Ambient Air Boundary
Extent of Highest Estimated Deposition Receptors with Deposition of 25% of Background
Mine Site
Disturbed Area
Volume Sources (Roads)
Wetlands
NWI Wetland
Stream/River

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Figure 5.2.3-16

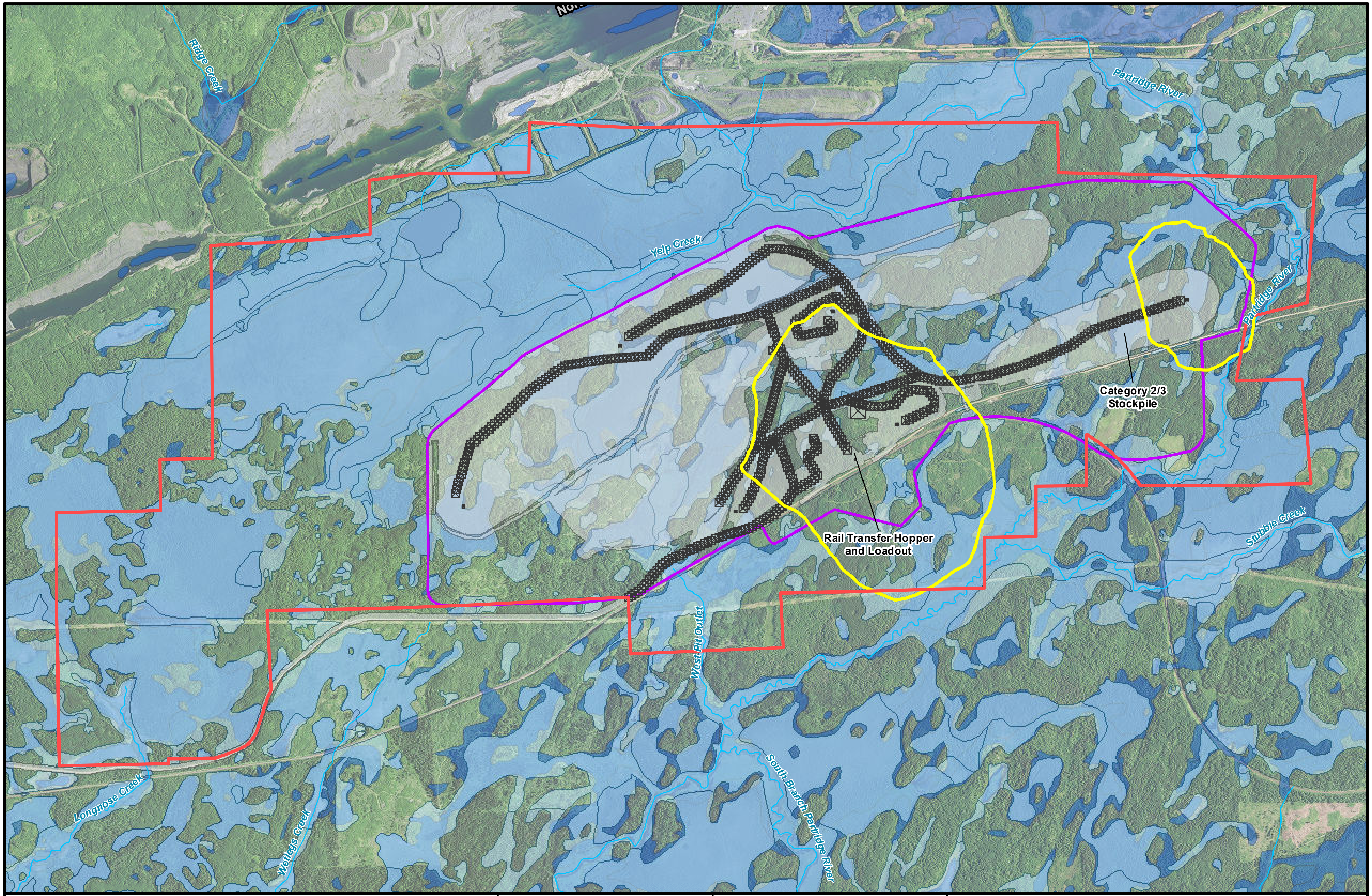
Model - Estimated Dust Deposition Compared to Background Effects Level - Mine Site

NorthMet Mining Project and Land Exchange PFEIS

Minnesota

June 2015

949 -Page Intentionally Left Blank-



Ambient Air Boundary

Extent of Highest Estimated Deposition Receptors with Deposition of 100% of Background

Mine Site

Disturbed Area

Volume Sources (Roads)

Wetlands

NWI Wetland

Stream/River

US Army Corps of Engineers
St. Paul District

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Figure 5.2.3-17
Model - Estimated Metal Deposition Compared to Background Effects Level - Mine Site
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Minnesota

June 2015

951

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Leakage from Stockpiles/Mine Features and Seepage from Mine Pits

The stockpiles, mine pits, and other mine features (e.g., WWTF) are located within the Partridge River Watershed. Water containing constituents generated in the waste rock stockpiles and mine pits has the potential to enter the shallow groundwater system via potential leakage through the liners (e.g., stockpiles and WWTF equalization basins) or seepage from the pits. The leakage or seepage that enters groundwater would then be transported toward the Partridge River along groundwater flowpaths. There are five groundwater flowpaths connecting the mine features to the Partridge River, which include: East Pit – Category 2/3 flowpath, Ore Surge Pile flowpath, WWTF flowpath, Overburden Storage and Laydown Area flowpath, and West Pit flowpath. Because the water quality within these flowpaths has the potential to change as a result of the NorthMet Project Proposed Action, these same flowpaths were considered in the assessment of potential indirect wetland effects associated with leakage or seepage from mine features (PolyMet 2015b).

Wetlands were identified within the groundwater flowpaths, and the bog wetlands within and surrounding the Mine Site were subcategorized as either ombrotrophic or minerotrophic consistent with the November 2011, USACE Memorandum (Eggers 2011a). There are 515.8 acres of wetland resources within the groundwater flowpaths. Other wetlands were classified as dominated by groundwater, although all wetlands receive precipitation and virtually all water movement in peat wetlands occurs horizontally in the upper layers of peat. Approximately 66 percent of the wetlands within the flowpaths are classified as dominantly minerotrophic (groundwater-fed) while 34 percent of the wetlands are supported only by precipitation (ombrotrophic) (see Table 5.2.3-7).

Water quality modeling results indicate groundwater quality along each flowpath would likely change from existing conditions. It was conservatively assumed that these changes may cause potential indirect effects to the character, function, and quality of minerotrophic wetlands; therefore, it was also assumed that all downgradient minerotrophic wetlands located within the five Mine Site surficial aquifer flowpaths may have potential indirect wetland effects related to water quality changes as a result off leakage/seepage from mine features (PolyMet 2015b). This analysis indicates areas that can be conservatively assumed to have potential indirect effects due to changes in groundwater quality. These specific wetland areas are identified for consideration in the proposed wetland monitoring plan.

Table 5.2.3-7 Wetlands within the Mine Site Groundwater Flowpaths

Eggers and Reed Class[1]	Hydrology	West Pit Acres	Overburden Storage and Laydown Area Acres	WWTF Acres	Ore Surge Pile Acres	East Pit - Category 2/3 Acres
Coniferous bog (Minerotrophic)	Precipitation/ Groundwater	0.04	0.0	0.0	0.0	6.3
Coniferous bog (Ombrotrophic)	Precipitation	16.5	0.0	0.0	0.0	148.2
Coniferous swamp	Groundwater	0	2.9	20.1	10.2	0.04
Deep marsh	Groundwater	4.9	0.0	0.0	0.0	0.0
Open bog	Precipitation	0.0	0.0	0.0	0.0	8.9
Sedge/wet meadow	Groundwater	0.0	0.0	0.0	0.0	1.2
Shallow marsh	Groundwater	3.4	0.1	0.0	0.0	5.5
Shrub swamps (including alder thicket and shrub-carr)	Groundwater	90.5	47.7	18.8	27.6	103.1
Total Acres of Wetland		115.3	50.7	38.9	37.8	273.2

Source: PolyMet 2015b.

[1] Eggers and Reed 1997, 2014.

The Partridge River currently represents the primary discharge location for shallow groundwater at the Mine Site. During operations, reclamation, and closure and long-term maintenance, groundwater in areas south of the mine pits would continue to discharge to the Partridge River while groundwater in areas north of the mine pits would discharge to the mine pits. The amount of groundwater emerge in surface water and wetlands between the mine features and the Partridge River would be expected to be minimal relative to the amount of groundwater emerge in the Partridge River itself. Significant quantities of groundwater are not expected to discharge to the wetlands because of the very low hydraulic conductivities of the underlying peat layers (PolyMet 2015b). The water quality model assumed that the leakage/seepage from mine features releases directly to the Partridge River; therefore, it is assumed that groundwater would not emerge in surface water or wetlands along intermediate portions of the flow paths (PolyMet 2015m). The water quality model cannot be used to quantify the amount of leakage/seepage from mine features that discharges directly to individual wetlands. However, the water quality model was used to provide a conservative estimate of the potential indirect wetlands effects caused by water quality changes due to leakage/seepage from mine features (PolyMet 2015b).

The leakage/seepage analysis could not indicate or suggest that an effect or adverse effect would occur on wetlands; however, the analysis only indicated those areas that could be conservatively assumed to have a potential indirect effect due to changes in groundwater (PolyMet 2015b).

Dunka Road Effects

Loaded mine haul trucks would not travel on the Dunka Road. Empty mine haul trucks would only travel on Dunka Road when they are in need of maintenance at the Area 1 Shop. The total one-way trips per year have been estimated to be 44 trips. Given the low traffic volumes of haul trucks (less than one trip per week) and that the ore trucks would likely be empty; no potential indirect wetland effects were identified for wetlands abutting Dunka Road (PolyMet 2015b). The additional light vehicles (e.g., pickups and SUVs), field service trucks, and fuel trucks that would travel on Dunka Road more regularly would not contribute to wetland effects.

5.2.3.2.3 Plant Site Direct Wetland Impacts

PolyMet proposes to reuse the former LTVSMC processing plant and Tailings Basin. The processing plant is located on uplands with no wetland resources present. The existing constructed plant reservoir located east of the concentrator is not regulated as a wetland. Therefore, no direct wetland impacts are anticipated in this portion of the Plant Site.

Direct wetland impacts would result from the following Plant Site components: construction of the Tailings Basin, pump station, treated water discharge pipelines, flotation tailings pipeline, Tailings Basin containment system to manage Tailings Basin seepage, rock buttress for stability along the north and east sides of Cell 2E, drainage swale and overflow channel located northeast of Cell 2E, and the Hydrometallurgical Residue Facility.

Direct wetland impacts within the Plant Site would total 148.4 acres. These wetlands impacts would be caused by fill (12 percent), excavation (31 percent), excavation and fill (less than one percent), and the containment system (58 percent), and therefore, these wetlands would be permanently lost. Table 5.2.3-8 summarizes the directly impacted wetlands within the Plant Site by community type while Table 5.2.3-9 identifies the activity that causes the impacts expected within the Plant Site. The majority of the wetlands (94 percent) that would be impacted are rated as low quality and 6 percent are rated as moderate quality wetlands.

The rock buttress described in Section 3.2.3 and Section 4.2.13 would abut the existing toe of the Tailings Basin. The water containment system would extend approximately 300 ft around the northern and western sides, and portions of the eastern sides of the Tailings Basin, encapsulating the Tailings Basin, the rock buttresses and wetlands between it and the rock buttresses. Construction of the Tailings Basin for the NorthMet Project Proposed Action would also result in expansion of the existing eastern footprint onto natural highland. The majority of the impacted wetlands are rated as low quality, primarily because the hydrology supporting these wetlands has been modified by seepage from the Tailings Basin and other drainage modifications made in the area (PolyMet 2015b). These hydrologic modifications have resulted in inundation and changes in wetland cover types from forested and scrub shrub wetlands (as evidenced in aerial photographs from the 1940s prior to LTVSMC operations) to deep marsh (Barr 2008b).

Wetlands located outside of the Cliffs Erie Permit to Mine Ultimate Tailings Basin boundary (this boundary is shown on Figure 5.2.3-18 and Figure 5.2.3-19) but within the Hydrometallurgical Residue Facility are included in the direct wetland impact analysis. As previously noted, approximately 28.6 acres of wetlands in the Hydrometallurgical Residue Facility are not subject to state or federal regulations as they are located within an actively permitted waste storage facility. Two wetlands located in the Hydrometallurgical Residue Facility are subject to state or federal regulation covering 7.5 acres and would be directly impacted by fill. Both wetlands are shallow marsh wetlands (see Figure 5.2.3-19).

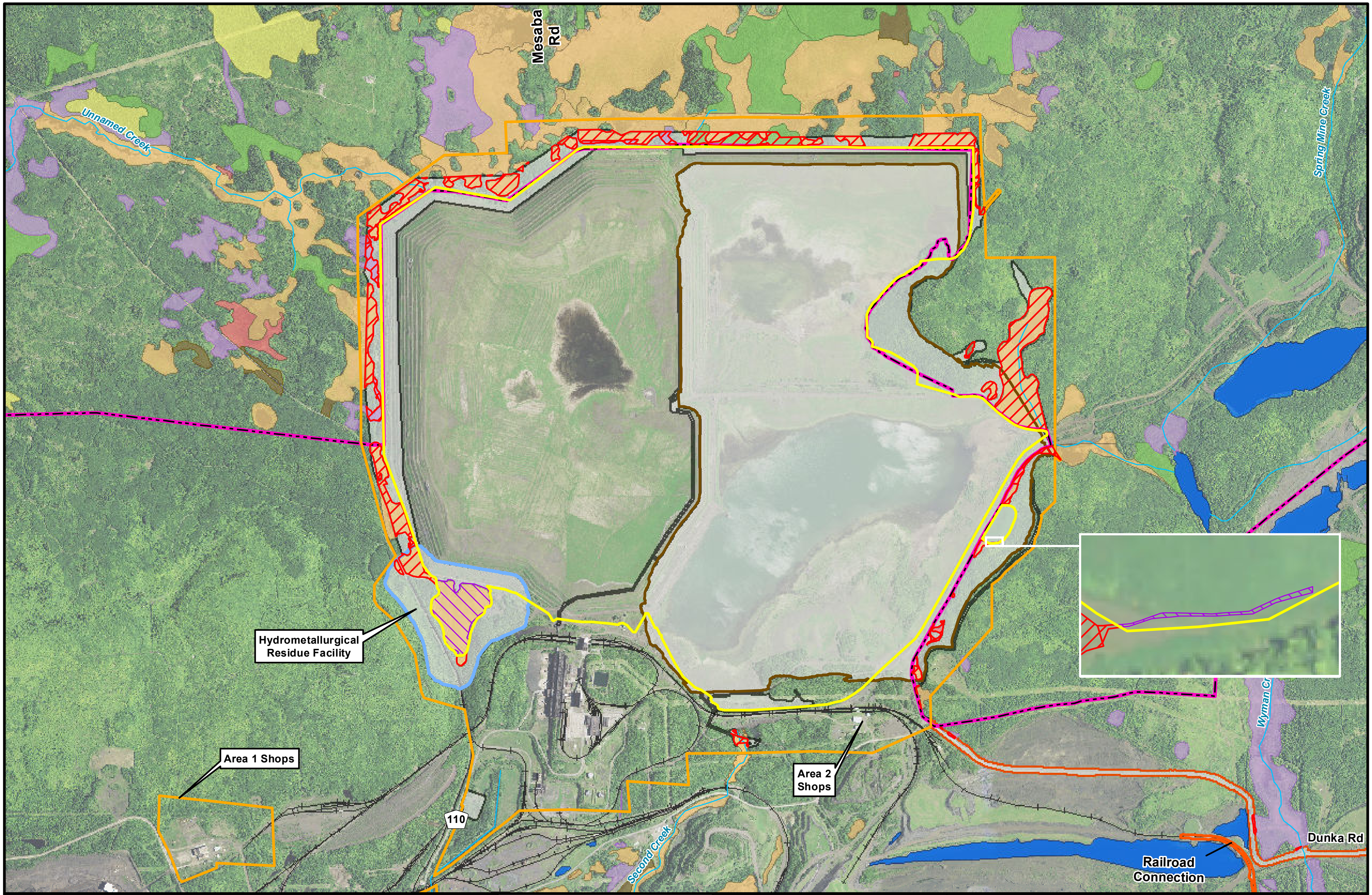
There would be no direct wetland impacts along the Colby Lake Water Pipeline Corridor or in the Second Creek area as there would be no construction within these two areas.

Table 5.2.3-8 Total Projected Direct Wetland Impacts for the Plant Site

	Directly Impacted Wetlands at the Plant Site		
Eggers and Reed Class[1]	**Acres**	**%**	**No.[2]**
Coniferous bog	0.0	0	0
Coniferous swamp	10.7	7	3
Deep marsh	74.0	50	14
Hardwood swamp	0.7	<1	1
Open bog	0.0	0	0
Open water (includes shallow, open water, and lakes)	0.0	0	0
Sedge/wet meadow	1.5	1	6
Shallow marsh	52.7	36	13
Shrub swamp (includes alder thicket and shrub-carr)	8.9	6	6
Total Direct Impacts	148.4	100	44

Source: PolyMet 2015b.

[1] Eggers and Reed 1997, 2014.
[2] There are 44 unique wetlands directly impacted at the Plant Site, which includes the Tailings Basin and Hydrometallurgical Residue Facility footprint. One wetland (ID 1155) has been split between the Tailings Basin and Hydrometallurgical Residue Facility footprint in the Wetland Data Package for a total of 45 wetlands directly impacted in Wetland Data Package report.



Plant Site
Directly Affected Wetland
Exempt Wetland
Disturbed Area
Cliffs Erie, LLC Permit to Mine Ultimate Tailings Basin Limit
Area 2
Transportation and Utility Corridor
Hydrometallurgical Residue Facility
Existing Railroad
Stream/River

Eggers & Reed Wetland Types

Coniferous Bog
Coniferous Swamp
Deep Marsh & Shallow Marsh
Hardwood Swamp
Open Bog
Sedge Meadow & Wet Meadow
Shrub Swamps (Alder Thicket & Shrub-Carr)
Shallow, Open Water & Lake

US Army Corps of Engineers
St. Paul District

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Figure 5.2.3-18
Plant Site Wetlands and Direct Wetland Impacts
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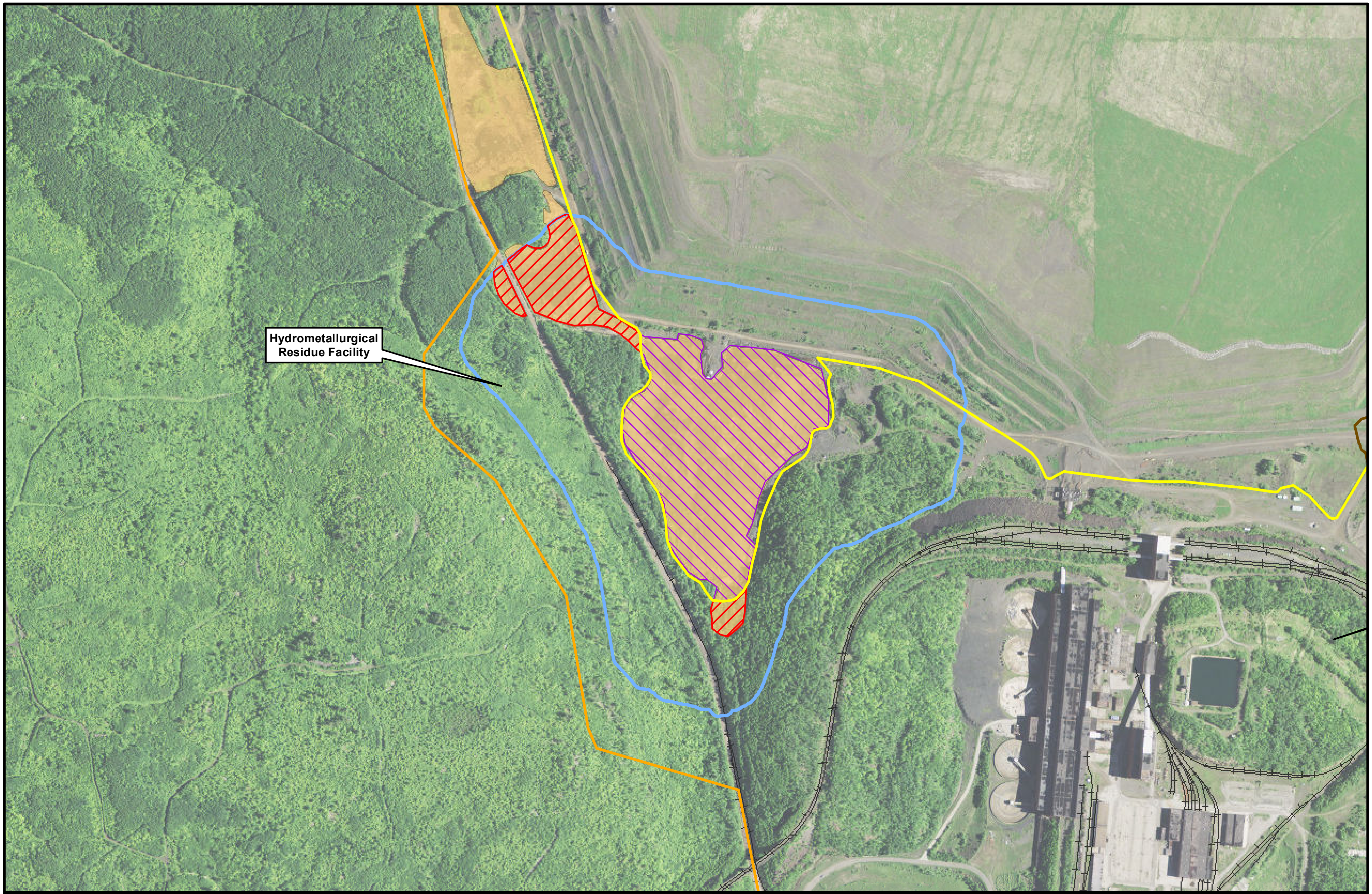
1057 -Page Intentionally Left Blank-



Hydrometallurgical Residue Facility
Cliffs Erie, LLC Permit to Mine Ultimate Tailings Basin Limit
Directly Affected Wetland
Exempt Wetland
Plant Site
Existing Railroad
Stream/River

Eggers & Reed Wetland Types

Coniferous Bog
Coniferous Swamp
Hardwood Swamp
Deep Marsh & Shallow Marsh
Open Bog
Sedge Meadow & Wet Meadow
Shrub Swamps (Alder Thicket & Shrub-Carr)
Shallow, Open Water & Lake

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Figure 5.2.3-19
Hydrometallurgical Residue Facility Wetlands and Direct Wetland Impacts
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

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Table 5.2.3-9 Type of Projected Direct Wetland Impacts at the Plant Site

Type of Impact	Directly Impacted Wetlands at the Plant Site Acres	%	No.[1]
Fill	17.6	12	17
Excavation	45.2	31	1
Fill and Excavation	0.2	<1	1
Containment System	85.4	58	26
Total Direct Impacts	148.4	100	45

Source: PolyMet 2015b.

[1] There are 44 unique wetlands directly impacted at the Plant Site, which includes the Tailings Basin and Hydrometallurgical Residue Facility footprint. One wetland (ID 1155) has been split between the Tailings Basin and Hydrometallurgical Residue Facility footprint in the Wetland Data Package for a total of 45 wetlands directly impacted in Wetland Data Package report. This would result in impacts on wetlands as a result of filling at the Hydrometallurgical Residue Facility and placement of the containment system at the Tailings Basin.

5.2.3.2.4 Plant Site Indirect Wetland Effects

The indirect wetland effects were assessed by identifying wetlands in Area 2 within 500-ft increments beginning at the Plant Site and continuing out to a total of 30,000 ft (see Figure 5.2.3-20). The area of evaluation for the Plant Site indirect wetlands effects included wetlands within Area 2 where wetland type information had been developed and wetlands within and near Second Creek, and does not include the directly impacted wetlands. No wetlands are located within the former LTVSMC processing plant; therefore, no indirect wetland effects would occur from its reuse. Furthermore, no indirect wetland affects would occur at the Hydrometallurgical Residue Facility as all wetlands would be directly impacted.

The potential indirect wetland effects to the Second Creek area of analysis was assessed based on changes to hydrology due to groundwater flow or seepage, drawdown or surface water quantity, or changes in surface water quality or metals deposition. There are no predicted potential indirect wetland effects due to wetland fragmentation, changes in watershed area, or dust deposition in the Second Creek area of analysis (PolyMet 2015b).

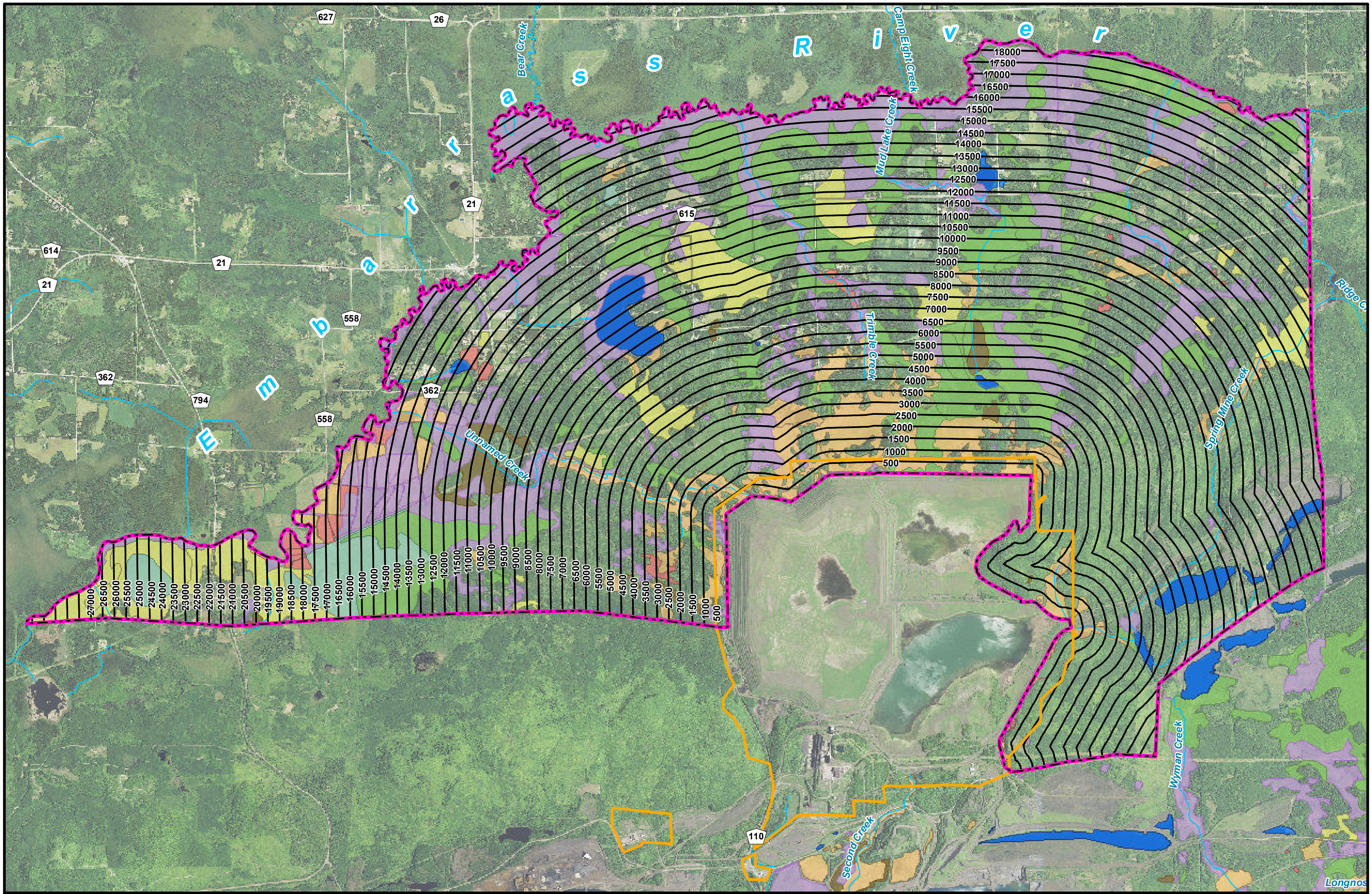
Wetland Fragmentation

Construction of the Plant Site features (e.g., containment system) would result in 0.5 acre of wetland fragments losing their functions. Wetland fragments would result in the following wetland types: shallow marsh (61 percent), deep marsh (35 percent), coniferous swamp (4 percent), and shrub swamps (less than 1 percent). Furthermore, no wetland fragmentation would result from activities to wetlands in Second Creek area of analysis (PolyMet 2015b). The wetland fragments that are expected to maintain their functions would be included in the wetland hydrology and vegetation monitoring plan that would be developed and implemented for the NorthMet Project Proposed Action.

Changes in Hydrology due to Surficial Groundwater Flow Paths or Seepage from Plant Site

There are three surficial aquifer groundwater flowpaths from the Plant Site (see Figure 5.2.3-21), which include: Unnamed Creek (west flowpath), Trimble Creek (northwest flowpath), and Mud

Lake Creek (north flowpath). Wetland types within the flowpaths that would have potential indirect wetland effects resulting from changes in hydrology are presented in Table 5.2.3-10.



500 ft Increments
Area 2
Plant Site
Stream/River

Eggers & Reed Wetland Types

Coniferous Bog
Coniferous Swamp
Hardwood Swamp
Open Bog
Deep Marsh & Shallow Marsh
Sedge Meadow & Wet Meadow
Shrub Swamps (Alder Thicket & Shrub-Carr)
Shallow, Open Water & Lake

Minnesota Department of Natural Resources
US Army Corps of Engineers St. Paul District
Forest Service U.S. Department of Agriculture

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Figure 5.2.3-20
Wetlands within 500 ft Increments at the Plant Site
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

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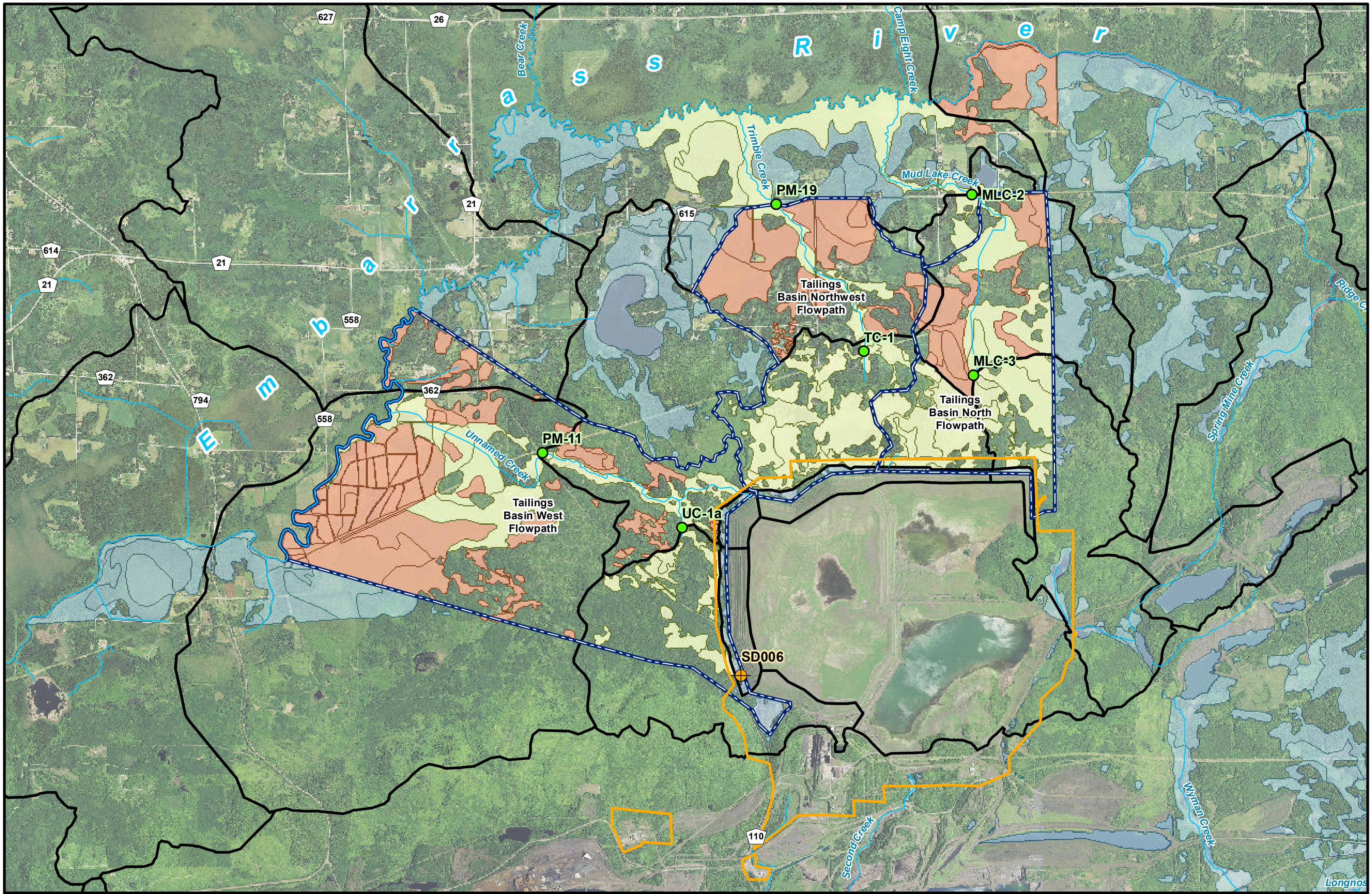

- Plant Site
- Surface Water Monitoring Location
- Approximate Location of NorthMet Project Surface Water Discharge
- Groundwater Flow Path
- Embarrass River Subwatershed
- Wetlands

Wetlands with Potential for Indirect Effects

- Surface Water and Groundwater
- Groundwater Only
- Stream/River

This document is a working document. This document may change over time as a result of new information, further deliberation, or other factors not yet known to the Co-lead Agencies.

0 0.25 0.5 1 1.5 Miles

US Army Corps of Engineers St. Paul District

Figure 5.2.3-21
Wetlands within Groundwater Flowpaths at the Plant Site
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

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Table 5.2.3-10 Wetlands within the Plant Site Flowpaths

Eggers and Reed Class[1]	Hydrology	Unnamed Creek (west flowpath) Acres	Trimble Creek (northwest flowpath) Acres	Mud Lake Creek (north flowpath) Acres
Coniferous bog (Ombrotrophic)	Precipitation	37.6	196.6	58.1
Coniferous swamp	Groundwater	375.5	308.4	630.6
Deep marsh	Groundwater	130.9	97.6	125.8
Hardwood swamp	Groundwater	126.1	0.0	40.9
Open bog	Precipitation	157.5	0.0	0.0
Open water	Groundwater	8.3	0.0	7.4
Sedge/wet meadow	Groundwater	99.3	17.7	0.4
Shallow marsh	Groundwater	196.5	225.8	124.1
Shrub swamps (including alder thicket and shrub-carr)	Groundwater	721.5	236.9	144.9
Total acres of wetland		1,853.0	1,083.0	1,132.3

Source: PolyMet 2015b.

[1] Eggers and Reed 1997, 2014.

The Tailings Basin containment system, located along the northern, northwestern, and western sides of the Tailings Basin, is modeled to collect at least 90 percent of the Tailings Basin groundwater seepage and 100 percent of the surface water seepage. The uncaptured groundwater seepage would travel within the northern, northwestern, and western groundwater flowpaths (see Section 5.2.2). The Tailings Basin containment system located along a portion of the eastern side of the Tailings Basin would collect 100 percent of groundwater and surface water seepage.

All of the surface flow that currently upwells near the west, northwest, and north toes of the Tailings Basin would be captured and treated by the WWTP and then discharged to the tributaries to prevent significant hydrologic effects due to reduction in flow. To the west, the discharge(s) would be directed to a location near the existing surface discharge SD-006 (see Figure 5.2.3-21). To the northwest and north, the discharge(s) would be spigotted at multiple locations along the downstream side of the Tailings Basin containment system to add flow to the adjacent wetlands (PolyMet 2015b). Flow to Mud Creek would be augmented entirely with off-site runoff diverted toward Mud Lake Creek by a drainage swale constructed northeast of Cell 2E. Augmentation would not be necessary at the eastern segment of the Tailings Basin containment system as this area is currently flowing into the Tailings Basin; therefore, the collection of seepage would not have a hydrologic effect to the watershed (PolyMet 2015b). For a detailed discussion of seepage from the Plant Site, refer to Section 5.2.2.

Seepage from the south side of the Plant Site is generally restricted by bedrock outcrops and does not contribute to the groundwater flow south of the Plant Site. All of the seepage from the south side of the Plant Site is surface water, thereby forming the headwaters of Second Creek. There would be no potential indirect effects on wetlands in or abutting Second Creek as a result of changes in groundwater flow (PolyMet 2015b).

Change in Hydrology due to Drawdown

The augmentation described above has been designed such that the existing flows within the tributaries at the Plant Site are maintained within plus or minus 20 percent, which is within the range of annual variability in precipitation as well as streamflow, within the Embarrass River Watershed. Therefore, changes to downstream hydrology, including adjacent wetlands, would be expected to be within the range of that typically observed due to natural variability (PolyMet 2015b).

Potential indirect effects on Mud Lake Creek, Trimble Creek, and Unnamed Creek due to reduced or increased seepage at the toe of the Tailings Basin are greatest immediately downstream of the toe, where seepage and augmentation account for nearly all the water yield. Downstream of the toe, the indirect effects on these three creeks would be reduced as the watershed area tributary to that location increases, and the portion of total water yield derived from runoff increases. Therefore, hydrologic effects diminish as distance from the Tailings Basin increases. Wetlands further from the Tailings Basin would likely experience less potential for indirect effects due to hydrologic changes (PolyMet 2015b).

Flow augmentation at the southern toe of the Tailings Basin has been designed such that flows to Second Creek would be within ±20 percent of the pre-Consent Decree condition, which is within the range of annual variability in precipitation as well as streamflow, within the Partridge River and Embarrass River watersheds. No potential indirect wetland effects would be anticipated for the wetlands abutting Second Creek (PolyMet 2015b).

Wetland hydrology is a complex mix of precipitation, surface runoff, and, in some cases, groundwater. Despite the use of augmentation to mitigate effects, the response of complex natural systems to human disturbances could only be estimated. Therefore, monitoring of wetland hydrology and vegetation communities would be the most appropriate way to document the extent and magnitude of wetland responses to the NorthMet Project Proposed Action.

Please refer to Section 5.2.3.2.2, Changes in Hydrology Due to Drawdown subsection, for the hydrologic wetland sensitivity assessment that was performed to estimate how wetland communities would respond to groundwater drawdown by assuming that they would change to drier native plant communities or variants of the original community.

Wetlands Abutting Unnamed Creek, Trimble Creek, Mud Lake Creek, and Second Creek

There are 2,754.8 acres of wetlands abutting Unnamed Creek, Trimble Creek, and Mud Lake Creek within Area 2, and Second Creek, which include shrub swamps, coniferous swamp, hardwood swamp, shallow marsh, deep marsh, and sedge/wet meadow (see Figure 4.2.3-5) are presented in Table 5.2.3-11.

Table 5.2.3-11 Wetlands Abutting Unnamed Creek, Trimble Creek, Mud Lake Creek, and Second Creek

	Unnamed Creek		Trimble Creek		Mud Lake Creek		Second Creek		Total Wetlands Abutting Creeks	
Eggers and Reed Class[1]	**Acres**	**%**	**Acres**	**%**	**Acres**	**%**	**Acres**	**%**	**Acres**	**%**
Coniferous swamp	16.3	3	130.3	15	474.3	41	0.0	0	620.9	23
Deep marsh	53.8	10	5.9	1	0	0	14.3	8	74.0	3
Hardwood swamp	98.1	19	0	0	31.0	3	0.0	0	129.1	5
Sedge/wet meadow	0	0	17.7	2	0	0	0.0	0	17.7	1
Shallow marsh	85.8	16	36.7	4	0	0	45.8	26	168.3	6
Shrub swamp (including alder thicket or shrub-carr)	273.0	52	695.8	78	657.1	57	118.8	66	1744.7	63
Total Acres of Wetlands	527.1	100	886.4	100	1,162.4	100	178.9	100	2,754.8	100

Sources: PolyMet 2015b

[1] Eggers and Reed 1997, 2014.

Water management at the Plant Site would consist of flow augmentation immediately downstream of the Tailings Basin containment system to minimize hydrologic effects on downstream watercourses (PolyMet 2015b). The hydrologic analysis (see Section 5.2.2) estimated that the changes in average annual flow of Unnamed Creek, Trimble Creek, Mud Lake Creek, and Second Creek would be within the annual variability that naturally occurs within the Partridge River and Embarrass River watersheds. Therefore, no potential indirect wetland effects were identified for the wetlands abutting Unnamed Creek, Trimble Creek, Mud Lake Creek, and Second Creek (PolyMet 2015b).

Water Quality Changes

The screening analysis for depositional effects conducted to estimate potential annual deposition of dust, metals, and sulfur to wetlands within and adjacent to the Plant Site was performed using AERMOD. The estimated deposition from fugitive dust emissions was used to identify wetlands that have the potential for water quality changes. The estimated deposition from fugitive dust emissions was used to identify a threshold for a negative effect on vegetation.

Below is a summary of the assessment from the *NorthMet Project Wetlands Data Package* (PolyMet 2015b).

Receptors

The receptors of interest for this analysis were the wetlands that were not directly impacted. The respective initial receptor grids for the Plant Site were set up with near-field receptor spacing of 250 meters within the ambient air boundary and the far-field receptor spacing was 1,000 meters from the ambient air boundary out to 5 km.

Dust Deposition and Speciation to Individual Metals and Sulfur

For the dust emission sources identified for assessing potential metals and sulfur deposition at the Plant Site, the highest estimated dust deposition rate for each receptor node was then speciated to the respective metal and sulfur deposition rates based on the contribution of the sources to a receptor node and the metal and sulfur composition identified for each contributing source (e.g., tailings at the Plant Site). The estimated metal or sulfur deposition for each contributing dust source at a receptor node was then summed to provide a “total” deposition rate for each respective metal and for sulfur at that receptor location. Dust deposition rates were speciated for arsenic, cadmium, chromium, lead, manganese, nickel, and selenium. Copper and vanadium were also included. For each receptor node, the post-processing of the dust deposition rate by source contribution was then summed to provide a “total” metal deposition rate and a “total” sulfur deposition rate.

Sulfur associated with fugitive dust is part of the mineral matrix of the rock particles (sulfide). Therefore, weathering of the particle must occur before any of the sulfur would be released to soil, soil water, or surface water. Because the NorthMet ore is low in mercury, the tailings would also be low in mercury, and the pilot study indicated that the mercury preferentially goes to the flotation concentrate. The mercury is also expected to be strongly bound within the mineral matrix. This would also be true for the LTVSMC tailings that would be used to construct the Tailings Basin dams and that may be present on some road surfaces. Therefore, any mercury present in dust from the Tailings Basin would not be biologically available (PolyMet 2015b). Potential mercury air emissions from ore processing (i.e., potential emissions from the autoclave) were evaluated for potential local deposition impacts (see Section 5.2.7).

Estimates of Rural Background Deposition

For dust, an annual effects-level deposition rate of 365 $g/m^2/yr$ was compared to modeled annual dust deposition rates. This deposition rate is a potential effects threshold for photosynthesis (i.e., potential for reduced photosynthesis due to “dusting” of the plant surface). However, for this analysis, the vegetative surface area of the wetlands was not calculated or included in the analysis. The modeled dust deposition rate was assumed to be applied to the land surface area, which is a smaller area than the vegetative surface area. Vegetative surface area can be up to 13 times greater than the land surface area. By only assessing dust deposition to the land surface area instead of the vegetative surface area, it is likely the ratio of modeled deposition rate to the effects level was being overestimated. In other words, the modeled deposition rate is not being spread over the larger surface area of the vegetation which would reduce the effective deposition rate. Because this application did not include the deposition of dust to the vegetative surface area, it is likely that the areas identified to exceed the effects threshold of 365 $g/m^2/yr$ have been overestimated.

For metals, background deposition is based on the data from *Atmospheric Deposition of Trace Metals at Three sites near the Great Lakes* (Sweet et al. 1997), which indicated that precipitation was under-collected by 45 to 70 percent when sample volumes were compared to corresponding rain gage amounts. Because wet deposition was considered to be underestimated, the wet deposition component was adjusted upward by a factor of 1.6.

Total background sulfur deposition included both wet and dry deposition, which was calculated to be 0.16 $g/m^2/yr$. The estimated background deposition used in the analysis for metals and sulfur was from data collected at sites characterized as open areas in rural settings that are reasonably distant from industrial sources and population centers. For forested areas, dry deposition may be underestimated. Vegetation can effectively scavenge fine particles and aerosols from the atmosphere and this interception can result in dry deposition being 50 percent or more of the total deposition. A monitoring site in Ely (Fernberg Road), dry deposition was assumed to be 22 percent of total deposition. Therefore, it is likely that the background sulfur deposition estimated for this analysis may be low due to an underestimation of dry deposition;

however, no adjustments were made to the background sulfur deposition estimated for this analysis.

Significance Levels for Estimating the Potential Effects for Identifying Future Monitoring

For dust, metals, and sulfur, the following general categories were used for assessing the significance of a modeled deposition rate at a receptor node:

- Less than 100 percent of background: no potential for effects expected.
- Greater than 100 percent of the background value: potential for effects, include in future wetland monitoring.

These are general categories of potential for effects. Since this was a screening analysis to identify wetlands for potential inclusion in the monitoring program, there was some flexibility in identifying a potential level of deposition that suggested a potential for effect and would then trigger a requirement for monitoring. Another consideration for selecting a deposition rate that was a high percent of the background rates was the likely overestimation of modeled deposition and the underestimation of background deposition.

Adding to the conservatism in the modeling of particulate metals, this screening analysis used a maximum dust deposition from a range of possible modeled values and a high-end metal or sulfur concentration for each source contributing to that receptor node to derive a maximum potential metal or sulfur deposition for a receptor node.

Using a maximum concentration for each contributing emission source to speciate a metal or sulfur deposition from a maximum modeled dust deposition rate for each receptor node overestimates individual metal or sulfur deposition. Also adding to the conservatism of this analysis is the underestimation of background deposition because the ratio of the NorthMet Project Proposed Action-related deposition is compared to the background deposition. If background deposition is underestimated, that would indicate that estimated NorthMet Project Proposed Action-related deposition at more receptor nodes are higher than background and further increases the area for potential future monitoring. The underestimation of background metal deposition (i.e., wet deposition due to under-collection of precipitation) was identified by Sweet et al. (1997). In addition to the underestimation of background metal deposition, background wet sulfate deposition may be underestimated, as well, because the National Atmospheric Deposition Program data for the Fernberg Road monitoring site indicated rainfall in the last three years was about 22 percent below the annual average. If sulfate deposition from 2007 and 2008 was used (both years approximately normal for precipitation amount), a background sulfur deposition rate of 0.23 $g/m^2/yr$ was calculated—about 44 percent higher than the background deposition used in the screening analysis. If the higher estimate of background sulfur deposition was used in the screening analysis, a smaller number of receptor nodes would have been identified to have modeled sulfur deposition that was more than 100 percent of background deposition and the area for potential monitoring would be smaller than that identified. Also, it was found that for forested areas, dry deposition may be systematically underestimated due to sample collection and analysis methodology. It is possible that the background sulfur deposition estimated for this analysis may be low due to an underestimate of dry deposition.

Given the potential for overestimation of modeled deposition and underestimation of background deposition, and balancing the conservatism when their respective results are combined in this analysis, it seems reasonable to select the wetlands estimated to receive greater than 100 percent of background deposition (a potential doubling of the background deposition) for consideration in potential future monitoring (PolyMet 2015b).

Fugitive Dust/Metals and Sulfide Dust Emissions

At the Plant Site, dust deposition was highest in three locations: southwest corner, northwest of the Plant Site; southeast corner; and the northeast corner, towards Area 5. All receptors have model-estimated dust deposition of 50 percent or less of the effects-level background of 365 $g/m^2/yr$ (see Figure 5.2.3-22). The model-estimated dust deposition is largely constrained to within the ambient air boundary at the Plant Site, and the model-estimated dust deposition is 50 percent or less of the effects-level background dust deposition. There would be no potential indirect wetland effects due to dust deposition in the Second Creek area of analysis (PolyMet 2015b).

At the Plant Site, there would be two locations showing model-estimated metal and sulfur deposition rates greater than 100 percent of background deposition: 1) approximately the southern and western two-thirds of the basin and 2) a small area on the northern and eastern portion of the ambient air boundary (see Figure 5.2.3-23). Approximately 90 percent of the receptor nodes with the highest model-estimated metal and sulfur deposition rates (rates greater than 100 percent of background deposition) were located within the ambient air boundary. The remaining 10 percent of the receptor nodes with the highest modeled-estimated metal and sulfur deposition are located to the south and east of the Plant Site outside of the ambient air boundary (PolyMet 2015b).

Of the 25,846 acres of wetlands identified within the Plant Site receptor grid, deposition modeling results indicate that 193.9 acres of wetland could be potentially indirectly affected (modeled metal deposition rates greater than 100 percent of background). Of the 193.9 acres, 58.8 acres would be located within the Plant Site ambient air boundary (PolyMet 2015b). The 193.9 acres of wetlands should be included in any future monitoring to be conducted for the NorthMet Project Proposed Action.

The deposition modeling results identified approximately 44 acres in the Second Creek area of analysis that could potentially indirectly affected (modeled metal deposition greater than 100 percent background). Of the 44 acres, 1 acre is located within the Plant Site ambient air boundary. These wetlands are accounted for in the 193.9 acres noted above and would already be included in any future monitoring.

The deposition modeling results for dust, metals, and sulfur would likely not have an adverse effect on wetlands; however, the modeling only indicated those areas that had deposition rates greater than 100 percent of background deposition (PolyMet 2015b). These specific wetlands areas would be identified for consideration in any future monitoring to be conducted for the NorthMet Project Proposed Action.

The initial assessment provided a discussion on conservatism, including a discussion that the estimated sulfur deposition was as particle-bound sulfur, with the sulfur being inherent to the mineral matrix of the dust and not readily available for dissolution in soils or surface waters. A supplemental assessment has been conducted to provide for a worst-case scenario in that all of the sulfur in fugitive dust converts to sulfate and would mix with surface water in a wetland (Barr 2015f). A summary of the supplemental assessment evaluation of sulfur from stack emissions is included in Section 5.2.7.2.6, while the fugitive dust evaluation is presented herein.

Based on a conservative assumption that all sulfur in fugitive dust converts to sulfate and mixes with surface water in wetlands, a potential incremental increase in sulfate was calculated as 4.2 mg/L. When the potential incremental sulfate concentration is mixed with annual precipitation, the sulfate value was calculated as 1.7 mg/L. Because the sulfur is inherent to the mineral matrix of the dust particles, it is likely that less than 100 percent of the sulfur would be weathered from the particles and be available to go into solution if deposited to soils or water. While this potential incremental change may warrant future monitoring, it would not be expected to have an effect on methylmercury concentrations in surface water based on available data that indicate a relative insensitivity of wetlands to additional sulfate (Barr 2015f).

Although the actual potential for deposition of fugitive dust to wetlands, and the potential release of sulfur in that dust, is uncertain, any adverse effects on wetlands are unlikely. The fugitive dust control plan for both the Mine Site and the Plant Site (including the Tailings Basin) would minimize such deposition, and the sulfur from any rock dust particles that would be deposited may not be released or only released slowly through weathering. Using a conservative assumption that all sulfur in the deposited dust is both released and transformed to sulfate, no significant increase in methylmercury concentrations would be expected (Barr 2015f). Additional information in regards to mercury methylation is provided in Section 5.2.2.3.4. A discussion of mercury deposition and bioaccumulation in fish and the assessment of the cumulative effects is provided in Section 6.2.6.3.3.

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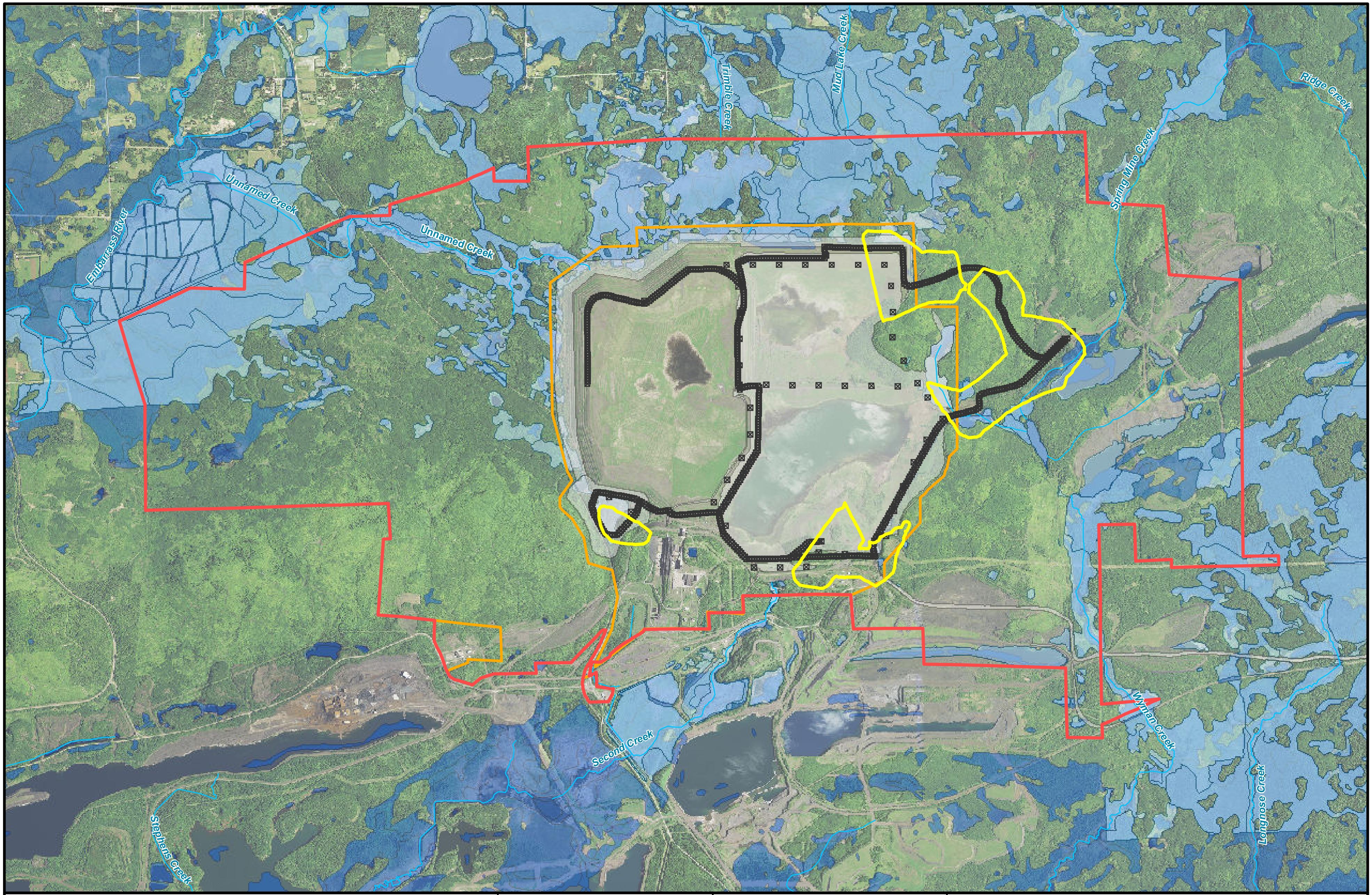

Ambient Air Boundary
Extent of Highest Estimated Deposition Receptors with Deposition of 50% of Background
Plant Site
Disturbed Area
Volume Sources (Roads)
Wetlands
NWI Wetland
Stream/River

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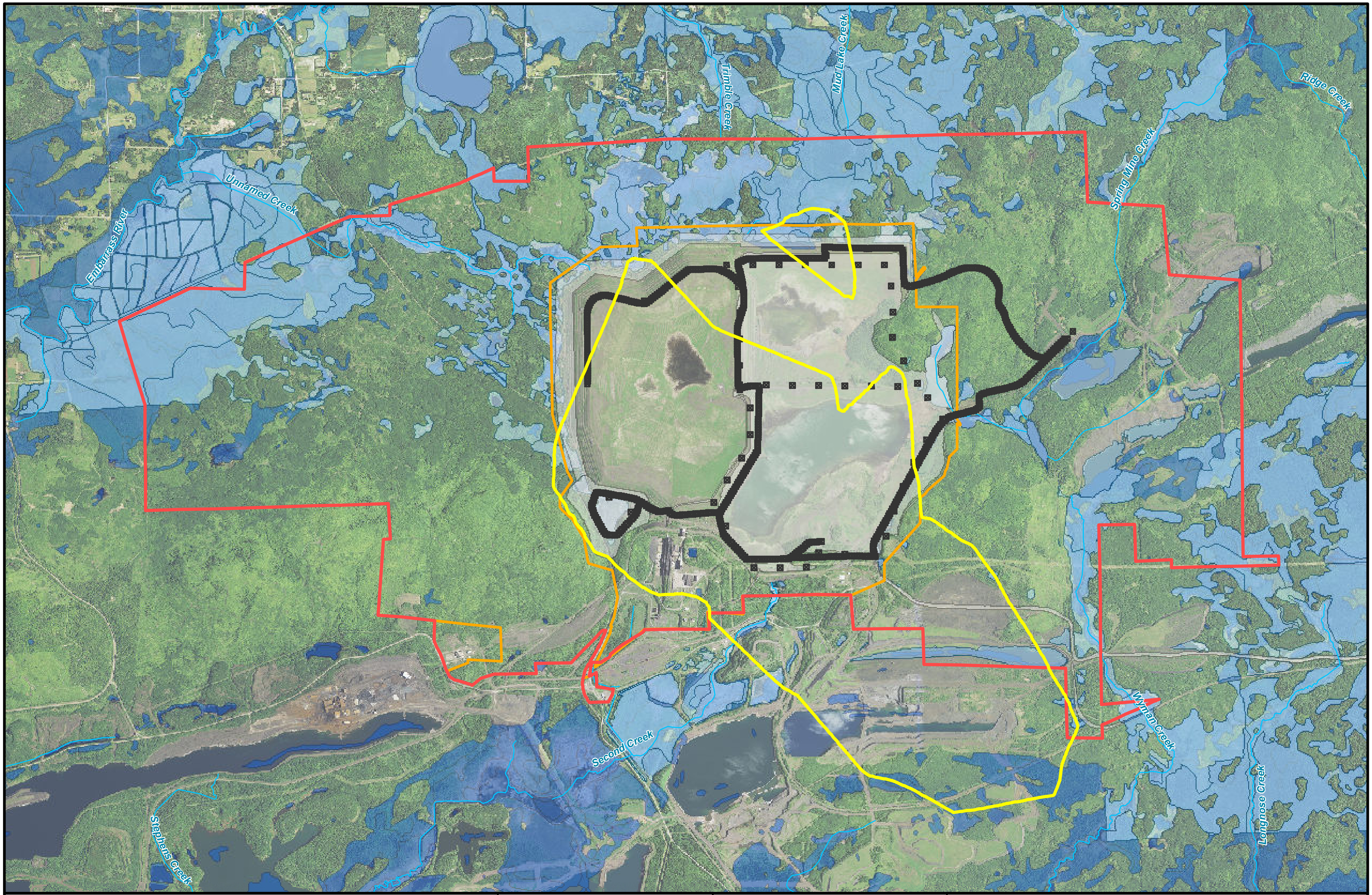
0 0.25 0.5 1 Miles

Figure 5.2.3-22
Model - Estimated Dust Deposition Compared to Background Effects Level - Plant Site
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

1344 -Page Intentionally Left Blank-



Ambient Air Boundary

Extent of Highest Estimated Deposition Receptors with Deposition of 100% of Background

Plant Site

Disturbed Area

Volume Sources (Roads)

Wetlands

NWI Wetland

Stream/River

US Army Corps of Engineers
St. Paul District

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N W E S

0 0.25 0.5 1 Miles

Figure 5.2.3-23

Model - Estimated Metal Deposition Compared to Background Effects Level - Plant Site

NorthMet Mining Project and Land Exchange PFEIS

Minnesota

June 2015

1346 -Page Intentionally Left Blank-

Water Quality Changes

The NorthMet Project Proposed Action could affect water quality downstream of the Tailings Basin and in the Second Creek area by alternating the chemistry and volume of seepage and surface water discharges leaving the Tailings Basin and to the headwaters of Second Creek (PolyMet 2015b; PolyMet 2015j). The NorthMet Project Proposed Action is predicted to meet all water quality evaluation criteria, or not worsen conditions where contamination already exceeds the criteria. The collection of existing seepage by the containment system and augmentation with WWTP effluent water would generally improve downstream water quality relative to current conditions. Effects that would occur on surface water and groundwater quality are discussed in Section 5.2.2. Even if water quality improves, there would be a potential for indirect effects to wetlands due to changes in water quality. Potential indirect wetland effects due to water quality changes that would likely occur at the Plant Site would be a result of changes in groundwater quality, in surface water quality, or in both groundwater and surface water quality and would be limited to the wetlands abutting Second Creek (PolyMet 2015b).

Wetland areas that would be potentially affected by water quality changes are shown in Figure 5.2.3-21 and listed in Table 5.2.3-12. Note that within this section, the term groundwater and surface water refer to the path by which NorthMet Project Proposed Action water leaves the Tailings Basin (e.g., potential effects from Tailings Basin groundwater seepage that discharges to surface water at a downstream location are classified as a potential effect due to changes in groundwater quality). Potential indirect effects due to changes in surface water quality are expected to diminish as the distance from the Tailings Basin increases. Upstream of County Road 666, there are approximately 179 acres of wetlands abutting Second Creek that could be potentially indirectly affected by the change in water quality due to stream flow augmentation of Second Creek.

Table 5.2.3-12 Wetland Areas Potentially Indirectly Affected by Changes in Water Quality

Wetland Area Potentially Affected by Changes in Water Quality	Mud Lake Creek (North)	Trimble Creek (Northwest)	Unnamed Creek (West)	Downstream of Groundwater Flowpaths[3]	Total
	Acres	Acres	Acres	Acres	Acres
Groundwater Quality[1]	296.5	514.0	1,162.1	--	1,972.7
Surface Water and Groundwater Quality[2]	835.8	568.9	690.9	570.2	2,665.7
Total	1,132.3	1,082.9	1,853.0	570.2	4,638.4

Source: PolyMet 2015b.

[1] Groundwater refers to water leaving the Tailings Basin within the surficial aquifer. Effects resulting from the discharge of that seepage to surface water have been considered an effect due to groundwater in the analysis.

[2] All areas potentially affected by changes in surface water quality have also been potentially affected by changes in groundwater quality.

[3] Potentially affected wetlands are located along Trimble Creek and Mud Lake Creek, but outside of groundwater flowpaths (see also Footnote (1)).

Potential for indirect effects from changes in groundwater quality may occur anywhere along the modeled groundwater flowpaths previously mentioned. Wetlands abutting the three creeks that may be indirectly affected (4,068.2 acres) by changes in groundwater quality are shown on Figure 5.2.3-21. The effects on groundwater quality diminish as distance from the Tailings Basin increases, as the relative portion of total groundwater that originates from the Tailings Basin decreases (see Section 5.2.2). It has been determined that the amount of Tailings Basin seepage remaining in the surficial aquifer would be small; therefore, the potential for indirect effects as a result of changes in groundwater quality are anticipated to be small.

Potential effects from changes in groundwater quality may also occur in wetlands abutting tributary streams (all reaches of Unnamed Creek, Trimble Creek, and Mud Lake Creek) into which affected groundwater would discharge (see Figure 5.2.3-21). Wetlands abutting these streams and outside of the modeled groundwater flowpaths resulted in an additional 570.2 acres of potential indirect effects due to changes in groundwater quality (PolyMet 2015b).

Potential indirect effects from changes in surface water quality would also likely occur in wetlands within the surface watersheds immediately downstream of the Tailings Basin, which includes watersheds upstream of modeling locations UC-1a, TC-1, and MLC-3 (see Figure 5.2.3-21). The potential indirect effects from changes in surface water quality include 1,158 acres of wetlands (all of which would also likely be potentially indirectly affected by changes in groundwater quality). Downstream of these locations, potential indirect effects due to changes in surface water quality are limited to wetlands abutting the tributary streams. These areas include an additional 1,505 acres of wetlands (all of which may also be potentially indirectly affected by changes in groundwater quality) (PolyMet 2015b).

As with effects from changes in groundwater quality, potential effects as a result of changes in surface water quality would be expected to diminish as distance from the Tailings Basin increases and flows originating from the NorthMet Project Proposed Action are diluted by natural runoff.

The wetland hydrology downstream of the Tailings Basin is too complex to be accurately incorporated into the Plant Site probabilistic model detailed in Section 5.2.2. The response of such complex natural systems to water quality changes originating at the Tailings Basin can only be estimated (PolyMet 2015b). Therefore, monitoring of wetland hydrology and vegetation communities would be the best way to document the extent and magnitude of wetland responses (potential indirect wetland effects) to the NorthMet Project Proposed Action.

5.2.3.2.5 Summary of NorthMet Project Proposed Action Direct Impacts and Indirect Wetland Effects

Direct Impacts

Direct wetland impacts for the NorthMet Project Proposed Action are summarized in Table 5.2.3-13. Of the 166 wetlands within the NorthMet Project area, 128 wetlands would be directly impacted, totaling 913.8 acres of direct wetland impact. The Mine Site would contain the majority of the direct wetland impacts. The majority of the direct impacts would occur as a result of a combination of filling and excavation (65 percent) (see Table 5.2.3-14).

Table 5.2.3-13 Total Projected Direct Wetland Impacts for the NorthMet Project Proposed Action

Eggers and Reed Class[1]	Directly Impacted Wetlands Acres	%	No.
Coniferous bog	509.1	56	24
Coniferous swamp	82.6	9	17
Deep marsh	74.1	8	16
Hardwood swamp	13.2	1	3
Open bog	7.6	1	4
Open water (includes shallow, deep, open water, and lakes)	0.0	0	0
Sedge/wet meadow	39.6	4	11
Shallow marsh	76.7	8	23
Shrub swamp (includes alder thicket and shrub-carr)	110.8	12	31
Total Direct Impacts	913.8	100[2]	129

Source: PolyMet 2015b.

[1] Eggers and Reed 1997, 2014.
[2] Percent totals are less than 100 percent due to rounding.

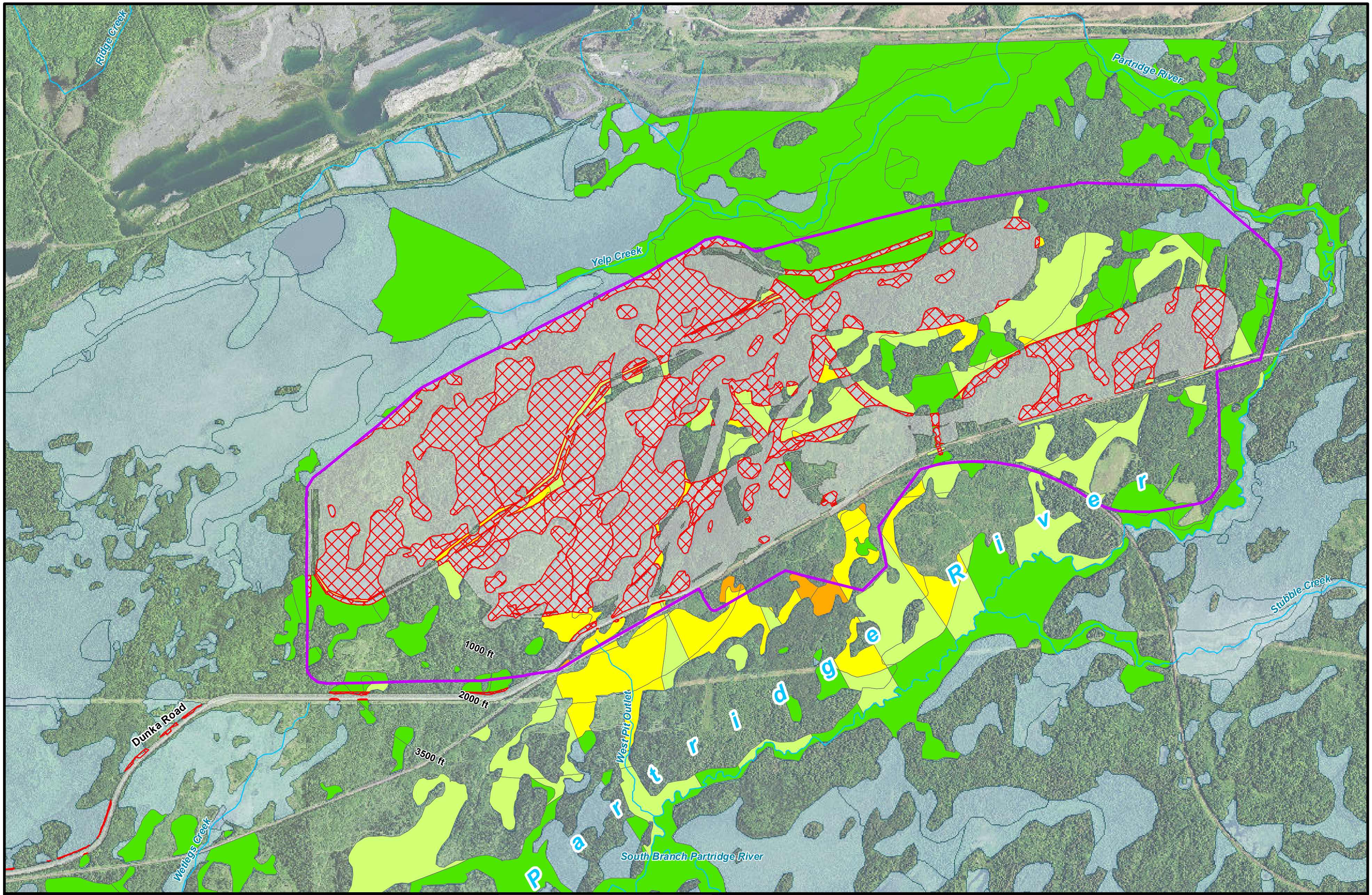
Table 5.2.3-14 Type of Projected Direct Wetland Impacts for the NorthMet Project Proposed Action

Type of Effect	Directly Impacted Wetlands Acres	%	No.
Fill	102.8	11	67
Excavation	133.1	15	15
Fill and Excavation	593.2	65	23
Containment System	84.7	9	24
Total Direct Impacts	913.8	100	129

Source: PolyMet 2015b.

<u>Potential Indirect Effects</u>

Potential indirect wetland effects from the NorthMet Project Proposed Action would result from one or more of the following six factors: 1) wetland fragmentation; 2) change in wetland hydrology resulting from changes in watershed area; 3) changes in wetland hydrology due to groundwater drawdown resulting from open pit mine dewatering; 4) changes in wetland hydrology from groundwater drawdown resulting from operation of the Plant Site, including groundwater seepage containment; 5) changes in stream flow near the Mine Site and Plant Site, as well as associated effects on wetlands abutting the streams; and 6) changes in wetland water quality related to atmospheric deposition of dust and rail car spillage associated with Mine Site and Plant Site operations. A rating system (scaled from 0 to 6) was developed for the wetlands based on the number of factors that may potentially affect it. Wetlands that were not determined to be potentially indirectly affected were rated as zero and wetlands that were determined to be potentially indirectly affected by all six factors were rated as a six; however, no wetlands were rated as a six (see Figures 5.2.3-24 and 5.2.3-29) (PolyMet 2015b). The NorthMet Project Proposed Action could indirectly affect up to either 7,694.2 acres of wetlands located within and around the NorthMet Project area, based on the method of wetlands crossing analog impact zones, or up to 6,568.8 acres of wetlands located within and around the NorthMet Project area, based on the method of wetlands within analog impact zones (PolyMet 2015b). The indirect effects analyses performed for the EIS were not performed to characterize impacts but were done to inform where monitoring should take place for those areas that were identified as having a potential for indirect wetland effects. Potential indirect wetland effects are presented in Table 5.2.3-15.



Mine Site
Direct Wetland Impacts
Disturbed Area
Stream/River

Potential Wetland Indirect Impact Factor Rating

5
4
3
2
1
No Impact

US Army Corps of Engineers
St. Paul District

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Feet

Figure 5.2.3-24
Mine Site Wetlands and Potential Indirect Wetland Effects
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

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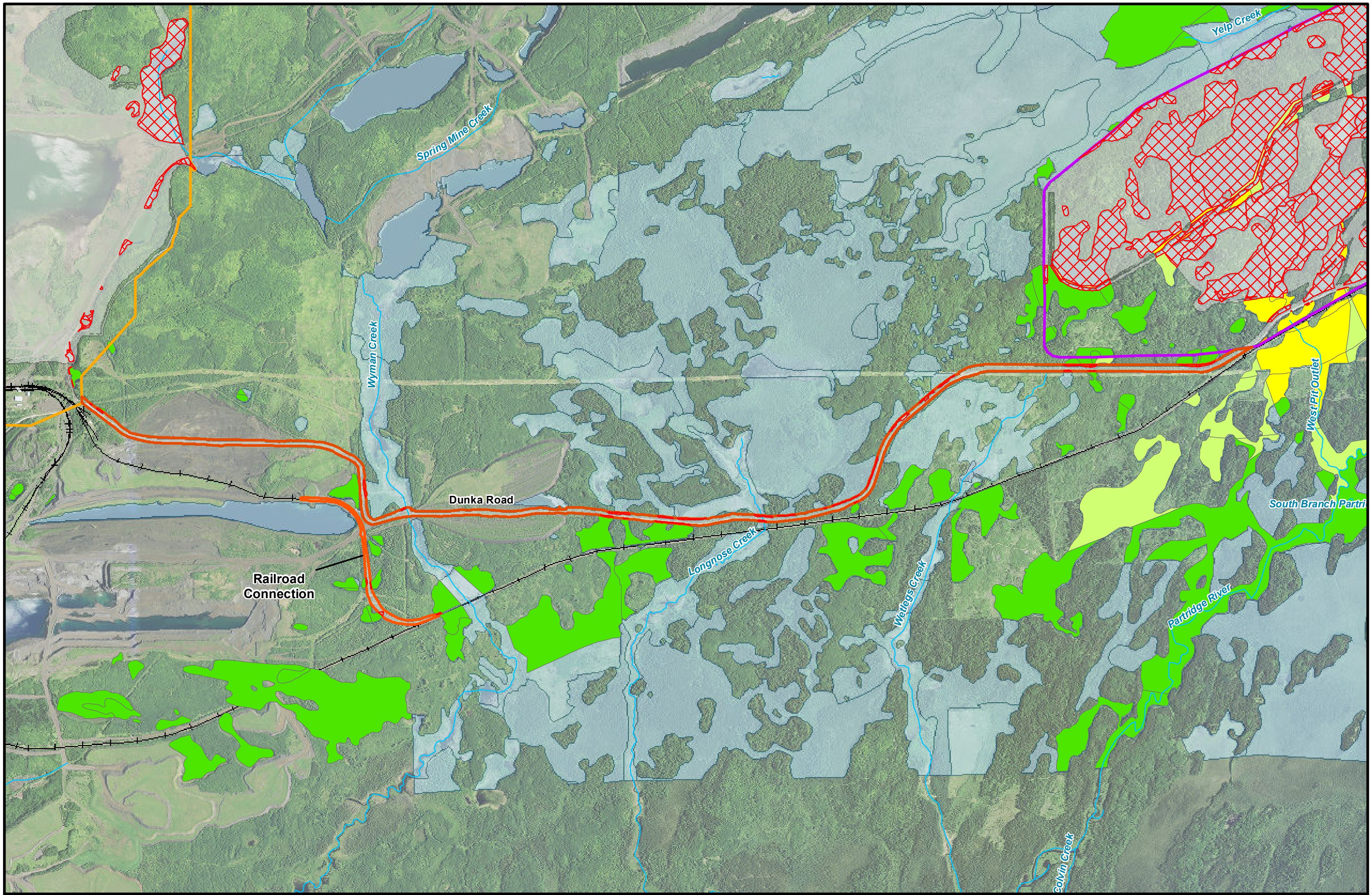

Transportation and Utility Corridor
Mine Site
Plant Site
Direct Wetland Impacts
Disturbed Area
Stream/River
Existing Railroad

Potential Wetland Indirect Impact Factor Rating

4
3
2
1
No Impact

US Army Corps of Engineers
St. Paul District

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0 1,000 2,000 4,000 Feet

Figure 5.2.3-25

Transportation and Utility Corridor Wetlands and Potential Indirect Wetland Effects

NorthMet Mining Project and Land Exchange PFEIS

Minnesota

June 2015

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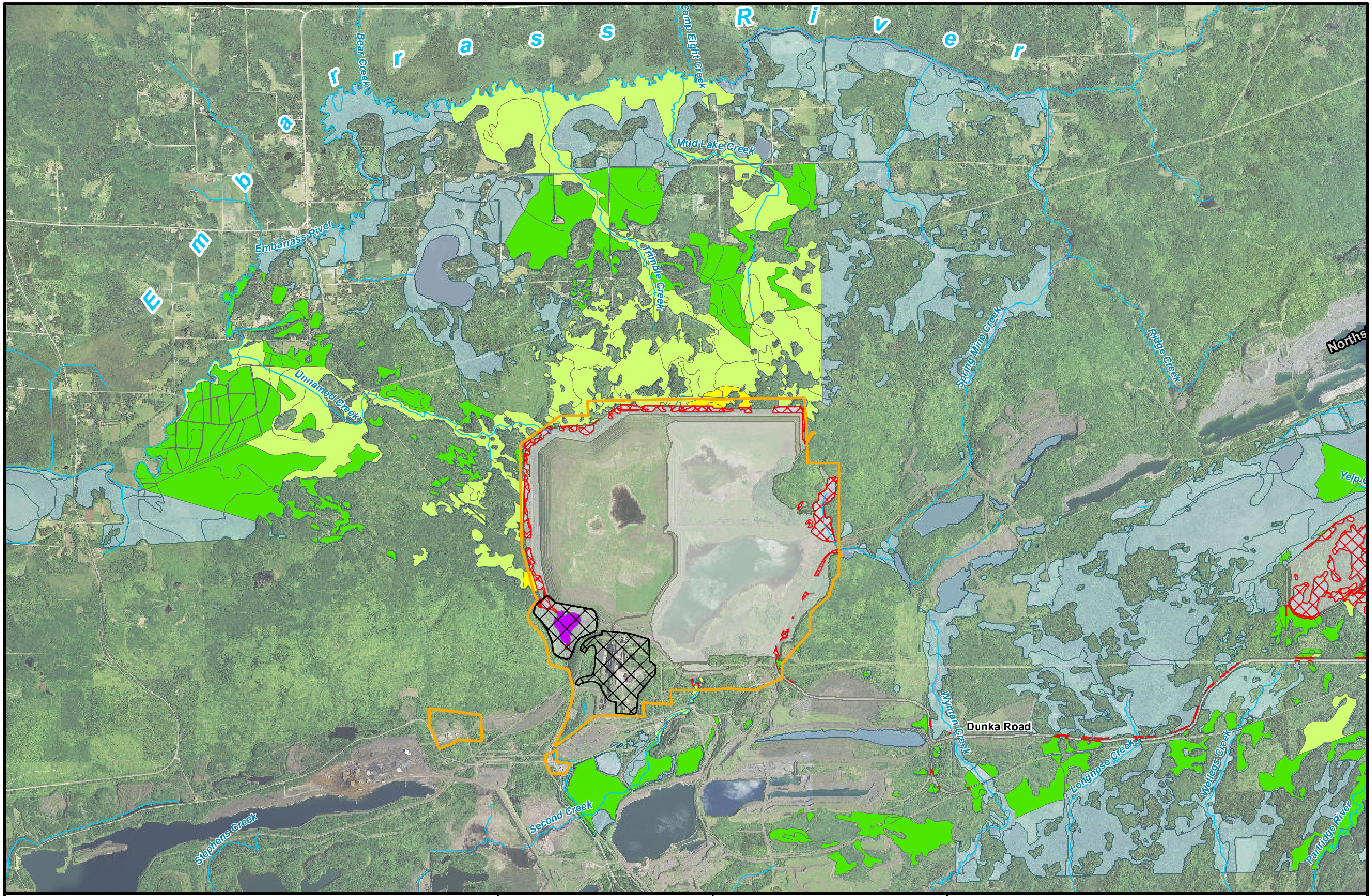

Plant Site
Direct Wetland Impacts
Areas Excluded from Plant Site Boundary
Disturbed Area

Stream/River
No Impact

Potential Wetland Indirect Impact Factor Rating

5
4
3
2
1
Exempt

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N W E S

0 0.25 0.5 1 Miles

Figure 5.2.3-26

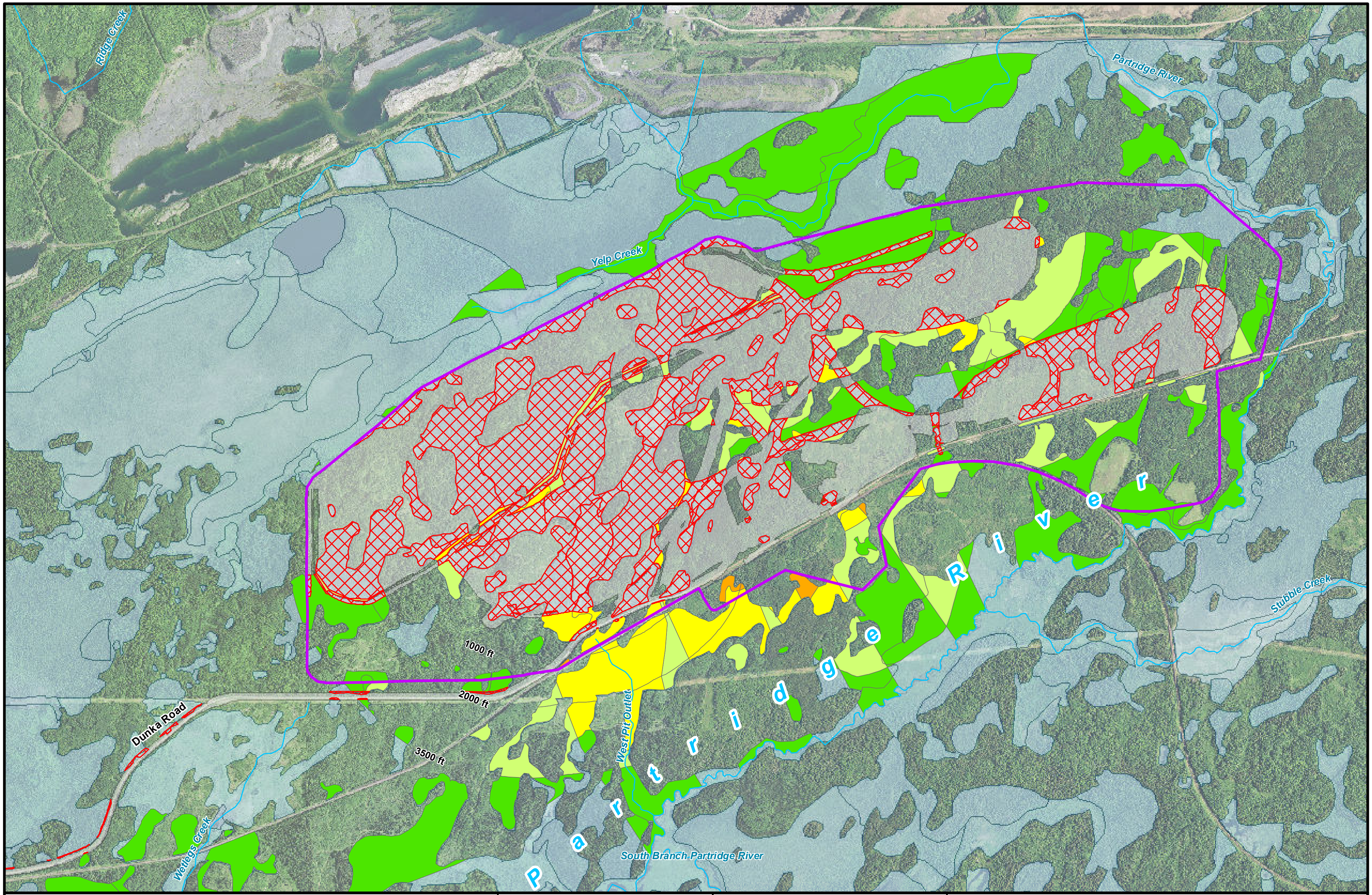
Plant Site Wetlands and Potential Indirect Wetland Effects

NorthMet Mining Project and Land Exchange PFEIS

Minnesota

June 2015

1454 -Page Intentionally Left Blank-



Mine Site
Direct Wetland Impacts
Disturbed Area
Stream/River

Potential Wetland Indirect Impact Factor Rating

5
4
3
2
1
No Impact

US Army Corps of Engineers
St. Paul District

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Figure 5.2.3-27

Mine Site Wetlands and Potential Indirect Wetland Effects - Alternate Method

NorthMet Mining Project and Land Exchange PFEIS

Minnesota

June 2015

1456

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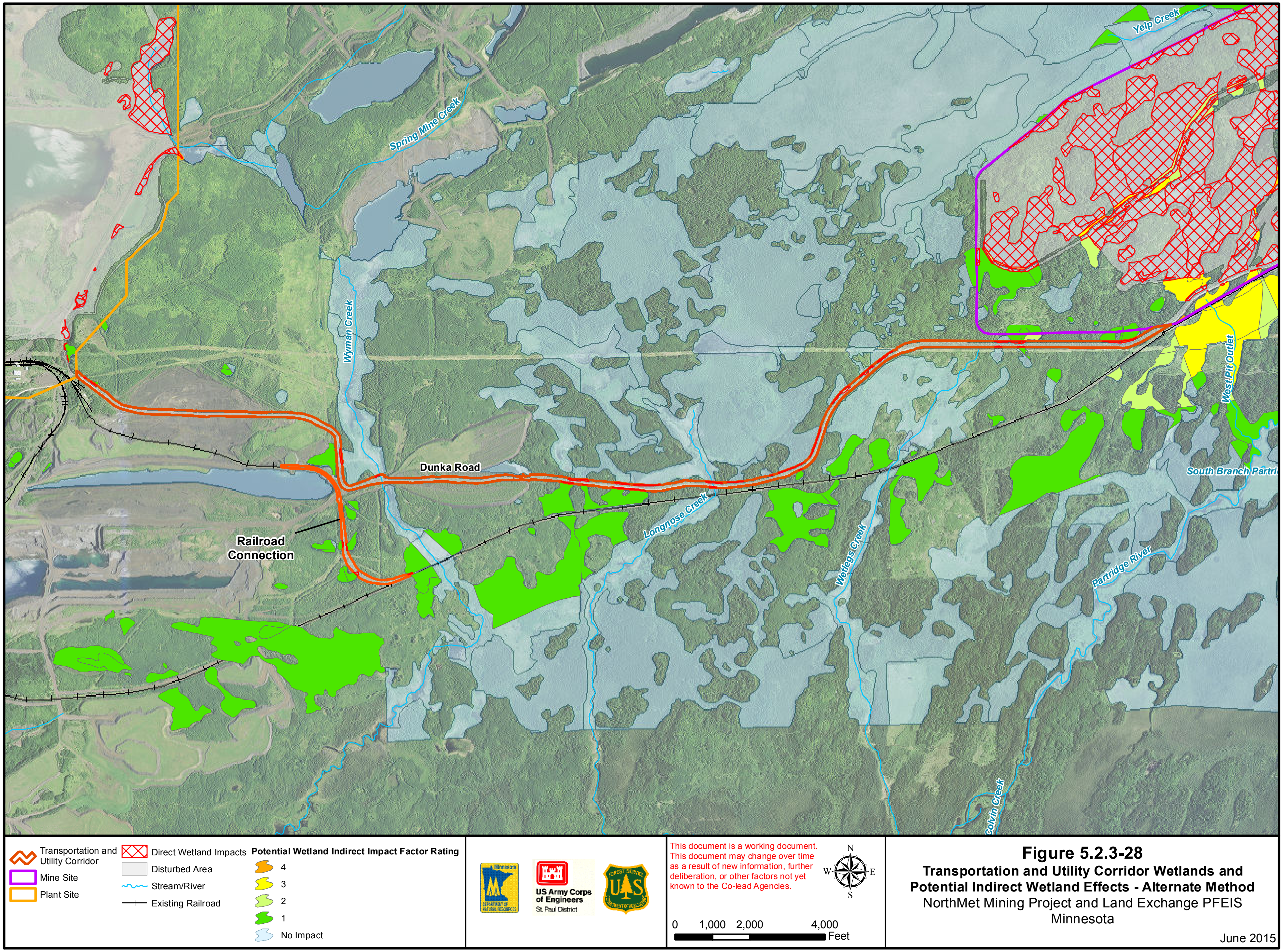
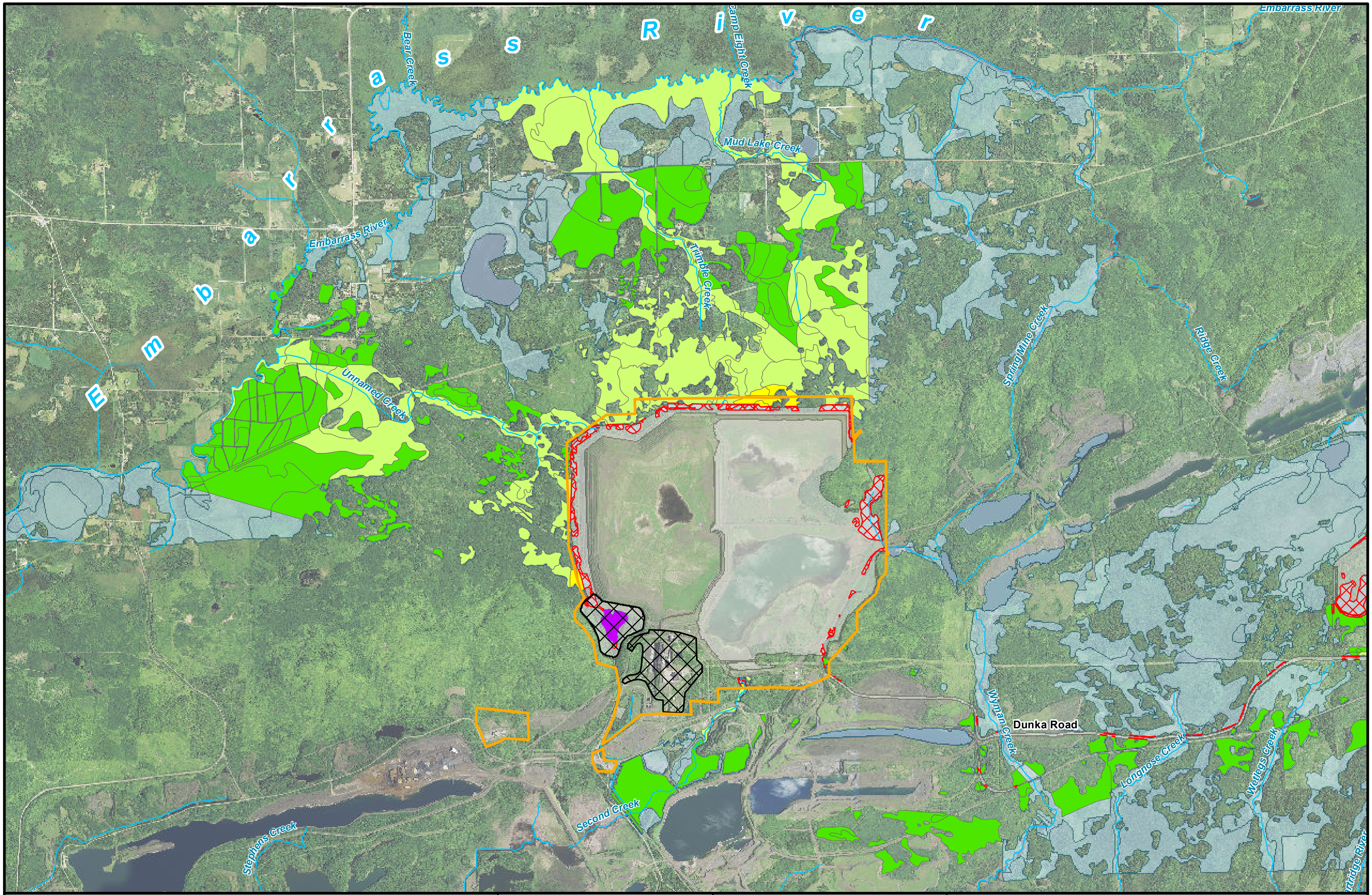


Figure 5.2.3-28
Transportation and Utility Corridor Wetlands and Potential Indirect Wetland Effects - Alternate Method
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

1458 -Page Intentionally Left Blank-



Plant Site
Direct Wetland Impacts
Areas Excluded from Plant Site Boundary
Disturbed Area
Stream/River
No Impact

Potential Wetland Indirect Impact Factor Rating

5
4
3
2
1
Exempt

Minnesota Department of Natural Resources
US Army Corps of Engineers St. Paul District
Forest Service U.S. Department of Agriculture

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N W E S

0 0.25 0.5 1 Miles

Figure 5.2.3-29
Plant Site Wetlands and Potential Indirect Wetland Effects - Alternate Method
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

1460 -Page Intentionally Left Blank-

Table 5.2.3-15 Summary of Projected Potential Indirect Wetland Impacts for the NorthMet Project Proposed Action

Rating[1]	Total Indirect Wetlands (based on the method of wetlands *crossing* analog impact zones)		Total Indirect Wetlands (based on the method of wetlands *within* analog impact zones)	
	Acres	**%**	**Acres**	**%**
1	4,305.9	56	3,466.1	53
2	3126.8	41	2,888.4	44
3	245.3	3	206.0	3
4	15.9	<1	8.1	<1
5	0.3	<1	0.3	<1
Total Acres of Indirect Wetland Impact[2]	7,694.2	100	6,568.8	100

Sources: PolyMet 2015b

[1] A wetland may be potentially indirectly affected by none of the six factors or up to a maximum of six, with different combinations of factors possible. A rating was developed for the wetlands based on the number of factors that may potentially affect it – from No Effect (0 factors) to 6 (all six factors potentially indirectly affecting the wetland).

[2] The analyses and assessments were completed using the same set of wetlands that were not directly impacted; therefore, there are wetlands that may be potentially indirectly affected by more than one type of assessed source. The potential indirect wetland affects for each wetland cannot be summed across the analysis as this would likely result in double-counting of wetland acres. The results of the analyses and assessments identify areas to be monitored for potential wetland effects.

As discussed below, wetland mitigation for potential indirect wetland effects would be determined by the agencies during permitting. If the NorthMet Project Proposed Action were to be permitted and it was determined that the NorthMet Project Proposed Action would cause future wetland effects, wetland monitoring would be conducted. Wetland hydrology and vegetation would be monitored, and additional monitoring locations may be considered during permitting. A component of the monitoring plan would be based on those wetlands that would have a high likelihood of indirect effects as a result of groundwater drawdown. The likelihood of potential wetland hydrology effects (low, moderate, and high), based on the method of wetlands crossing analog impact zones, would be 2,147.6 acres, of which 866.9 acres of wetlands (15 percent) would have a high likelihood of wetland hydrology effects. The likelihood of potential wetland hydrology effects (low, moderate, and high), based on the method of wetlands within analog impact zones, would be 733.3 acres, of which 46.4 acres of wetlands (1 percent) would have a high likelihood of wetland hydrology effects. If the monitoring determined that indirect wetland effects had occurred, additional compensation may be required if determined necessary by the permitting agencies.

In the event that the required wetland monitoring identified additional indirect effects, permit conditions would likely include a plan for adaptive management practices to be implemented, such as expanded monitoring and hydrologic controls. Additionally, compensatory mitigation may be required if additional impacts are identified during annual reporting. Permit conditions would likely include an adaptive management plan to account for any additional effects that may be identified in the annual monitoring and reporting.

5.2.3.3 NorthMet Project Proposed Action Wetland Impact Avoidance, Minimization, Mitigation, and Monitoring Measures

This section discusses measures that were taken to avoid and minimize wetland impacts, evaluates PolyMet's proposed wetland mitigation for unavoidable impacts, discusses other potential mitigation measures that may benefit wetlands, and identifies key elements of a wetland monitoring plan. The wetland impact, avoidance, minimization, mitigation and monitoring plan presented in the EIS would be reviewed during permitting; therefore, the mitigation and proposed monitoring could change during permitting.

5.2.3.3.1 Wetland Avoidance and Minimization

Section 404 regulations of the CWA, Minnesota's WCA rules, and Minnesota's water quality standards under *Minnesota Rules* 7050.0186 require that impacts to wetlands be avoided and minimized to the extent practicable, and if wetland impacts cannot be avoided and/or minimized, then compensatory mitigation practices would be necessary.

Final regulations and guidelines associated with Section 404 of the CWA require that project proponents eliminate or reduce adverse impacts to waters of the United States by taking certain specific steps during project planning. These include: 1) modify the project to avoid adverse impacts, 2) incorporate measures to minimize adverse impacts, and 3) compensate for unavoidable adverse impacts through restoration, enhancement, creation, or in-lieu fee.

PolyMet proposes to avoid and minimize wetland impacts through a number of measures that are incorporated into the proposed mine plan. Direct wetland impacts at the Mine Site have been reduced during the development of the NorthMet Project Proposed Action. Modifications to the NorthMet Project Proposed Action that have occurred during the development of the EIS have resulted in avoidance and minimization of impacts on wetland resources. To date, these modifications have reduced the acreage of wetlands impacted from 1,257 to 913.8 acres, a 27 percent decrease.

At the Mine Site, waste rock would be placed back into the East Pit and Central Pit after year 11, thereby reducing the need for additional surface stockpile areas that would otherwise affect wetlands. In addition, PolyMet proposes to combine the saturated overburden and temporary stockpiles that contain membrane liners, which were separate in the original NorthMet Project Proposed Action design. The Overburden Storage and Laydown Area would only store peat and unsaturated overburden (PolyMet 2015a). By reducing the footprint of the Overburden Storage and Laydown Area and stockpiles, direct wetland impacts were reduced. Similarly, PolyMet proposes to construct the Category 4 Stockpile in the footprint of the Central Pit, which would be mined later and thus avoid additional direct wetland impacts. Reactive waste rock stockpiles would be lined, and stormwater runoff that contacted reactive rock would be contained to help prevent water quality-related effects on adjacent wetlands. In addition, hydrologic effects would be reduced by the use of seepage control measures, which would be installed at the mine pits to restrict shallow groundwater movement through higher permeability areas and help prevent drawdown of wetland water levels near mine pits. Haul road construction/layout has been re-configured to have fewer haul roads and locations thereby reducing land and wetland disturbance and truck distance to be driven. Haul road construction would include placement of large rocks as a foundation to allow shallow subsurface groundwater flowpaths in the wetlands to be maintained within the active areas of the Mine Site between the pits and stockpiles.

Specifically, utilizing existing Plant Site infrastructure, the existing LTVSMC Tailings Basin, and the Transportation and Utility Corridor all serve as avoidance measures since building these on undeveloped sites could impact at least hundreds of acres of additional wetlands. Reusing existing infrastructure limits wetland impacts from these activities to previously disturbed areas. Additionally, cutoff berms/walls, trenches, and sump and pump systems would be used to collect current and future surface seepage from around the toe of the Tailings Basin (PolyMet 2011b). This surface seepage would ultimately be re-routed to the Tailings Basin, thus avoiding or minimizing discharges to surrounding wetlands. Construction of the containment system, however, would reduce the amount of seepage flowing to four tributaries of the Embarrass River (PolyMet 2015a). Streamflow would be augmented using WWTP effluent so that the target annual average flow that supports existing wetland hydrology would be met.

5.2.3.3.2 Wetland Mitigation

As previously noted, jurisdictional wetlands are regulated under state and federal laws, including the WCA (*Minnesota Rules* Chapter 8420), *Minnesota Rules*, part 7050.0186, and Sections 401 and 404 of the CWA. In addition, some wetlands are also designated as Minnesota Public Waters and subject to the Public Waters Work Permit Rules (*Minnesota Rules* Chapter 6115). However, no public water wetlands would be impacted by the NorthMet Project Proposed Action.

Both the state and federal wetland regulations require that a permit, approval, and/or certification be issued by the regulatory agency for wetland impacts as defined by the respective regulations. The USACE St. Paul District is the permitting authority for the DA permit pursuant to Section 404 of the CWA; the MDNR Division of Lands and Minerals administers the WCA approval process as part of the Permit to Mine (*Minnesota Rules*, part 8420.0200, subpart 1D); and the MPCA has authority under Section 401 of the CWA to certify that discharges authorized under Section 404 comply with water quality standards.

The wetland mitigation planning process relied on the WCA wetland replacement siting rules (*Minnesota Rules* part 8420.0522), compensatory mitigation requirements under state water quality standards (*Minnesota Rules* part 7050.0186), and the USACE *St. Paul District Policy for Wetland Compensatory Mitigation in Minnesota* (2009).

<u>Sequencing</u>

The compensatory wetland mitigation site selection for the NorthMet Project Proposed Action began in 2005 and has gone through a rigorous site selection evaluation. Prior to the 2008 Federal Mitigation Rule, the Aitkin and Hinckley sites were selected, initial approvals by the regulatory agencies were received, and substantial investments were made by PolyMet, to develop both sites for compensatory mitigation. The USACE guidance that was utilized prior to the implementation of the 2008 Federal Mitigation Rule was to look for mitigation sites that could provide the following: restoration of historical wetlands, high probability of success, achieves at least partial in-kind mitigation and sites that had ditched and/or tiled peatlands to provide for restoration. When the 2008 Federal Mitigation Rule went into effect, the USACE informed PolyMet of the priority for siting any future compensatory mitigation within the St. Louis River/Great Lakes Basin. The Zim Site was subsequently proposed as a third site. PolyMet, along with, in some cases, state and federal agencies, have conducted and are continuing to conduct extensive efforts to find additional suitable sites within in the Great Lakes Basin for wetland mitigation.

The 2008 Federal Mitigation Rule and 2009 USACE St. Paul District Policy specifies a preferential sequence for compensatory mitigation (i.e., use of mitigation banking credits, use of project-specific compensation that is based on a watershed approach, use of project-specific compensation that is on-site and in-kind, and use of project-specific compensation that is off-site and/or out-of-kind), and aims to select mitigation sites as close as possible to the watershed of impact; however, sometimes this cannot be accomplished. The 2009 USACE St. Paul District Policy accepts out-of-watershed mitigation; however, the USACE's preference is for the mitigation to be within the same watershed as a proposed project. The term "watershed approach" is defined in 33 USC § 332.2 as "an analytical process for making compensatory mitigation decisions that support the sustainability or improvement of aquatic resources in a waters. It involves consideration of watershed needs, and how locations and types of compensatory mitigation projects address those needs…"

As such, the compensatory mitigation approach by PolyMet followed the 2009 USACE St. Paul District Policy in effect at the time the proposed compensation sites were selected. Further, the Zim Site was developed in accordance with a watershed approach. In combination, the proposed compensatory mitigation is appropriate for the siting and scale of the impacts that would result from the NorthMet Project Proposed Action. As noted above for the project-specific compensation, the following compensatory mitigation siting sequence is required: on-site, in the same 10-digit HUC watershed, in the same 8-digit HUC watershed, in the same modified 6-digit watershed, in the same 4-digit HUC watershed, and then statewide.

While on-site replacement of wetlands is listed first in the sequencing, on-site conditions may not be the most suitable for successful wetland mitigation. In fact, 33 USC § 332.3(b) states that compensatory mitigation should be located where it is most likely to successfully replace lost functions and services within the watershed, not specifically on-site. Moreover, the preferred mitigation methodology stated under the 2008 Federal Mitigation Rule begins with the utilization of mitigation banks and in-lieu fee programs within appropriate service areas prior to permittee-responsible mitigation (33 USC § 332.3(b)(2)-(3)). Following the use of mitigation banks and in-lieu fee programs, the 2008 Federal Mitigation Rule states that permittee-responsible mitigation following a watershed approach (i.e., providing for mitigation in the best suitable location within the proposed impact watershed) should be used (33 USC § 332.3(b)(4)). Only after mitigation banks, in-lieu fee programs (where available), and permittee-responsible mitigation under a watershed approach have been exhausted or are infeasible should permittee-responsible mitigation through on-site and in-kind mitigation be considered (33 USC § 332.3(b)(5).

Compensatory mitigation is defined as restoration (reestablishment or rehabilitation), establishment (creation), enhancement, and/or, in certain circumstances, preservation of aquatic resources for the purposes of offsetting unavoidable adverse impacts that remain after all appropriate and practicable avoidance and minimization has been achieved (33 CFR § 332.2). When comparing the alternatives, restoration is the best approach for replacing lost functions; preservation does not replace the lost functions and creation is both slow to replace the functions and has a lower degree of success. Restoration should generally be the first option considered because the likelihood of success is greater and the impacts to potentially ecologically important uplands are reduced compared to establishment. Also, the potential gains in terms of aquatic resource functions are greater, compared to enhancement and preservation (33 CFR § 332.3(a)(2) and 40 CFR § 230.93(a)(2)). Furthermore, the 2009 USACE St. Paul District Policy guidance states that restoration is the preferred compensatory mitigation technique. Restoration sites historically supported wetlands and frequently retain some wetland components (e.g., hydric soils) even after man-made disturbances such as drainage and cropping. Restoration also applies to increasing the functional level of existing, degraded wetlands. Restoration through re-establishment involves techniques for returning wetland functions to a location where no wetland currently exists. This technique results in a gain in both wetland acres and wetland functions.

The primary goal of wetland mitigation is to restore high-quality wetland communities of the same type, quality, and function as those to be impacted to the extent practicable. To achieve that goal, state and federal guidelines were followed during the wetland mitigation planning process, with a preference placed on restoring drained wetlands over creating wetlands. The five main categories of mitigation methods considered appropriate in northern Minnesota by state and federal agencies were 1) restoration of former or degraded wetlands, 2) enhancement of existing wetlands, 3) wetland preservation, 4) wetland creation, and 5) upland buffers.

USACE Mitigation Ratios and Financial Assurance

The 2009 USACE St. Paul District Policy applies three factors to determine compensation ratios: in-place versus out-of-place, in-kind versus out-of-kind, and in-advance versus not in-advance. These factors are defined as follows:

- In-place mitigation means the replacement of the impacted aquatic site would take place in the same 8-digit Hydrologic Unit Code (HUC) watershed as the proposed impacted resource. The USACE St. Paul District Policy uses the term "in-place" to include on-site, which is defined as an area located on the same parcel of land as the impact site, or on a parcel of land contiguous to the impact site.
- Out-of-place mitigation means the replacement of the impacted aquatic site would take place in a different 8-digit HUC watershed as the proposed impacted resource.
- In-kind mitigation means the replacement of the impacted aquatic site with a resource of a similar structural and functional type to the impacted resource (same species composition).
- Out-of-kind mitigation means the replacement of an impacted aquatic site with a resource of a different structural and functional type from the impacted resource (different species composition).
- In-advance mitigation is a form of mitigation that is designed, permitted, and constructed in advance of a permitted impact.

The temporal loss issue is addressed by the in-advance versus not-in-advance factor. The 2008 Federal Mitigation Rule states that compensation ratios of greater than 1:1 can be applied to account for factors including temporal loss and the difficulty of restoring or establishing certain wetlands/aquatic resources (33 CFR 332.3 (f)).

The 2008 Federal Mitigation Rule also states that "difficult-to-replace" wetlands/aquatic resources include bogs and forested wetlands (33 CFR 3323.3(e)(3) and Preamble, page 19633). The majority of wetlands that would be impacted by the NorthMet Project Proposed Action would be "difficult-to-replace" (coniferous bog, open bog, coniferous swamp, and hardwood swamp) (USACE 2013). The 2008 Federal Mitigation Rule includes a provision for a case-by-case determination of mitigation ratios higher than the minimum 1:1 where necessary to account for the difficulty of restoring or establishing the desired aquatic resource type and functions.

USACE St. Paul District Policy (2009) states that compensation ratios can be raised on a case-by-case basis if the impacted wetland/aquatic resource provides rare or exceptional functions, including plant communities that rate "exceptional" using MnRAM, or have a high rating using a Floristic Quality Assessment. Most of the wetlands that would be impacted by the NorthMet Project Proposed Action would generate high Floristic Quality Assessment scores for those plant community types in Minnesota (Milburn et al. 2007). Therefore, per the 2009 USACE St. Paul District Policy, the District Engineer may determine that a higher compensation ratio would be required to offset losses of wetlands that would be difficult to replace and/or provide an exceptional or high functional level/condition.

The 2009 USACE St. Paul District Policy states a base compensation ratio of 1.5:1 (1.5 credits of compensatory mitigation for every 1 acre of wetland loss), and a minimum of 1:1, with a provision for a case-by-case determination of higher ratios to account for factors including difficult-to-replace, rare, and/or exceptional wetlands/aquatic resources. For low- to moderate-quality wetlands, the 1.5:1 base ratio would apply in accordance with District Policy. For impacts to wetlands that have exceptional or high functional levels/conditions, are difficult-to-replace, and/or where there is a considerable temporal loss in replacing functions (e.g., forested wetlands), the USACE may require additional compensation in accordance with District Policy. The 1.5:1 ratio can be reduced by qualifying for the following incentives, but can be no less than a minimum 1:1 ratio:

- In-place incentive: the project-specific mitigation site is located on site or within the same 8-digit HUC watershed as the authorized wetland impacts or bank credits are purchased within the same bank service area—reduce ratio by 0.25.
- In-kind incentive: the mitigation wetlands are of the same type (same wetland plant community) as the wetlands authorized to be impacted—reduce ratio by 0.25.
- In-advance incentive: 1) a project-specific mitigation site must have wetland hydrology and initial hydrophytic vegetation established at least one full growing season in advance of the authorized wetland impacts provided initial performance standards are met, or 2) USACE-approved bank credits are purchased—reduce ratio by 0.25.

If none of these incentives are met, the minimum mitigation ratio required is 1.5:1. If one of the three incentives is met, the minimum required mitigation ratio is 1.25:1; if two or three are met, the ratio is 1:1. According to USACE St. Paul District's compensatory wetland mitigation policy (USACE 2009), requirements for mitigation can exceed the 1.5:1 mitigation ratio if the impacted wetlands provide rare or exceptional functions.

District guidance on compensatory mitigation emphasizes the consideration of a functional approach to offset proposed project impacts. While bogs and forested wetlands are characterized as difficult-to-replace, the proposed compensation sites for the NorthMet Project Proposed Action (discussed below) would be likely to achieve in-kind compensation to offset functional losses. The proposed mitigation sites were selected based on availability and the high likelihood of meeting performance criteria.

The proposed wetland restoration and enhancement performance criteria place a strong emphasis on ensuring that the proposed mitigation strategy provides for the adequate replacement of lost functions. For purposes of compensatory mitigation, the focus is on functions. The 2008 Federal Mitigation Rule specifically eliminated use of the term "values." An abbreviated MnRAM functional assessment, which was agreed upon by the USACE, was utilized to assess wetland functions for the Mine Site, Transportation and Utility Corridor, and Plant Site. Both the USACE and WCA require functions to be replaced; however, both agencies use a set of defined ratio requirements to determine the number of acres required to replace functions lost as there is currently no suitable quantitative functional assessment method in Minnesota. Based on the findings and where impacts occur (e.g., types of wetlands), the mitigation ratios and credits have been increased to take into account the functions lost due to the NorthMet Project Proposed Action. For example, additional compensatory mitigation (i.e., higher replacement ratios) is proposed to offset loss of bog wetlands, which is a difficult-to-replace wetland type. All of the wetland mitigation proposed would be restoration with a minimal component of wetland preservation; no creation of wetlands would be part of the off-site mitigation.

The USACE St. Paul District has not made a final determination of the compensation ratios that would be required. A decision on whether proposed compensation would qualify for the 0.25 incentive for in-advance requires additional information including: 1) development of performance standards that would specify the hydrology and initial vegetation to be established, and 2) number of growing seasons that wetland compensation sites would be established in advance of authorized impacts. Final determination of compensation ratios and use of incentives would be determined during permitting.

The compensatory mitigation ratios proposed in the FEIS for the NorthMet Project Proposed Action are based on recommended USACE St. Paul District guidance. They assume successful outcomes for the proposed compensatory mitigation sites. Base compensation ratios, as presented in the FEIS, for impacts on high-quality, difficult-to-replace bog and forested wetlands have been increased to 2:1 (USACE 2013). For impacts on low- and moderate-quality wetlands, a base ratio of 1.5:1 would be applied (USACE 2013). In-kind, in-place, and in-advance incentives to reduce the recommended base ratios would be considered at the time of permitting. USACE St. Paul District guidance on recommended compensation ratios takes these incentives into account. The final decision on compensatory mitigation ratios and the use of incentives would be determined at the time of the CWA Section 404 permit decision based on current District guidance.

USACE compensatory wetland mitigation is regulated by 33 CFR 332.3(n), which describes the use of financial assurances. The District Engineer may determine that financial assurances are unnecessary for a compensatory mitigation project if alternate mechanisms are available to ensure a high level of confidence that the mitigation would be provided and maintained.

The CWA Section 404 permit and the Permit to Mine (see below) both have financial assurance mechanisms to ensure successful completion of the 1) compensatory mitigation (in the case of the CWA Section 404) and 2) NorthMet Project Proposed Action (in the case of the Permit to Mine). Financial assurance can be a condition of a permit under CWA Section 404, and the MDNR has authority to require a performance bond or other instrument that meets criteria in rule for compliance with the conditions of the Permit to Mine. Section 3.2.2.4 provides a discussion of the financial assurance for the NorthMet Project Proposed Action.

The USACE generally requires compensatory mitigation for adverse impacts to aquatic resources under 33 CFR 332.3(n). This regulation establishes standards and criteria for the general compensatory mitigation requirements of the Section 404 permit. Specifically, 33 CFR 332.3(n)(1) addresses financial assurance stating:

> The district engineer shall require sufficient financial assurances to ensure a high level of confidence that the compensatory mitigation project will be successfully completed, in accordance with applicable performance standards.

Financial assurance for the direct wetland impact mitigation would be required until success of the mitigation sites can be assured. While this wetland mitigation would be expected to be approved and constructed in advance of any authorized wetland impacts, it is unclear whether these sites would be well-enough established for financial assurance to be waived. The USACE would also consider the application of financial assurances for potential indirect wetland effects and monitoring. The USACE would require consideration of financial assurances during the permitting process.

State Mitigation Ratios and Financial Assurance

Minnesota Rules, part 7050.0186, requires compensatory mitigation to be sufficient to ensure replacement of the diminished or lost designated uses of the wetland that was physically altered. To the extent prudent and feasible, the same types of wetlands impacted are to be replaced in the same watershed, before or concurrent with the actual alteration of the wetland. In addition, the WCA states that for wetlands in counties where 80 percent or more of pre-settlement wetlands exist, including St. Louis County, minimum replacement ratio requirements are as determined by mitigation location and type (see Table 5.2.3-16). Based on the WCA wetland replacement standards (*Minnesota Rules* 8420.0522, Subpart 4), the required replacement ratio would be either 1:1 or 1.5:1. For those wetlands that would be replaced in the watershed with the same wetland type, the base replacement ratio that would likely be required is 1:1, and for those wetlands that would be replaced outside of the watershed, the ratio would be increased to 1.5:1. The actual replacement ratios required in permitting may be more than the minimums shown in Table 5.2.3-16, subject to the evaluation of wetland functions.

Table 5.2.3-16 Summary of Wetland Mitigation Ratios

Regulation	Location of Impacts	Replacement	Minimum Replacement Ratio
Minnesota Administrative Rules			
		Minimum Replacement Ratios: Wetland Banking	
	>80% area or agricultural land	Outside bank service area	1.5:1
		Within bank service area	1:1
		Minimum Replacement Ratios: Project-Specific	
	>80% area or agricultural land	Outside major watershed or out-of-kind	1.5:1
		Within major watershed and in-kind	1:1
USACE			
	>80% area	Not in-place, in-kind nor in-advance	1.5:1
		In-place, in-kind and in-advance	1:1

Sources: Wetland Conservation Act (MDNR 1991); USACE 2009.

Minnesota Rules 8420.0522 outlines the replacement standards for wetlands as regulated under WCA. *Minnesota Rules* 8420.0522, subparts 9(A) and (B) discuss financial assurance requirements for compensatory wetland mitigation stating:

> (A) For wetland replacement that is not in advance, a financial assurance acceptable to the local government unit must be submitted to, and approved by, the local government unit to ensure successful replacement. The local government unit may waive this requirement if it determines the financial assurance is not necessary to ensure successful replacement. The local government unit may incorporate this requirement into any financial assurance required by the local government unit for other aspects of the project.
> (B) The financial assurance may be used to cover costs of actions necessary to bring the project into compliance with the approved replacement plan specifications and monitoring requirements.

Financial assurance could be waived by the approval authority if it is determined that financial assurance is not necessary to ensure wetland replacement. Additionally, the MDNR has the authority through the Permit to Mine process to require a performance bond or other instrument that meets criteria in rule as means to ensure compliance with *Minnesota Rules,* part 6130, which includes successful completion of reclamation and closure activities. Please refer to Section 3.2.2.4 for more information on financial assurance.

The financial assurance requirements would be part of the WCA permitting process for the NorthMet Project Proposed Action. Wetland replacement for the NorthMet Project Proposed Action is anticipated to be approved and constructed in advance of any authorized wetland impacts (under WCA approval) and, therefore, would not require financial assurance.

Section 401 of the CWA requires the MPCA to certify that all projects that receive a federal license or permit are in compliance with state and federal water quality guidelines. Therefore, as part of their review, the MPCA conducts a separate review for compliance with water quality standards and policies and guidelines, which includes mitigation for wetland impacts and approval of the wetland replacement ratios. This review process must be completed before the DA permit pursuant to Section 404 of the CWA can be issued.

Summary of Mitigation Requirements

PolyMet would ultimately need to satisfy both the federal and state mitigation requirements. The number of mitigation credits to be earned by replacement wetlands would be determined during permitting by the appropriate agencies reviewing the wetland mitigation plan. This would be based on the extent to which the sites meet the target goals established during permitting. These include, among other things, restoration of wetland appropriate hydrology and the establishment of a target plant community or type. The NorthMet Project Proposed Action is estimated to directly impact 913.8 acres. Depending on the location, type, and timing of compensatory mitigation, the minimum required amount of replacement wetlands for direct impacts, based upon USEPA recommendations, could potentially range from 913.8 acres up to 1,827.6 acres (i.e., 1:1 up to 2:1 compensation ratios).

The USACE has concluded that the mitigation sites selected and the wetland credits generated at the three mitigation sites would be acceptable for use in compensating for direct wetland losses. The USACE has not made a final decision on the mitigation ratios that would be required to compensate for direct wetland impacts; if fully successful, it is likely these three mitigation sites would generate sufficient credits to compensate for the 940.7 acres of wetlands directly impacted. In the event that not all of the credits generated by these sites are utilized to compensate for direct wetland impacts, any excess credits could be used to compensate for indirect losses (USACE 2015a). The current proposed mitigation presented below shows that PolyMet could have an excess of mitigation credits from the three mitigation sites if the mitigation sites are successful and meet the performance standards. However, it is understood that mitigation sites sometimes are not fully successful; contingency plans (discussed below) would be developed for the NorthMet Project Proposed Action and approved during permitting. The USACE encourages the development of mitigation for foreseeable indirect effects, which the current proposed mitigation plan appears to achieve.

Financial assurance for the direct wetland impact mitigation would be required until success of the mitigation sites can be assured. While this wetland mitigation is expected to be approved and constructed in advance of any authorized wetland impacts, it is unclear whether these sites would be well enough established for financial assurances to be waived. The USACE would also consider the application of financial assurances for potential indirect wetland effects and monitoring. Both the USACE and state would require consideration of financial assurances during the permitting process.

Wetland mitigation for potential indirect wetland effects would be determined by the agencies during permitting. If the NorthMet Project Proposed Action were to be permitted and constructed, wetland monitoring would be conducted to determine if the NorthMet Project Proposed Action caused future indirect wetland effects. Wetlands hydrology and vegetation would be monitored, and additional monitoring locations may be considered during permitting. A component of the monitoring plan would be based on those wetlands that have a high likelihood of indirect effects as a result of groundwater drawdown. If the monitoring determined that indirect wetland effects had occurred, additional compensation may be required if determined necessary based on the monitoring results. In the event that the required wetland monitoring identified additional indirect effects, permit conditions would likely include a plan for adaptive management practices to be implemented, such as expanded monitoring and hydrologic controls. Additionally, compensatory mitigation may be required if additional impacts are identified during annual reporting.

Wetland Mitigation Study Limits

The NorthMet Project area lies in St. Louis County in the St. Louis River Watershed (#3) within the Lake Superior basin (wetland mitigation Bank Service Area #1). Locations for wetland mitigation projects were evaluated in the following priority order:

- on-site;
- off-site in the St. Louis River Watershed (same 8-digit HUC);
- off-site in the Great Lakes Basin (same 4-digit HUC); and
- off-site in an adjacent 4-digit HUC, selecting an 8-digit HUC as close as possible to the impacted site.

Each of these potential locations areas is described below.

On-site Mitigation

In accordance with the USACE's St. Paul District Compensatory Wetland Mitigation Policy (USACE 2009) and state guidelines, the potential for creating wetlands on-site was considered first. The Wetland Management Plan (PolyMet 2015c) identified the potential for on-site restoration during reclamation. On-site wetland restoration (101.8 acres) is planned in the following areas: temporary Category 2/3 Stockpile, Overburden Storage and Laydown Area, some haul roads and adjacent ditches, and WWTF ponds and process water ponds. Establishment of on-site wetlands is expected to occur during reclamation. Of the 101.8 acres of planned on-site wetland restoration, 72 acres of wetlands may be created at the temporary mine stockpile areas after removal of the Category 2/3 Stockpile and the Overburden Storage and Laydown Area. The remaining acres of wetland restoration would be within the other above mentioned Project areas. Design of wetland restoration areas would be further evaluated in the detailed reclamation design and would include the preservation of upland buffer around the perimeter of the wetland restoration areas. The establishment of the estimated 101.8 acres of on-site wetland restoration is not included in the mitigation credits. The generation of wetland credits in these areas has the potential to be used on a contingency basis, but compensatory credit would not be considered at this time for a variety of reasons, including the fact that any restoration efforts would not occur for many years.

Off-site Mitigation

The initial wetland mitigation study scope focused on the areas containing greater than 80 percent of their historic wetland resources as defined in the WCA. This area was selected as the initial study area to comprehensively cover the priority mitigation areas, with the understanding that suitable opportunities may not be available within each priority area.

Available wetland mitigation banking credits that were available for purchase by PolyMet were evaluated in portions of bank service areas 1 through 6 and found to be insufficient to satisfy the compensatory mitigation requirements for the NorthMet Project Proposed Action. Subsequently, a GIS analysis was performed to identify potential wetland mitigation sites within the defined study area. The primary goal of the analysis was to identify large, potentially drained wetlands located primarily on private or tax-forfeit land within the study area to provide preliminary data for more detailed ground investigations to proceed. To achieve the goal of the mitigation plan, which is to replace lost wetland functions using compensatory wetland types in-kind to the degree practicable, areas where drained wetlands could be restored were preferable over areas where wetlands could be created (Barr 2008m). Other siting criteria used in the GIS analysis included potential wetland enhancement areas, potential wetland preservation areas, and potential wetland creation areas (Barr 2008m). Sites were identified by overlaying and evaluating numerous existing spatial data sources to locate those sites with the greatest mitigation potential. Some of the data sources utilized included the following:

- geomorphology/soil types (Loesch 1997);
- land ownership (separated by county/state/federal and private ownership) (MLMIC 1983);
- land slope/Digital Elevation Model (MLMIC 1999);
- streams/ditches (MDNR 1980);
- major watersheds; and
- land cover (Loesch 1998).

The analysis was conducted by establishing specific filtering criteria to identify potential wetland mitigation sites. The general filtering criteria included the following:

- land slopes of less than or equal to 1 percent slope;
- areas mapped as peat or lacustrine geomorphology;
- private or county tax-forfeit property;
- areas within 1.1 miles of a ditch; and
- areas meeting all of the above criteria with at least 100 contiguous acres.

The analysis was limited to sites with more than 100 acres of wetland mitigation potential due to the anticipated difficulties in planning numerous, small wetland mitigation projects, and the desire to identify opportunities that were feasible. In addition, the NorthMet Project Proposed Action represented an opportunity to restore large wetland systems and provide greater public and ecological benefit that are typically not available with smaller projects.

This GIS analysis resulted in the development of a polygon data layer, which contained nearly 900 areas with potential for mitigation in the study area. This analysis resulted in several findings.

First, a large proportion of the study area was in state and federal ownership. Discussions with the various state and federal entities regarding wetland mitigation on their respective properties resulted in the following conclusions:

- The USFS was unable to provide assurances that they would be able to protect restored wetlands on federal lands in perpetuity as required by wetland regulations.

- The State of Minnesota provided general criteria for restoring wetlands on state lands. The criteria required either a justification for how revenue production (i.e., peat mining, forest harvest) would not be affected or provide land in exchange that had a comparable value. PolyMet determined that these were not acceptable criteria and the state provided no certainty that the NorthMet Project Proposed Action would be viable if PolyMet expended 1 to 2 years of effort to meet the imposed criteria. This conclusion was supported in part by an effort to restore wetlands on Site 8362, a partially state-owned site, as discussed below.
- The Board of Water and Soil Resources has oversight regarding the administration of the Minnesota WCA. The Board of Water and Soil Resources provides guidance and interpretation of the WCA rules and has the most extensive experience with application of the rules. The Board of Water and Soil Resources' experience with wetland restoration on tribal lands found that impressing permanent conservation easements granted to the state was not possible to protect the restored wetlands.
- PolyMet had a signed agreement with St. Louis County near Floodwood to restore wetlands as mitigation (see discussion on Site 8362 below) for the NorthMet Project Proposed Action. The agreement was nullified by the state courts. In addition, legal proceedings through the state legislature and state court would have been required for ditch abandonment and for placement of a conservation easement on the land.

Therefore, it was determined that, because of these uncertainties and risks, mitigation on state and federal lands represented a minimal potential for a private enterprise to conduct compensatory wetland mitigation on these lands.

Second, many of the wetland systems within the study area have not been affected by historic drainage or other significant alteration. In areas lacking significant alterations, wetland preservation and establishment of upland buffers constitute the primary methods to generate wetland compensation credits within the study area. Wetlands that meet the criteria for wetland restoration credits include completely drained wetlands, partially drained wetlands, and wetlands with at least a 20-year history of agricultural production (Barr 2008m).

Third, much of the study area was characterized by surface geology that is not indicative of large wetland systems prone to easy drainage. The majority of the Arrowhead region, including Cook, Lake, and much of St. Louis counties, is mapped with surface geology typified by steep, igneous bedrock terrains; rolling surficial deposit plains; and rolling to undulating areas of supraglacial drift (Loesch 1997). These geomorphological associations are also typically associated with steeper land slopes containing few drained or sufficiently altered wetlands.

Opportunities exist for accomplishing the preferred method of wetland compensation—restoration—within the St. Louis River Watershed and northeastern Minnesota in general. Tens of thousands of acres of peatlands are adversely affected by ditch systems. Specific to the St. Louis River Watershed, hundreds of acres of ditched, hydric soils in agricultural use exist in the central portion of the watershed. A determination by the USACE as to the practicality of wetland restoration within one or more of these sites has not been completed. The wetland mitigation opportunities were determined to not be feasible or prudent for one or more of the following different factors: private property, public roads, and active gravel operations that could be hydrologically impacted by wetland restoration; insufficient wetland drainage; insufficient agricultural history existing public ditches that could not be abandoned; potentially contaminated soils; unwilling landowners; considerable existing upstream drainage through the site; active pursuit of the properties by others; and/or presence of severed mineral rights on many of the lands (Barr 2008m).

St. Louis River Watershed (Same 8-digit HUC)

Approximately 101 potential wetland mitigation areas were identified within the St. Louis River Watershed and other watersheds tributary to Lake Superior. The specific areas identified as having potential for wetland restoration were evaluated in more detail by reviewing NWI maps, plat maps, recent aerial photographs, and USGS topography to find the sites with the highest potential.

The sites with the highest potential were further evaluated by conducting site visits and meetings with various regulatory agencies. The majority of these potential mitigation sites, however, were eliminated from further consideration due to issues that included: lack of wetland drainage or altered land uses that would qualify as wetland restoration or enhancement (e.g., unaltered sites can qualify for regulatory compensation credits such as wetland preservation and upland buffers); infeasibility of planning numerous small projects; potential flooding of private property, roads, or other infrastructure; upstream ditch drainage through the potential wetland restoration areas that would have to be maintained; potential soil contamination; regulatory applicability; complex land ownership; existing peat mining operations; and legal considerations.

For purposes of the CWA regulatory program, the term *highest potential* is not the applicable standard for evaluating compensatory mitigation. Rather, *practicable* is the standard used in conjunction with the fundamental goal of compensatory mitigation: replace lost wetland functions, in-kind and in-place, to the extent practicable. Potential compensation sites are not limited to those that are least difficult and/or least expensive. Sites that have some greater difficulty and/or cost may be practicable, particularly if they are the only sites that would meet the fundamental goal of compensatory mitigation.

The area around Meadowlands and Floodwood appeared to have the most suitable characteristics. Two contiguous areas in this region, covering approximately 270 square miles, were mapped as level peat. The one site found to be initially feasible was designated as Site 8362. Site 8362 was located within the same watershed as the NorthMet Project area, had the greatest potential for wetland restoration with limited peripheral issues, and contained the potential to restore bog wetlands similar to those proposed for effect. Thus, Site 8362 was initially selected for further study and PolyMet signed an agreement with St. Louis County. Approximately 640 acres of the site are owned by the State of Minnesota with the remainder designated as tax-forfeit land. Further pursuit of wetland restoration activities at Site 8362 was halted for a number of reasons that rendered the site impracticable, including the following:

- The district court nullified PolyMet’s agreement with St. Louis County in April 2007, thereby not allowing any further study of the site.
- There was a lack of local support, and there was, in fact, broad opposition from local residents.
- Extensive hydrologic monitoring and evaluation was required to document the degree of drainage at the site to support the proposed mitigation credits. This would have required long-term monitoring to adequately demonstrate the drainage and there was uncertainty

regarding the outcome of such monitoring. Such monitoring activities were no longer allowed after April 2007 due to the district court action.

- Preservation credits would only be allowed where there was a demonstrable threat that could be eliminated (i.e., peat mining, tree-topping, or all-terrain vehicle activity). There are only about 400 acres of documented minable peat and the County had indicated they were unlikely to agree to limit tree-topping activities. Therefore, the ability to show a demonstrable threat that would meet regulatory criteria appeared unlikely.
- Even if the agreement with the county was reestablished, that agreement would have required ditch-abandonment proceedings in district court with public hearings that would have likely been opposed by local residents.
- The agreement with the County (if it were to be reinstated) would have also required receiving legislative authorization to place a permanent conservation easement over the restoration area. The likelihood of that was uncertain.

One additional wetland restoration area has been further identified since the DEIS within the NorthMet Project area watershed. The Zim Sod (Zim) wetland mitigation site is located in St. Louis County in the St. Louis River major watershed (#3), within the Lake Superior basin (bank service area #1) (see Figure 5.2.3-30).

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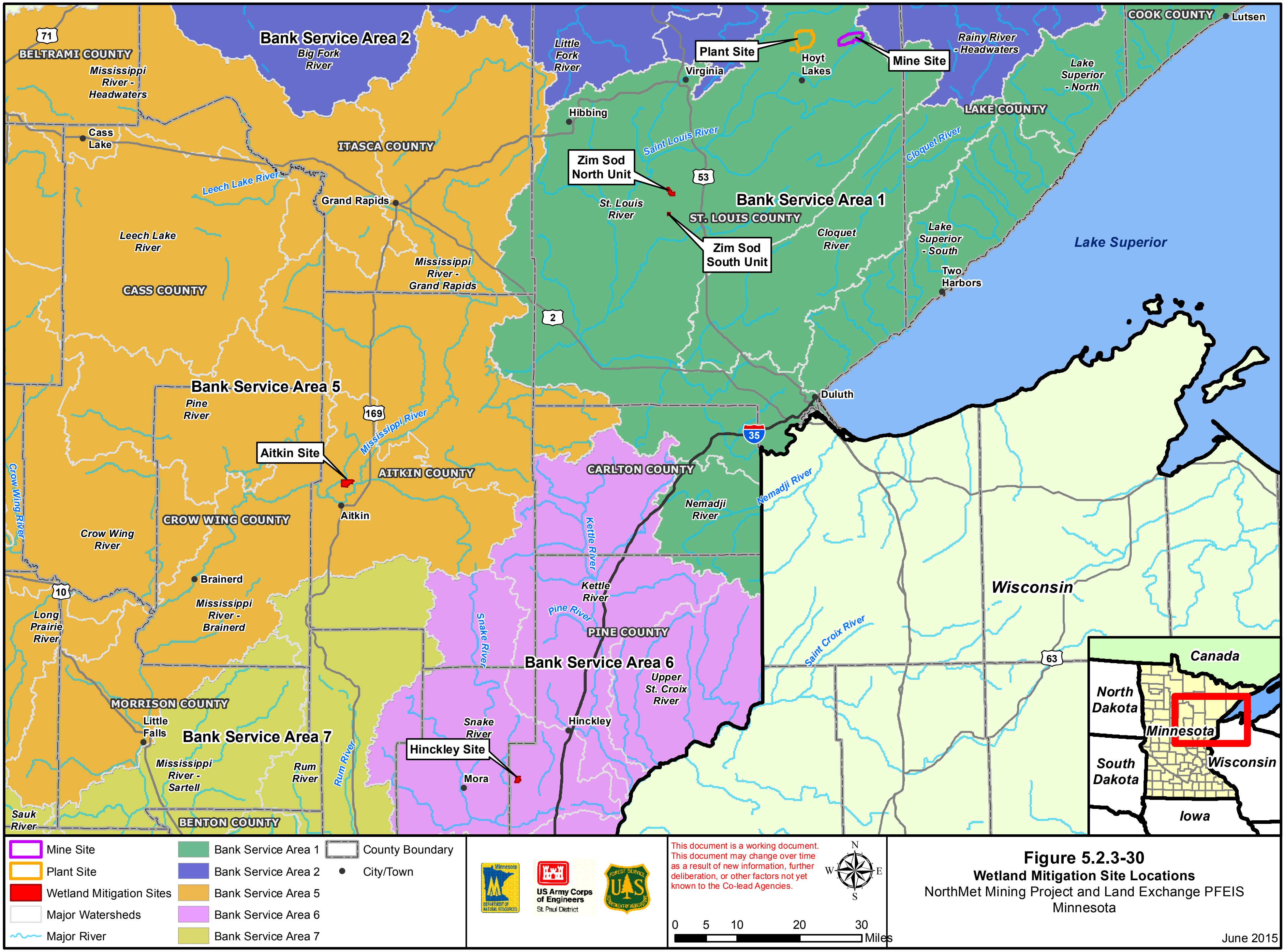

Figure 5.2.3-30
Wetland Mitigation Site Locations
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

2028 -Page Intentionally Left Blank-

Great Lakes Basin (Same 4-digit HUC)

With Site 8362 no longer a feasible mitigation option, pursuit of the high-priority sites identified in watersheds adjacent to the St. Louis River Watershed was initiated along with the continued search for existing bank credits, wetland banks in various stages of planning, and various other potential wetland mitigation opportunities located in central and northwestern parts of Minnesota.

Fifteen sites were determined to have high potential for wetland mitigation in watersheds located adjacent to the St. Louis River Watershed. Of these, 10 sites were evaluated in the Mississippi River-Grand Rapids Watershed, three sites were evaluated in the Kettle River Watershed, and two sites were evaluated in the Nemadji River Watershed. After further study, these sites were eliminated from further consideration due to issues that included: lack of wetland drainage or altered land uses that would fit the regulatory requirements for restoration credit; potential flooding of roads or other infrastructure; upstream ditch drainage through the wetland that would have to be maintained; complex land ownership; existing peat mining operations; and legal considerations.

Adjacent 4-digit HUC, Selecting an 8-digit HUC as Close as Possible to the Impacted Site

Ten potential wetland mitigation sites, initially determined to have some potential, were located in watersheds neighboring the watersheds adjacent to the St. Louis River. These sites were evaluated to determine the relative potential for mitigation, the level of risk and uncertainty, and the likely costs. These sites were primarily located in Aitkin County.

Eight of these 10 sites were eliminated from further consideration due to issues that included unwilling landowners, significant private properties that would be hydrologically affected by wetland restoration, insufficient agricultural history, insufficient wetland drainage to qualify for restoration credit, considerable existing upstream drainage through the site, or active pursuit of the properties by others. Two priority properties were identified with willing landowners that had the potential to accomplish compensatory wetland mitigation for nearly the entire NorthMet Project area. These sites are located in watersheds neighboring those adjacent to the St. Louis River and outside the 1854 Ceded Territory. These two sites included the Aitkin mitigation site (Aitkin) and the Hinckley mitigation site (Hinckley). The Aitkin and Hinckley sites are located within the Mississippi River Basin (4-digit HUC) and 8-digit HUC watersheds of Elk-Nokasippi #10 and Snake River #36, respectively (see Figure 5.2.3-30). The Aitkin Site is located in Aitkin County in bank service area #5 and the Hinckley Site is located in Pine County in bank service area #6 (see Figure 5.2.3-30). USACE St. Paul wetland compensatory mitigation replacement ratios are based on three factors: in-place versus out-of-place, in-kind versus out-of-kind, and in-advance versus not in-advance (see Table 5.2.3-16). As previously stated, the USACE St. Paul District and the state have not made a final determination of the compensation ratios that would be required for the NorthMet Project Proposed Action. Base compensation ratios for USACE would be either 2:1 or 1.5:1 and for the state 1.5:1 or 1:1 depending on the location, quality of the wetland, wetland type, and timeframe of the compensation. The final decision on compensatory mitigation ratios would be determined during permitting.

Off-site Wetland Restoration Projects

The off-site wetland restoration projects, as defined in the Wetland Management Plan (PolyMet 2015c), that would provide required mitigation for the NorthMet Project Proposed Action wetland impacts include Hinckley, Aitkin, and the Zim wetland mitigation sites (see Figure 5.2.3-30). As previously noted, the Zim site is located within the NorthMet Project area 8-digit HUC watershed, whereas Aitkin and Hinckley are located outside the 8-digit HUC watershed area. The mitigation would be considered in advance if the initial phases of restoration on all of the proposed off-site wetland mitigation sites would be completed at least one full growing season in advance of the authorized wetland impacts provided initial performance standards are met for which the mitigation would compensate.

The proposed mitigation is expected to compensate for all the direct wetland impacts, as well as the indirect fragmentation impacts—a total of 940.7 acres (see Tables 5.2.3-18 and 5.2.3-19). The majority of the credits would be in-kind mitigation and nearly one-third of the credits would be from within the NorthMet Project area watershed (see Tables 5.23-17, 5.2.3-18, 5.2.3-19). Based on PolyMet's current mitigation proposal and assuming the mitigation efforts are fully successful and target communities are established, 83 percent of the impacts to coniferous bogs would be mitigated by in-kind and in-place credits, or 439.9 coniferous bog credits; the remaining 17 percent would be replaced out-of-kind. Out-of-kind credits would be used to mitigate impacts on wet meadow, shallow marsh, deep marsh, open bog, and coniferous bog communities; these would not be replaced in-kind because of hydrological and ecological constraints at the proposed mitigation sites. Forty-seven percent of the wetland impacts are currently proposed to be replaced in-kind, in-place, and before the impacts occur on site. An additional 29 percent of the proposed impacts are proposed to be replaced in-kind and before the impacts occur on site. Most of the additional mitigation credits that are proposed outside of the watershed would fulfill mitigation requirements above the minimum 1:1 ratio.

Mitigation credits assumed for calculations include 100 percent credit for restoration of drained/farmed wetlands, 75 percent credit for creation of on-site wetlands, 50 percent credit for partially drained wetlands and ditches, 25 percent credit for upland buffer, and 12.5 percent credit for preservation. The final mitigation credits required to offset the impacts of the proposed NorthMet Project Proposed Action would be determined by the agencies during wetland permitting. The amount of credit generated by the mitigation sites would ultimately be determined by the permitting agencies. This would be based on the extent to which the sites meet the target goals established during permitting. These include, among other things, restoration of wetland appropriate hydrology and the establishment of a target plant community or type.

<u>*Aitkin Site*</u>

The Aitkin Site is currently an active sod farm that has been drained by ditches and subsurface drain tiles. The overall objective of the restoration plan is to restore the hydrology by removal of the internal drainage system and the construction of outlets that regulate the required hydrological conditions (Barr 2008m). The site has also been used for sod, wheat, soybeans, sunflowers, and wild rice production. The 1,070-acre site is located north of the city of Aitkin, Minnesota, in Aitkin County. The site is in the Elk-Nokasippi major watershed within bank service area #5, adjacent to bank service area #1 where the NorthMet Project area would be located.

The site is located outside of the NorthMet Project area watershed. The proposed wetland mitigation area includes 808.3 acres of wetland restoration and 83.2 acres of upland buffer preservation. Restoration methods on the site are designed to restore the following wetland types: Type 3 (shallow marsh), Type 6 (shrub-carr), Type 7 (hardwood swamp), and Type 7 (coniferous swamp).

Hydrology monitoring at the Aitkin Site began in 2012, as well as at a reference wetland site, to characterize the pre-restoration hydrology, and continued in 2013 and 2014 (PolyMet 2015c). Based on the 2 years of monitoring data at the Aitkin Site, monitoring indicates that the majority of the site no longer has wetland hydrology. Results of 2014 monitoring will be submitted to the USACE and the MDNR in 2015. Concurrence of the monitoring results will be conducted by permitting agencies during the permitting process (PolyMet 2015c).The state and federal agencies have not yet made a determination on the drainage status of the mitigation site (i.e., drained, partially drained, etc.); this determination will be made during permitting, including credit ratios.

The minimum replacement ratio that would be allowed by the USACE is 1:1 (USACE 2009) for those wetlands that would be replaced with the same wetland type, and at least one full growing season in advance of the authorized wetland impacts provided initial performance standards are met; however, base compensation ratios for impacts on high-quality, difficult-to-replace bog and forested wetlands would be increased to 2:1 (USACE 2013). For impacts on low- and moderate-quality wetlands, a base ratio of 1.5:1 would be applied (USACE 2013). In-kind, in-place, and in-advance incentives to reduce the recommended base ratios would be considered at the time of permitting (see Tables 5.2.3-17 and 5.2.3-18). Compensation proposed at the Aitkin Site would be expected to meet in-kind compensation, resulting in a compensation ratio for high-quality wetland impacts of 1.75:1, and if in advance, the ratio would be reduced to 1.5:1. For low- to moderate-quality wetlands, the recommended base ratio of 1.5:1 would be required and could be reduced to 1.25:1 if in-kind and 1:1 if also in-advance. Under the Minnesota WCA, the replacement ratio that would likely be required is 1.5:1, because the Aitkin Site wetlands are out of the NorthMet Project area watershed (see Tables 5.2.3-17 and 5.2.3-19).

The site-specific mitigation design proposed by PolyMet includes the following methods of restoration to receive wetland mitigation credits, which would be reviewed and approval determined during permitting:

- Restoration of effectively drained wetland (restoration via reestablishment) on 758.3 acres for 100 percent mitigation credit or 758.3 credits;
- Hydrologic restoration of 50.1 acres of partially drained wetland (restoration via rehabilitation) to receive 50 percent credit or 25.0 credits; and
- Restoration of native vegetation on 83.2 acres of uplands and filled ditches, for 20.8 credits based on the 25 percent credit calculation for upland buffer.

The vegetation and hydrology would likely be restored to the site over a 1- to 2-year construction period, followed by up to 20 years of management, or more if warranted. The restoration work is expected to begin on the site after permit approval such that the initial phases of the restoration would be completed more than one full growing season before the impacts from the NorthMet Project Proposed Action would occur (PolyMet 2013o). Performance standards have been developed for the mitigation site to guide the restoration activities and to monitor whether vegetation and hydrology are meeting the design goals. To protect the site, a permanent conservation easement or deed recording would be prepared and recorded at approval of permit or prior to impact, as required by the permitting agency. The wetland restoration area would be monitored for up to 20 years beginning in the first full growing season after completing hydrologic restoration and ending upon certification by the USACE and MDNR that the wetlands have met performance standards (PolyMet 2013o; PolyMet 2015c).

The objective of the wetland restoration is to restore hydrology within the site by removing the internal drainage system and constructing outlets to establish specific hydrologic conditions that would meet the goals and performance standards established for the site and approved by the appropriate agencies. The hydrology would be restored utilizing broad, rock-lined weirs, and eliminating culverts with the exception of the culverts in a couple of locations. Once hydrology restoration has been achieved, an adaptive management program is proposed to guide development of the restored wetlands to achieve the targeted conditions. The vegetative restoration of the herbaceous layer in each wetland community would be conducted to promote the establishment of characteristic native species that are present in the seed bank or that may be transported to the area from adjacent wetlands. The goal of the restoration is to provide a setting and conditions in which the restoration areas would be restored to naturally self-sustaining and functioning wetlands to the extent feasible. The proposed wetland communities have been planned in areas that appear to match the natural hydrologic characteristics of each community type. However, during the restoration process, it is expected that the defined areas and wetland communities may change to some degree and the plan would allow for adaptation to the conditions. The overall plan for the Aitkin Site includes the following components: general site preparation, natural regeneration in all proposed communities, seeding/planting of shallow marsh and shrub-carr communities, planting hardwood swamp community, seeding/planting of coniferous swamp communities, and upland area establishment. General site preparation would be prior to or concurrent with hydrological restoration activities. Existing, non-native, and invasive vegetation would be removed through mechanical means or herbicide application. Diverse, native wetland vegetation is expected to develop in the restoration wetlands from the existing seed bank and from the wetland vegetation that surrounds the wetland restoration site through vegetative propagation and seed dispersal mechanisms. At the end of the second growing season these areas would be assessed to determine if additional seeding is required. These areas include shallow marsh, emergent fringes, and shrub-carr.

Hardwood swamp communities would require planting of trees in the spring of the second or third year after construction, depending on the success of herbaceous species establishment, the presence of invasive species, and the stability of the hydrology. Coniferous swamp communities would be established initially by direct-seeding tamarack in the spring.

Vegetation in the existing upland areas would be managed to promote natural succession of the existing plant communities. The primary maintenance activity would be control of non-native invasive species and seeding to develop diverse, native communities.

Hinckley Site

The Hinckley Site currently has about 375 acres under agricultural production and has been drained by ditches and sub-surface drain tiles. This 511-acre site is located southwest of the city of Hinckley, Minnesota at the intersection of Sod Road and Highway 107. The mitigation site is located in Pine County in the Snake River major watershed (#36) within bank service area #6, adjacent to bank service area #1 where the NorthMet Project area is located. The overall objective of the Hinckley restoration plan is to restore the hydrologic connection between upstream watersheds and the restoration site and to disable the internal drainage system on-site. The restoration process would start with activities to restore site hydrology (Barr 2008m).

The site is located outside of the NorthMet Project area watershed. The proposed wetland mitigation area includes 286.2 acres of wetland restoration and 91.2 acres of upland buffer preservation. Restoration methods on the site are designed to restore the following wetland types: Type 2 (fresh wet meadow), Type 2 (sedge meadow), Type 6 (shrub-carr), Type 6 (alder thicket), and Type 7 (hardwood swamp).

Hydrology monitoring at the Hinckley Site began in 2014, as well as at two reference wetland sites, to characterize the pre-restoration hydrology (PolyMet 2015c). Results of 2014 monitoring will be submitted to the USACE and the MDNR in 2015. Concurrence of the monitoring results will be conducted by permitting agencies during the permitting process (PolyMet 2015c). The state and federal agencies have not yet made a determination on the drainage status of the mitigation site (i.e., drained, partially drained, etc.); this determination will be made during permitting, including credit ratios.

The minimum replacement ratio that would be allowed by the USACE is 1:1 (USACE 2009) for those wetlands that are replaced with the same wetland type, and at least one full growing season in advance of the authorized wetland impacts provided initial performance standards are met; however, base compensation ratios for impacts on high-quality, difficult-to-replace bog and forested wetlands would be increased to 2:1 (USACE 2013). For impacts on low- and moderate-quality wetlands, a base ratio of 1.5:1 would be applied (USACE 2013). In-kind, in-place, and in-advance incentives to reduce the recommended base ratios would be considered at the time of permitting (see Table 5.2.3-17 and Table 5.2.3-18). Compensation proposed at the Hinckley Site would be expected to meet the in-kind incentive, resulting in a compensation ratio for high-quality wetland impacts of 1.75:1, and if in-advance, the ratio would be reduced to 1.5:1. For low- to moderate-quality wetlands, the recommended base ratio of 1.5:1 would be required and could be reduced to 1.25:1 if in-kind and 1:1 if also in-advance. Under the Minnesota WCA, the replacement ratio that would likely be required is 1.5:1, because the Hinckley Site wetlands are out of the NorthMet Project area watershed (see Tables 5.2.3-17 and 5.2.3-19).

The site-specific mitigation design proposed by PolyMet includes the following methods of restoration to receive wetland mitigation credits, which would be reviewed and approval determined during permitting:

- Restoration of effectively drained wetlands (restoration via reestablishment) on 277.4 acres for 100 percent mitigation credit or 277.4 credits;
- Hydrologic restoration of 8.7 acres of partially drained wetlands (restoration via rehabilitation) to receive 50 percent credit or 4.4 credits; and
- Restoration of native vegetation on 91.2 acres of uplands and filled ditches, for 22.8 credits based on the 25 percent credit calculation for upland buffer.

The vegetation and hydrology would likely be restored to the site over a 1- to 2-year construction period, followed by up to 20 years of management or more, if warranted. The restoration work is expected to begin on the site after permit approval such that the initial phases of the restoration would be completed more than one full growing season before the impacts of the NorthMet

Project Proposed Action would occur (PolyMet 2013o). Performance standards have been developed for the mitigation site to guide the restoration activities and to monitor whether vegetation and hydrology are meeting the design goals. To protect the site, a permanent conservation easement or deed recording would be prepared and recorded at the time of permit approval or prior to impact, as required by the permitting agency. The wetland restoration area would be monitored for up to 20 years beginning in the first full growing season after completing hydrologic restoration and ending upon certification by the USACE and MDNR that the wetlands have met performance standards (PolyMet 2013o; PolyMet 2015c).

The objective of the wetland restoration is to restore the hydrologic connection between the upstream watersheds and the site and disable the internal drainage system within the site. The hydrology would be restored by filling ditches and utilizing broad, rock-lined overflow weirs, and eliminating culverts where possible to establish specific hydrologic conditions that would meet the goals and performance standards established for the site and approved by the appropriate agencies. Once hydrology restoration has been achieved, an adaptive management program is proposed to guide development of the restored wetlands to achieve the targeted conditions.

The vegetative restoration of the herbaceous layer in each wetland community would be conducted to promote the establishment of characteristic native species that are present in the seed bank or that may be transported to the area from adjacent wetlands. The goal of the restoration is to provide a setting and conditions in which the restoration areas would be restored to naturally self-sustaining and functioning wetlands, to the extent feasible. The proposed wetland communities have been planned in areas that appear to match the natural hydrologic characteristics of each community type. However, during the restoration process, it is expected that the defined areas and wetland communities may change to some degree and the plan would allow for adaptation to the conditions.

The overall plan for the Hinckley Site includes the following components: general site preparation, natural regeneration in all proposed communities, seeding/planting of sedge/wet meadow and shrub-carr/alder-thicket communities, management of the existing hardwood swamp community, and upland area management. General site preparation would be prior to or concurrent with hydrological restoration activities. Existing, non-native, and invasive vegetation would be removed through mechanical means or herbicide application. Diverse, native wetland vegetation is expected to develop in the restoration wetlands from the existing seed bank and from the wetland vegetation that surrounds the wetland restoration site through vegetative propagation and seed dispersal mechanisms. At the end of the second growing season, these areas would be assessed to determine if additional seeding is required. These areas include sedge and wet meadows and shrub-carr/alder thickets.

The existing hardwood swamp would be managed to minimize the prevalence of non-native, invasive species; however, it is not anticipated that active seeding and planting would be required.

Vegetation in the existing upland areas would be managed to promote natural succession of the existing plant communities. The primary maintenance activity would be control of non-native invasive species such as buckthorn, honeysuckle, reed canary grass, and garlic mustard.

Zim Site

The Zim Site is currently an active sod farm that has been drained by ditches and sub-surface drain tiles. This site is located in two separate units (north and south) on approximately 569 acres of land located southwest of the city of Eveleth, Minnesota. The site is located in St. Louis County in the St. Louis River major watershed (#3), within the Lake Superior basin (bank service area #1). The overall objective of the Zim restoration plan is to restore a native wetland plant community.

The site is located within the NorthMet Project area watershed. The proposed wetland mitigation area includes 508.2 acres of wetland restoration and preservation, and 22.7 acres of upland buffer preservation. Restoration methods on the site would be designed to restore a (Type 8) coniferous bog community; however, developing a bog community is highly dependent on soil and groundwater parameters that are difficult to control. Therefore, a coniferous swamp community would be the contingent community if the soil and groundwater conditions are not adequate for bog regeneration. Coniferous bog or swamp is the target for the whole site; however, where trees do not successfully establish, the target community would be a shallow, open water wetland. If the target community changes, the credit ratios would be recalculated and would be determined during the permitting process.

Hydrology monitoring at the Zim Site, as well as at a reference wetland site, began in 2012 to characterize the pre-restoration hydrology, and continued in 2013 and 2014 (PolyMet 2015c). Based on 2 years of monitoring data at the Zim Site, the majority of the sod fields on the site no longer have wetland hydrology. The forested locations on the Zim Site exhibit hydrology representative of partially drained wetlands. Results of 2014 monitoring will be submitted to the USACE and the MDNR in 2015. Concurrence of the monitoring results will be conducted by permitting agencies during the permitting process (PolyMet 2015c). The state and federal agencies have not yet made a determination on the drainage status of the mitigation site (i.e., drained, partially drained, etc.); this determination, including the determination of credit ratios, will be made during permitting.

The minimum replacement ratio that would be allowed by the USACE is 1:1 (USACE 2009) for those wetlands that are replaced with either the same wetland type, or at least one full growing season in advance of the authorized wetland impacts provided initial performance standards are met; however, base compensation ratios for impacts on high-quality, difficult-to-replace bog and forested wetlands would be increased to 2:1 (USACE 2013). For impacts on low- and moderate-quality wetlands, a base ratio of 1.5:1 would be applied (USACE 2013). In-kind, in-place, and in-advance incentives to reduce the recommended base ratios would be considered at the time of permitting (see Tables 5.2.3-17 and 5.2.3-18). Compensation proposed at the Zim Site would be expected to meet both in-kind and in-place incentives, thereby reducing the compensation ratio for high-quality wetland impacts from 2:1 to 1.5:1. If in-advance, the ratio would be further reduced to 1.25:1. For low- to moderate-quality wetlands, the recommended base ratio of 1.5:1 would be required and could be reduced to 1.25:1 if in-place and 1:1 if also in-advance or in-kind. Under the Minnesota WCA, the replacement ratio that would likely be required is 1:1 for those wetlands that are replaced with the same wetland type and in the same watershed (see Tables 5.2.3-17 and 5.2.3-19).

The site-specific mitigation design proposed by PolyMet includes the following methods of restoration to receive wetland mitigation credits, which would be reviewed and approval determined during permitting:

- Restoration of effectively drained wetlands on 401.5 acres for 100 percent mitigation credit or 401.5 credits;
- Restoration of 8.3 acres of excavated ponds for 100 percent mitigation credit or 8.3 credits;
- Hydrologic restoration of 48.1 acres of partially drained wooded wetlands to receive 50 percent credit or 24.1 credits;
- Restoration of natural surface grade and wetland conditions in 21.5 acres of ditches, which would be filled to receive 50 percent credit or 10.7 credits;
- Restoration of native vegetation on 22.7 acres of upland buffers within drained fields and filled ditches, each of which would remain drained due to open ditches that cannot be filled, for 5.7 credits based on the 25 percent credit calculation for upland buffer; and
- Easement protection of 28.8 acres of native coniferous bog communities at 12.5 percent credit for a total of 3.6 credits for preservation.

The vegetation and hydrology would be restored to the site over a 1- to 2-year construction period, followed by up to 20 years of management or more, if warranted. The restoration work is expected to begin on the site after permit approval such that the initial phases of the restoration would be completed more than one full growing season before the impacts of the NorthMet Project Proposed Action would occur (PolyMet 2013o). Performance standards have been developed for the mitigation site to guide the restoration activities and to monitor whether vegetation and hydrology are meeting the design goals (Barr 2011k). To protect the site, a permanent conservation easement or deed recording would be prepared and recorded at approval of permit or prior to impact, as required by the permitting agency. The wetland restoration area would be monitored for up to 20 years beginning in the first full growing season after completing hydrologic restoration and ending upon certification by the USACE and MDNR that the wetlands have met performance standards (PolyMet 2013o; PolyMet 2015c).

The objective of the wetland restoration is to restore hydrology within the site by filling the interior ditches, leveling the raised berms, and disabling drain tiles to establish specific hydrologic conditions that would meet the goals and performance standards established for the site and approved by the appropriate agencies. Once hydrology restoration has been achieved, an adaptive management program is proposed to guide development of the restored wetlands to achieve the targeted conditions. Coniferous bog or swamp communities would be determined using established and approved bog restoration methods. Native, harvested bog material would be spread throughout the site to facilitate the re-introduction of sphagnum mosses and other bog species that cannot be easily re-introduced by seed. Natural regeneration of the herbaceous ground cover, in combination with the addition of bog harvest materials, would be supported by intensive weed management. Tree and shrub seedlings would be installed by hand throughout the site. The site would be carefully monitored and managed, and supplemental plantings and seeding may be used to encourage development until performance standards are met. The overall plan for the Zim Site includes the following components: general site preparation, site grading and hydrology restoration, bog restoration methods, tree and shrub installation, natural regeneration and bog establishment, and supplemental planting and seeding.

Table 5.2.3-17 Summary of Proposed Wetland Mitigation Credits

Community/Credit Type	Wetland Mitigation Within Project Watershed[1]		Wetland Mitigation Outside Project Watershed[1]			Total Wetland Mitigation Acres[1]	Total Wetland Mitigation Credits[1,6]
	Zim Sod (acres)	Total Credits	Aitkin (acres)	Hinckley (acres)	Total Credits		
Off-site Restoration of Effectively Drained Wetlands[2]							
Type 2 Fresh (Wet) Meadow	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Type 2 Sedge Meadow	0.0	0.0	0.0	51.0	51.0	51.0	51.0
Type 3 Shallow Marsh	0.0	0.0	25.7	0.0	25.7	25.7	25.7
Type 4 Deep Marsh	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Type 5 Shallow, Open Water	8.3	8.3	0.0	0.0	0.0	8.3	8.3
Type 6 Shrub-Carr	0.0	0.0	0.0	113.2	113.2	113.2	113.2
Type 6 Alder Thicket	0.0	0.0	0.0	113.2	113.2	113.2	113.2
Type 7 Hardwood Swamp	0.0	0.0	171.0	0.0	171.0	171.0	171.0
Type 7 Coniferous Swamp	0.0	0.0	561.6	0.0	561.6	561.6	561.6
Type 8 Open Bog	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Type 8 Coniferous Bog	401.5	401.5	0.0	0.0	0.0	401.5	401.5
Off-site Restoration of Partially Drained Wetlands and Ditches[3]							
Type 2 Sedge Meadow	0.0	0.0	0.0	0.8	0.4	0.8	0.4
Type 3 Shallow Marsh	0.0	0.0	13.6	0.0	6.8	13.6	6.8
Type 6 Shrub-Carr	0.0	0.0	36.5	0.0	18.2	36.5	18.2
Type 7 Hardwood Swamp	0.0	0.0	0.0	7.9	4.0	7.9	4.0
Type 8 Coniferous Bog	69.6	34.8	0.0	0.0	0.0	69.6	34.8
Off-site Site Preservation[4]							
Type 8 Coniferous Bog	28.8	3.6	0.0	0.0	0.0	28.8	3.6
Off-site Upland Buffer	22.7	5.7	83.2	91.2	43.6	197.0	49.3
On-site Wetland	---	---	---	---	---	---	---
On-site Upland Buffer5	---	---	---	---	---	---	---
Upland Buffer Total[1]	**22.7**	**5.7**	**83.2**	**91.2**	**43.6**	**197.0**	**49.3**
Wetland Total[1]	**508.2**	**448.2**	**808.3**	**286.2**	**1,065.1**	**1,602.7**	**1,513.3**
Total [1]	**530.9**	**453.9**	**891.5**	**377.3**	**1,108.7**	**1,799.7**	**1,562.5**

Source: PolyMet 2015c.

[1] Totals may not add exactly due to rounding.
[2] Credits for restoration of completely drained wetlands are worth 100 percent of the acreage restored based on USACE St. Paul District Policy (Restoration via re-establishment) and the Minnesota WCA Chapter 8420.0526, Subpart 3.
[3] Credits for restoration of partially drained wetlands are worth 50 percent of the acreage restored based on USACE St. Paul District Policy (Restoration via rehabilitation) and the Minnesota WCA Chapter 8420.0526, Subpart 4.

[4] Credits for wetland preservation are worth 12.5 percent of the acreage protected under a conservation easement based on USACE St. Paul District Policy (Preservation) and the Minnesota WCA Chapter 8420.0526, Subpart 9 (per *Minnesota Statute* 103G.2251 modified August 1, 2011).

[5] Credits for upland buffers are worth 25 percent of the acreage of native, non-invasive vegetation established or maintained adjacent to the wetland based on USACE St. Paul District Policy (Preservation) and the Minnesota WCA Chapter 8420.0526, Subpart 1.

[6] The determination of final mitigation credits required to offset the impacts of the proposed NorthMet Project Proposed Action would be determined by the agencies during wetland permitting. This would be based on the extent to which the sites meet the target goals established during permitting. These include, among other things, restoration of wetland appropriate hydrology and the establishment of a target plant community or type.

Table 5.2.3-18 Summary of Proposed Wetland Mitigation for Direct Impacts Utilizing USACE Credits

	Mitigation Credits Available[1]				NorthMet Project Proposed Action Direct Wetland Impacts in Acres[1,2]			Total Credits Required for Mitigation at Base Ratio[1,9]	No More Than 2 Apply[9]			Total Applied Mitigation Credits[1,6,7,9]	Applied Mitigation Ratio[8,9]
Wetland or Credit Type	**Zim Sod**	**Aitkin**	Hinckley	**Total Mitigation Credits Available**	**Non-Forested, Non-Bog, and Low or Medium Quality Wetland (Base Ratio 1.5:1)[3]**	**Bogs, Forested, and High Quality Wetland (Base Ratio 2:1)[4]**	**Total Impact Acres**		**Incentive for Credits In-Kind -0.25:1**	**Incentive for Credits In-Place -0.25:1**	**Incentive for Credits In-Advance[5] -0.25:1**		
Type 2 Fresh (Wet) Meadow	0.0	0.0	0.0	**0.0**	1.4	14.4	15.8	30.9	---	---	---	**30.9**	1.69
Type 2 Sedge Meadow	0.0	0.0	51.4	**51.4**	6.9	17.1	23.9	44.4	(6.0)	---	---	**38.4**	1.61
Type 3 Shallow Marsh	0.0	32.5	0.0	**32.5**	53.1	23.9	77.0	127.5	(8.1)	---	(8.1)	**111.3**	1.44
Type 4 Deep Marsh	0.0	0.0	0.0	**0.0**	74.2	0.1	74.3	111.5	---	---	---	**111.5**	1.50
Type 5 Shallow, Open Water	8.3	0.0	0.0	**8.3**	0.0	0.0	0.0	0.0	---	---	---	**0.0**	---
Type 6 Shrub-Carr	0.0	18.2	113.2	**131.5**	1.4	2.5	3.9	7.1	(1.0)	---	---	**6.1**	1.57
Type 6 Alder Thicket	0.0	0.0	113.2	**113.2**	7.5	103.1	110.6	217.4	(27.6)	---	---	**189.8**	1.72
Type 7 Hardwood Swamp	0.0	171.0	4.0	**175.0**	0.7	12.5	13.2	26.0	(3.3)	---	---	**22.7**	1.72
Type 7 Coniferous Swamp	0.0	561.6	0.0	**561.6**	0.0	84.4	84.4	168.9	(21.1)	---	---	**147.8**	1.75
Type 8 Open Bog	0.0	0.0	0.0	**0.0**	0.0	7.6	7.6	15.3	---	---	---	**15.3**	2.00
Type 8 Coniferous Bog	439.9	0.0	0.0	**439.9**	0.0	530.0	530.0	1,060.0	(110.0)	(110.0)	---	**840.0**	1.58
Wetland Total[1]	448.2	783.3	281.8	**1,513.3**	145.2	795.6	940.7	1,808.9	---	---	---	**1,513.7**	1.61
Upland Buffer	5.7	20.8	22.8	**49.3**	---	---	---	---	---	---	---	**---[10]**	---
Total[1]	**453.9**	**804.1**	**304.6**	**1,562.5**	**940.7**			**1,808.9**	**(117.1)**	**(110.0) (295.2)**	**(8.1)**	**1,513.7**	1.61
Total Surplus Wetland Mitigation Credits for NorthMet Project Proposed Action (Total Credit Minus Total Applied Mitigation Credit)[1,9]				**48.8**									

Source: PolyMet 2015c.

[1] Totals may not add exactly due to rounding.
[2] The total includes fragmentation of wetlands that would occur at the Mine Site and Plant Site (26.9 acres).
[3] Base ratio 1.5:1 per USACE St. Paul District Policy (USACE 2009) for wetlands that are not considered high-quality or difficult-to-replace, which includes forested wetland and bog communities.
[4] Base ratio 2:1 per USACE May 29, 2013 Draft Memorandum (USACE 2013) for wetlands that are high quality or difficult-to-replace, which includes forested wetland and bog communities.
[5] Based on USACE May 29, 2013 Draft Memorandum (USACE 2013) for in-advance qualification assuming all mitigation would be constructed one full growing season before wetland impacts were to occur.
[6] Total Applied Mitigation Credits = Total Credits Required for Mitigation minus Incentive Credits.
[7] Credits applied may include surplus credits from different wetland types.
[8] The ratio of credits applied to NorthMet Project Proposed Action impacts (not including the surplus credits).
[9] The determination of final mitigation credits required to offset the impacts of the proposed NorthMet Project Proposed Action would be determined by the agencies during wetland permitting. This would be based on the extent to which the sites meet the target goals established during permitting. These include, among other things, restoration of wetland appropriate hydrology and the establishment of a target plant community or type.
[10] Includes 0.5 credit of upland buffer, applied from totals listed above.

2397 -Page Intentionally Left Blank-

Table 5.2.3-19 Summary of Proposed Wetland Mitigation for Direct Impacts Utilizing Minnesota Wetland Conservation Act Credits

Wetland or Credit Type	Mitigation Credits Available[1]				NorthMet Project Proposed Action Direct Wetland Impacts in Acres[1,2]	Credit Applied for 1:1 Replacement[1,6]	Additional Mitigation Required +0.5:1[3,6]	Total Mitigation Credits Applied	Applied Mitigation Ratio[9]
	Zim Sod	Aitkin	Hinckley	Total Mitigation Credits Available					
Type 2 Fresh (Wet) Meadow	0.0	0.0	0.0	**0.0**	15.8	15.8	7.9	23.7	1.5:1
Type 2 Sedge Meadow	0.0	0.0	51.4	**51.4**	23.9	62.7	12.0	35.9	1.5:1
Type 3 Shallow Marsh	0.0	32.5	0.0	**32.5**	77.0	77.0	38.5	115.5	1.5:1
Type 4 Deep Marsh	0.0	0.0	0.0	**0.0**	74.3	74.3	37.1	111.4	1.5:1
Type 5 Shallow, Open Water	8.3	0.0	0.0	**8.3**	0.0	0.0	0.0	0.0	1.5:1
Type 6 Shrub-Carr	0.0	18.2	113.2	**131.5**	3.9	3.9	1.9	5.8	1.5:1
Type 6 Alder Thicket	0.0	0.0	113.2	**113.2**	110.6	110.6	55.3	165.9	1.5:1
Type 7 Hardwood Swamp	0.0	171.0	4.0	**175.0**	13.2	13.2	6.6	19.7	1.5:1
Type 7 Coniferous Swamp	0.0	561.6	0.0	**561.5**	84.4	84.4	42.2	126.6	1.5:1
Type 8 Open Bog	0.0	0.0	0.0	**0.0**	7.6	7.6	3.8	11.5	1.5:1
Type 8 Coniferous Bog	439.9	0.0	0.0	**439.9**	530.0	530.0	45.0	575.0	1:1[4]
Wetland Total[1]	448.2	783.3	281.8	**1,513.3**	940.7	940.7	250.4	1,191.2	---
Upland Buffer	5.7	20.3	22.8	**49.3**	---	---	---	---	---
Total[1]	**453.9**	**804.1**	**304.6**	**1,562.5**	**940.7**	**940.7**	**250.4**	**1,191.2**	1.27:1[5]
Total Surplus Wetland Mitigation Credits for NorthMet Project Proposed Action (Total Credit minus 1:1Credits minus Additional Mitigation Required)[1,6]						**371.4**			
Total Wetland Mitigation Credits Used for NorthMet Project Proposed Action[1,6]						**1,191.2**			

Source: PolyMet 2015c

1 Totals may not add exactly due to rounding.
2 The total includes fragmentation of wetlands that would occur at the Mine Site and Plant Site (26.9 acres).
3 Additional mitigation required for mitigation out of the watershed at Aitkin and Hinckley sites. Determined by multiplying 0.5 by Total Impact Area.
4 Assume 1:1 replacement for 439.9 acres compensated in-kind and in the watershed and 1.5:1 for the remaining 90.1 acres replaced out of the watershed.

[5] The ratio of credits applied to NorthMet Project Proposed Action impacts (not including the surplus credits).

[6] The determination of final mitigation credits required to offset impacts of the proposed NorthMet Project Proposed Action would be determined by the agencies during wetland permitting. This would be based on the extent to which the sites meet the target goals established during permitting. These include, among other things, restoration of wetland appropriate hydrology and the establishment of a target plant community or type.

5.2.3.3.3 Mitigation Summary

Compensatory mitigation is required for the 913.8 acres of wetlands that would be directly impacted. In addition, compensatory mitigation for the 26.9 acres of wetland fragmentation would be provided up front. The overall wetland mitigation strategy for the NorthMet Project Proposed Action is to compensate for unavoidable wetland impacts in-place, in-kind where possible and in-advance of impacts when feasible in order to replace lost wetland functions. Due to both on- and off-site limitations and technical feasibility, it is not practicable to replace all impacted wetland types with an equivalent area of in-kind wetlands. Off-site wetland mitigation projects would be implemented to fulfill the requirements for compensatory mitigation. PolyMet's current off-site mitigation proposal includes the:

- Aitkin Site – 808.3 acres of wetland restoration and 83.2 acres of upland buffer;
- Hinckley Site – 286.2 acres of wetland restoration and 91.2 acres of upland buffer; and
- Zim Site – 508.2 acres of wetland restoration and 22.7 acres of upland buffer.

Off-site wetland compensation of 1,602.7 acres could provide 1,513.3 wetland mitigation credits. In addition, a total of 197.1 acres of upland buffer areas are proposed to be established with native vegetation around the wetland restoration areas. In accordance with USACE guidelines, credit for the upland buffer areas would be at a 4:1 ratio, resulting in an additional 49.3 credits. The total off-site mitigation could provide 1,562.5 wetland mitigation credits. Tables 5.2.3-17, 5.2.3-18, and 5.2.3-19 provide a summary of wetland mitigation. Compensatory mitigation ratios determined in permitting may vary from these assumptions.

Finally, establishment of approximately 101.8 acres of wetland would likely occur during reclamation of the Mine Site; this establishment is not included in the mitigation credits discussed above as credit is not being requested at this time.

In accordance with the 2008 Federal Mitigation Rule, USACE policy, and overall requirements of the CWA, the primary focus of compensatory mitigation is to replace lost wetland functions within the same 8-digit HUC watershed as the impact site—in this case, the St. Louis River Watershed/Great Lakes Basin. Initially, no practicable compensation sites were found in the St. Louis River watershed, but subsequently, the Zim Site was found and incorporated as part of the compensatory mitigation plan. The permanent functional loss of wetlands within the St. Louis River Watershed/Great Lakes Basin would be considered during permitting. This is particularly critical in that 8-digit HUC watersheds adjacent to the Great Lakes—including the St. Louis River Watershed—have been identified as coastal watersheds for purposes of the 2008 Federal Mitigation Rule.

The majority of the credits would be in-kind mitigation, and nearly one-third of the credits would be from within the NorthMet Project area watershed (see Tables 5.2.3-17, 5.2.3-18, 5.2.3-19). Based on PolyMet's current mitigation proposal and assuming the mitigation efforts are fully successful and target communities are established, 83 percent of the impacts to coniferous bogs would be mitigated by in-kind and in-place credits, or 439.9 coniferous bog credits; the remaining 17 percent would be replaced out-of-kind. Out-of-kind credits would be used to mitigate impacts on wet meadow, shallow marsh, deep marsh, open bog, and coniferous bog communities; these would not be replaced in-kind because of hydrological and ecological constraints at the proposed mitigation sites. Forty-seven percent of the wetland impacts are currently proposed to be replaced in-kind, in-place, and before the impacts occur on site. An additional 29 percent of the proposed impacts are proposed to be replaced in-kind and before the impacts occur on site. Most of the additional mitigation credits that are proposed outside of the watershed would fulfill mitigation requirements above the minimum 1:1 ratio. The preferred location of siting any additional compensatory mitigation that may be required for the NorthMet Project Proposed Action would be within the St. Louis River/Great Lakes Basin.

The USACE requires a detailed compensatory mitigation plan for anticipated wetland impacts that would occur during the first 5 years of the NorthMet Project Proposed Action. A detailed mitigation plan must be submitted for each subsequent 5-year increment of wetland impacts to the USACE for approval. The anticipated wetland types to be restored off-site include a combination of the same and different types as the impacted wetlands. Some off-site wetlands would be restored in advance of impacts, while other wetlands would be restored after the impacts.

The change in wetland hydrology from groundwater drawdown at the Mine Site was assessed by two different methodologies; therefore, total indirect wetland effects were provided based on both approaches. The NorthMet Project Proposed Action could indirectly affect up to either 7,694.2 acres of wetlands located within and around the NorthMet Project area, based on the method of wetlands crossing analog impact zones, or up to 6,568.8 acres of wetlands located within and around the NorthMet Project area, based on the method of wetlands within analog impact zones (PolyMet 2015b). Regardless of the method used, wetland mitigation for indirect wetland effects would be determined by the agencies during permitting. If the NorthMet Project Proposed Action were to be permitted and constructed, wetland monitoring would be conducted to determine if the NorthMet Project Proposed Action causes future indirect wetland effects. Wetlands and vegetation would be monitored; additional monitoring locations may be considered during permitting. A component of the monitoring plan would be based on those wetlands that have a high likelihood of indirect effects as a result of groundwater drawdown. If the monitoring determined that indirect wetland effects had occurred, additional compensation may be required if determined necessary by the permitting agencies. In the event that the required wetland monitoring identified additional indirect effects, permit conditions would likely include a plan for adaptive management practices to be implemented, such as expanded monitoring and hydrologic controls. Additionally, compensatory mitigation may be required if additional impacts are identified during annual reporting. Permit conditions would likely include an adaptive management plan to account for any additional impacts that may be identified in the annual monitoring and reporting.

5.2.3.3.4 Monitoring Plan for Mitigation Sites

Wetland hydrology monitoring has begun at the mitigation sites to assess hydrological conditions prior to the determination about the NorthMet Project Proposed Action and would continue after hydrology restoration is complete to determine whether or not the restored wetland areas are in conformance with performance standards and would determine whether continued monitoring would be required.

The wetland restoration area monitoring would begin during the first full growing season after completing hydrologic restoration. In addition to monitoring of the restored wetlands, one reference wetland of each restoration community type would be monitored within the general area of each restoration site in areas with relatively natural hydrologic conditions similar to that of the proposed target communities. A monitoring plan would be submitted to the appropriate state and federal agencies for review and approval that would include proposed locations of reference wetlands prior to implementing the monitoring program (PolyMet 2013o; PolyMet 2015c).

Vegetative monitoring would entail conducting a detailed vegetation survey at least once per year (typically July to August) in each wetland mitigation community, as well as the reference wetland communities, to evaluate the success of the restoration during the appropriate monitoring period for each community type.

Hydrologic monitoring would involve the installation and periodic monitoring of shallow recording wells at multiple locations sufficient to characterize hydrology. Continuous recording wells that record water table elevations multiple times each day would be utilized to the extent feasible and would be placed throughout the sites sufficient to characterize hydrology. Hydrologic monitoring would be used to measure the success of hydrologic restoration relative to the established performance standards for each community type and to assess the extent of wetlands on each site (PolyMet 2015c; PolyMet 2013o). Water elevations would be recorded at least once per week from May through mid-July and monthly thereafter until the end of the growing season (PolyMet 2015c).

The duration of monitoring would depend on the target wetland communities at each site and the success of establishment of those communities. Bogs and forested wetlands would be monitored for up to 20 years, or more if warranted. Monitoring of emergent and shrub-carr wetland communities would continue for up to 10 years, or more if warranted. Certain components of the monitoring may be discontinued sooner if performance standards were met and approval was provided by the USACE and MDNR (PolyMet 2015c; PolyMet 2013o).

After restoration, the monitoring design may be altered to better characterize restored conditions (PolyMet 2013o). Water levels would be recorded several times each day in the stilling wells for the duration of the growing season; staff gauges would be checked weekly for the first 10 weeks of the growing season and twice monthly thereafter. Hydrology monitoring in saturated soil communities would be completed using shallow water table monitoring wells within each community recorded several times each day for the duration of the growing season (PolyMet 2013o). Hydrologic parameters for Hinckley and Aitkin would be evaluated in the mitigation areas more intensively during the first 2 years and then would be performed at a level appropriate to the hydrologic characteristics of each area thereafter (PolyMet 2014h; PolyMet 2014i; PolyMet 2014j). Reference wells would be established for each community type and monitoring with those wells would continue for the duration of site hydrology monitoring (PolyMet 2013o).

Hydrologic monitoring at the three mitigation sites would generally occur for at least 5 years; however, certain wetland types may be monitored longer. In shrub communities, monitoring would generally be for 8 years, and in forested communities, it would generally be 20 years. Monitoring would begin in the first full growing season after beginning hydrologic restoration to document the progress and condition of the wetland communities at the mitigation site. Monitoring reports would be prepared and submitted to the appropriate agencies, and the frequencies of the reports would be based on permit conditions. The monitoring report completed after the final growing season would assess whether or not the restored wetlands are in conformance with performance standards (PolyMet 2014h; PolyMet 2014i; PolyMet 2014j).

Reports would describe the status of the wetland mitigation, summarize the results of the vegetative and hydrologic monitoring, discuss management activities and corrective actions conducted during the previous period, and discuss activities planned for the following period. The reports would be submitted to the USACE and MDNR by December 31 of each year. Monitoring requirements would be determined during the permitting process.

Contingencies for Unsuccessful Mitigation

If the restored wetland communities at any of the mitigation sites did not meet performance standards, remedial or corrective actions and possibly additional mitigation credits may be required and would be determined by the USACE and state during the permitting process. For example, PolyMet could characterize site conditions relative to the performance standards in each monitoring report and, if the standards were not met, remedial actions would be proposed to meet the standard(s). The following contingencies have been proposed by PolyMet (PolyMet 2013o) and would be finalized and approved during permitting:

- Performance standards within any planned community type not met for 3 consecutive years would be analyzed to determine the effects on the approved wetland mitigation credits and propose an alteration to the plan, which could include a modification of wetland community type, changes to the proposed credit ratios, and additional wetland mitigation.
- If any wetland community has not developed as planned and as defined in the performance standards after the fifth full growing season after restoration, PolyMet would work with the USACE and MDNR on appropriate alternative plans, including alternative mitigation or revisions to the overall mitigation ratio based on changes to wetland community types.
- Any plan revisions would be submitted to the USACE and MDNR for review and approval prior to implementation.

If it is determined that additional wetland mitigation would be required due to unsuccessful mitigation restoration, PolyMet would first utilize the excess credits (see Tables 5.2.3-18 and 5.2.3-19) and then would identify and pursue wetland mitigation opportunities, including wetland preservation options, within the watershed of the NorthMet Project area. PolyMet would use available information from BWSR and other relevant entities that is available at the time it is determined additional potential wetland mitigation is needed. Information on the wetland mitigation opportunities identified and pursued would be coordinated with and submitted to the USACE and state for review and approval prior to making final decisions on additional mitigation (PolyMet 2013o).

5.2.3.3.5 Monitoring Plan for Mine Site and Plant Site Wetland for Potential Indirect Effects

Wetland monitoring would occur in and around the Mine Site and Plant Site prior to and during construction and operation of the NorthMet Project Proposed Action, if permitted, and would be used to assess whether or not potential indirect effects on wetlands were occurring. If monitoring of wetlands for potential indirect effects did determine effects were occurring, additional compensation may be required, if determined necessary, based on monitoring results. Monitoring is proposed within all wetlands containing a potential indirect wetland impact factor rating of 3 to 5 and a sampling of those wetlands with factor ratings of 1 or 2 (see Figures 5.3.2-31 and 5.2.3-32) (PolyMet 2013o). A component of the monitoring plan would be based on those wetlands that would have a high likelihood of indirect effects as a result of groundwater drawdown. If indirect wetland effects were to occur, PolyMet would be required to work with the USACE and state to respond, which may include the option to provide compensatory mitigation for any documented indirect effects. The monitoring plan would be updated annually based on results from the previous year. A total of 56 monitoring wells and four reference wells are proposed to document potential indirect wetland effects.

The criteria for determining if potential indirect wetland effects are occurring is provided below. In addition, permit conditions would include an adaptive management plan, summarized below, to account for any additional effects that may be identified in the annual monitoring and reporting. To determine if indirect effects occur, hydrology, vegetation, and wetland boundaries would be monitored, documented, and compared with baseline monitoring and reference wetlands.

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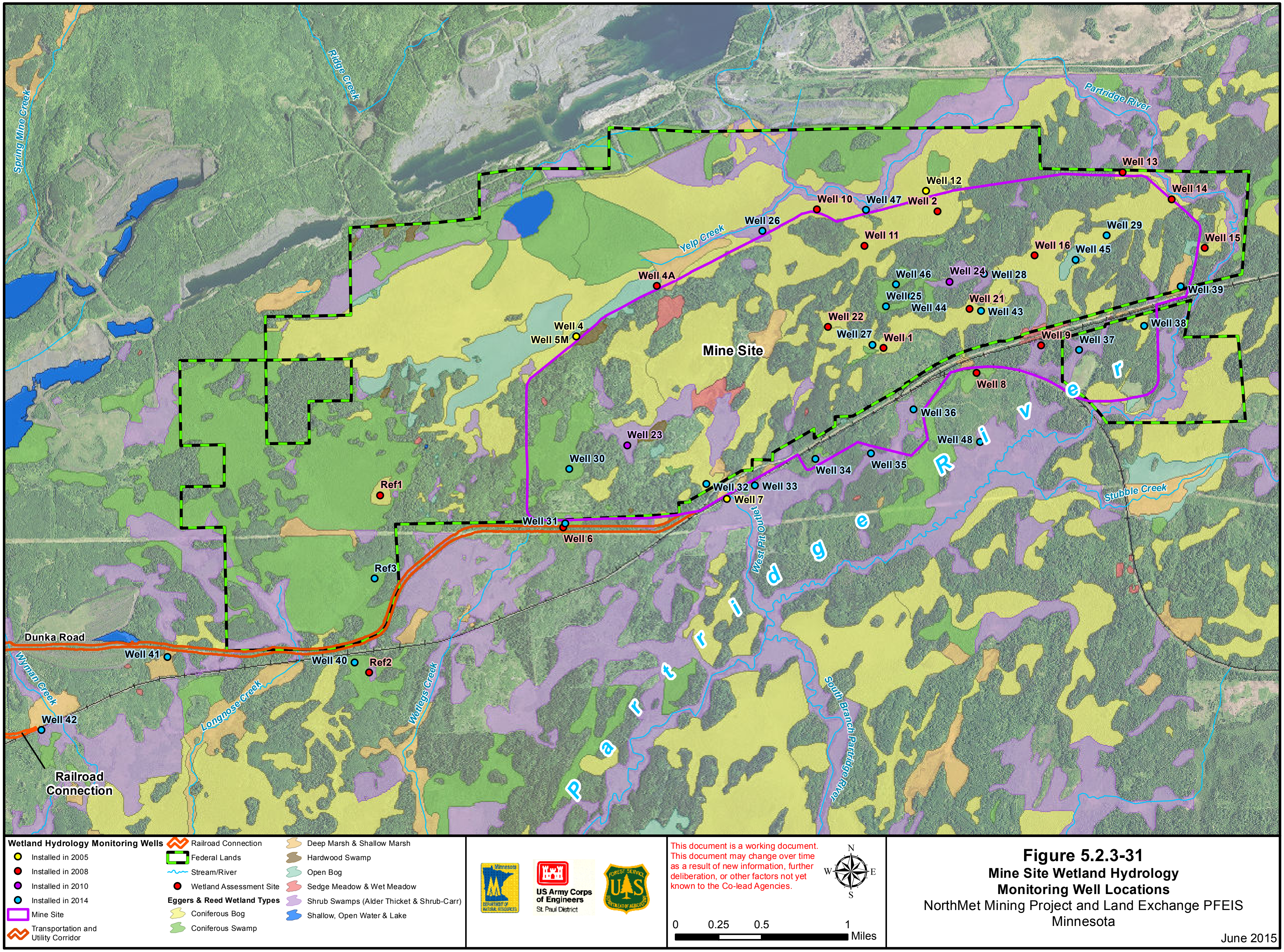

Figure 5.2.3-31
Mine Site Wetland Hydrology Monitoring Well Locations
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

2594

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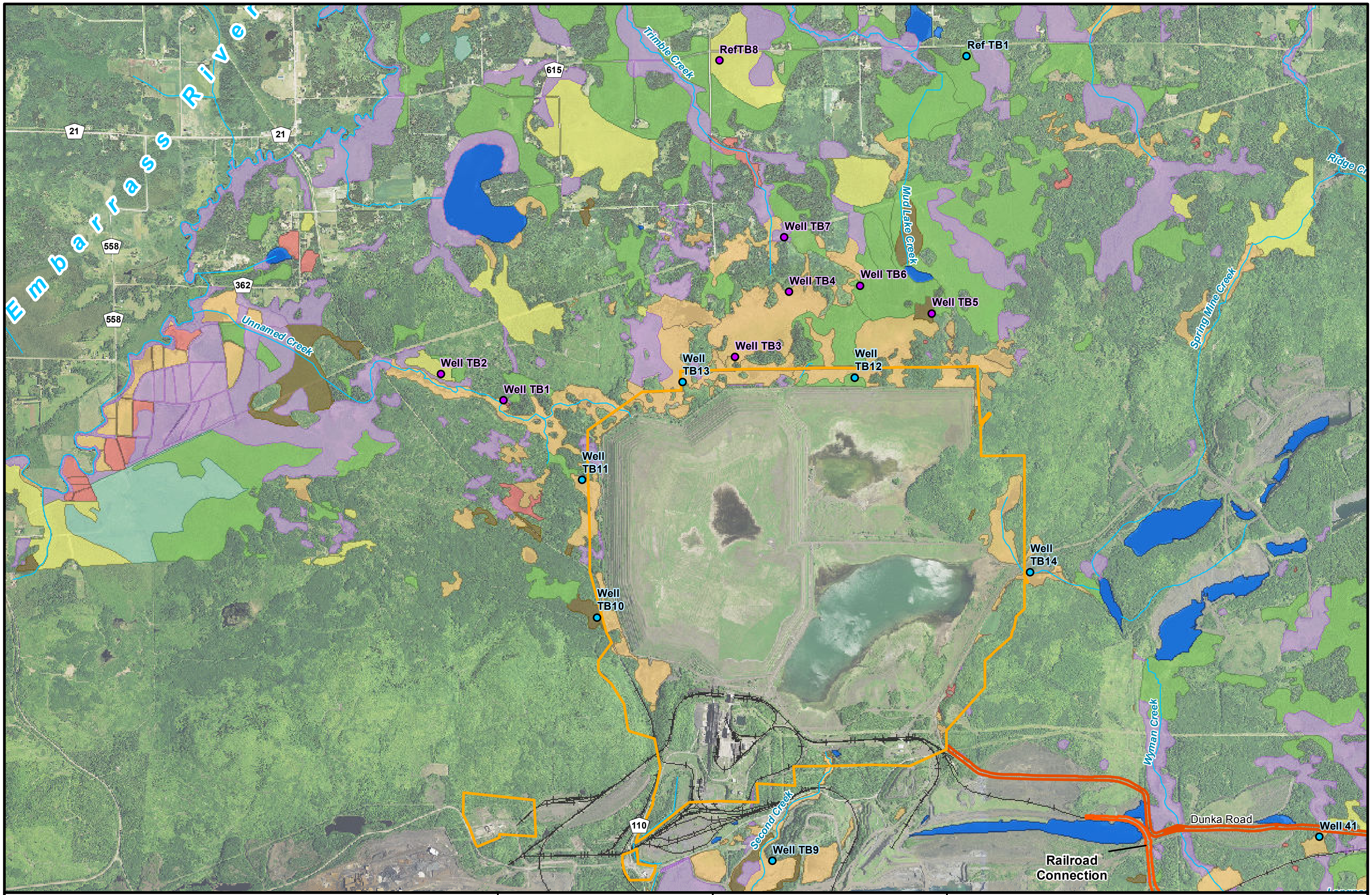

Wetland Hydrology Monitoring Wells

- Installed in 2005
- Installed in 2008
- Installed in 2010
- Installed in 2014
- Plant Site

- Transportation and Utility Corridor
- Stream/River

Eggers & Reed Wetland Types

- Coniferous Bog
- Coniferous Swamp
- Deep Marsh & Shallow Marsh
- Hardwood Swamp
- Open Bog
- Sedge Meadow & Wet Meadow
- Shrub Swamps (Alder Thicket & Shrub-Carr)
- Shallow, Open Water & Lake

US Army Corps of Engineers
St. Paul District

This document is a working document. This document may change over time as a result of new information, further deliberation, or other factors not yet known to the Co-lead Agencies.

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Figure 5.2.3-32

Plant Site Wetland Hydrology Monitoring Well Locations

NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

2596

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Pre-Project Wetland Hydrology Monitoring Sites

In 2005, 20 shallow manual wells and four recording wells were initially installed at 19 locations around the Mine Site. A total of 11 monitoring locations were situated around the perimeter of the Mine Site and are not expected to be affected by the NorthMet Project Proposed Action. The remaining eight monitoring locations are located within the Mine Site and have the potential to be affected by the NorthMet Project Proposed Action. In 2008, two wells were removed because they were within future stockpile locations, two new wells were added at the Mine Site, one well was relocated out of the direct effect area, and two wells were installed in reference wetlands located west of the Mine Site (PolyMet 2015c). Furthermore, in 2008, all monitoring locations were instrumented with recording wells so water levels could be recorded every 2 to 4 hours. In 2010, two wells were relocated because they were determined to be in areas that would be directly impacted by the NorthMet Project Proposed Action. During 2008 through 2010, there were 21 locations monitored at the Mine Site. In 2014, wetland monitoring locations were installed at 25 additional locations at the Mine Site and Transportation and Utility Corridor. In addition, in 2014 another reference wetland was selected, for a total of three reference wetlands to monitor (see Figure 5.2.3-31) (PolyMet 2015c). Pre-project monitoring did not include collection of vegetation or wetland boundaries other that what was completed during the wetland delineation and baseline wetland type evaluation (PolyMet 2015c; PolyMet 2013o).

Shallow monitoring wells were installed at eight locations around the Plant Site in 2010. One of the eight wells was installed in a reference wetland located north of the Plant Site that would not be affected by the NorthMet Project Proposed Action. Two monitoring wells were placed west of the Plant Site along Unnamed Creek; two wells were placed north of the Plant Site, adjacent to a large deep marsh wetland complex; and three wells were placed along the flowpath of Trimble Creek. The monitoring wells were typically placed to a depth of 2 to 5 ft bgs. In 2014, shallow monitoring wells were installed at seven additional locations in the Plant Site area and a second reference wetland was selected (see Figure 5.2.3-32).

The monitoring protocol would continue for the life of the NorthMet Project Proposed Action, if approved, though portions of the monitoring design could be altered to improve the design or to eliminate unnecessary data collection, which would be done in coordination with the appropriate agencies. Pre-project hydrology monitoring of wetlands and groundwater within and surrounding the Mine Site started in 2005 and in 2010 at the Plant Site at well locations approved by the USACE and MDNR, and would continue throughout the NorthMet Project Proposed Action in accordance with the planned study (PolyMet 2015c). The primary objectives of the Mine Site and Plant Site wetland hydrology monitoring studies include the following:

1. Gain a better understanding of the wetland hydrology at the Mine Site and Plant Site (i.e., defining whether specific wetlands are recharging the surficial deposits aquifer or are discharging to surface waters).
2. Collect baseline hydrology data at the Mine Site and Plant Site that could be used to assess the effect of the NorthMet Project Proposed Action on wetland hydrology.
3. Review the data collected at the Mine Site in the hydrogeologic study along with the wetland hydrology data to determine whether specific wetlands within the Mine Site area have perched water tables or are in direct hydrologic connection with the surficial deposits aquifer.

4. Determine the potential for indirect wetland effects at the Mine Site and Plant Site resulting from the NorthMet Project Proposed Action.

The majority of the pre-project monitoring locations would be utilized for future monitoring during mining activities. The monitoring of the well locations would be expanded to include vegetation sampling and wetland boundaries, and additional monitoring locations may be considered during permitting. .

Project Wetland Hydrology Monitoring Sites

Wetland hydrology monitoring would be conducted during operation of the NorthMet Project Proposed Action to document indirect wetland effects. Prior to the start of the NorthMet Project Proposed Action, monitoring would be established based on permit conditions, which would describe the purpose, methods, and criteria to be implemented to document indirect wetland effects. As previously stated, the monitoring wells were planned within all wetlands with effect factor ratings of 3 and within a sampling of wetlands with effect factor ratings of 1 and 2 located throughout the areas of potential indirect wetland effects.

As noted in the Section 404 permit application, PolyMet proposes to install shallow water table monitoring wells at each of the proposed wetland monitoring locations shown in Figures 5.2.3-31 and 5.2.3-32. Each monitoring location would have one recording well and one manual well; if any wells were to become damaged, PolyMet would replace the wells as soon as practical to maintain data continuity. Monitoring would continue in all of the existing wells, with the exception of wells #1 and #6. These two wells would be moved outside of areas that would be directly impacted (see Figures 5.2.3-31 and 5.2.3-32). Hydrologic monitoring would continue at the existing and proposed monitoring locations and at reference wetland locations every year throughout the growing season for the life of the mine operation. PolyMet would review the monitoring information and, if it were determined that certain wells were not providing useful information, the monitoring plan could be modified with the concurrence of the USACE and MDNR.

Reference Wetland Hydrology Monitoring Sites

Pre-project monitoring locations would include three reference wetlands, one within each of the three major project areas (see Figures 5.2.3-31 and 5.2.3-32), approved by the USACE and MDNR to document the natural hydrologic fluctuations in wetlands that would not be affected by the NorthMet Project Proposed Action and would facilitate interpretation of the NorthMet Project Proposed Action hydrologic data.

Wetland Vegetation and Boundary Monitoring

In addition to hydrology monitoring, wetland vegetation monitoring would be conducted during the operation of the NorthMet Project Proposed Action. Baseline conditions for wetland vegetation would be established during the first growing season after permit issuance and at 5-year intervals throughout the life of the mine. Data would be used to document potential shifts in vegetation that are inconsistent with changes documented in the reference wetlands. Baseline data already available from existing plots, wetland delineation, monitoring, and other on-site studies may also be used to document baseline conditions if these data may help to determine the cause of changes in vegetation characteristics or to demonstrate natural variability within the wetlands (PolyMet 2013o).

PolyMet has also proposed that portions of the monitored wetlands be reviewed every 5 years, concurrent with the vegetation monitoring, to evaluate wetland boundaries. Wetland boundaries would be field-delineated and located using a GPS with sub-foot horizontal accuracy. The field-based delineation would map at least 25 percent of the wetland boundary at each of the wetlands with monitoring locations. The boundaries would be mapped on a rotating basis to include 25 percent of the wetland boundary every 5 years, including some overlap every 10 years. A transect composed of at least two wetland delineation sample points would be completed along a sections of the boundary reviewed in each of the monitored wetlands (PolyMet 2013o).

The delineation data would be compiled to map the boundary of each of the wetlands with monitoring locations. Based on the portion of the wetland that is delineated, the whole wetland boundary would be mapped using desktop review of current aerial photography, topography (LIDAR or site-specific data), and hydrology monitoring data. The results would be reported to the USACE and MDNR at the end of each year of monitoring (PolyMet 2013o).

Criteria Impacts Threshold Levels

The hydrology, vegetation, and wetland boundary monitoring data collected as part of the proposed monitoring program by PolyMet would be evaluated to determine if adverse, indirect wetland effects occur as a result of the NorthMet Project Proposed Action. PolyMet has proposed the following criteria threshold levels for indicating if an adverse, potential indirect wetland effects are occurring (PolyMet 2013o):

- A 50 percent reduction of the baseline wetland hydrology hydroperiod. Antecedent precipitation and reference wetland hydrology would be considered in the evaluation of wetland hydrology hydroperiod. The hydroperiod of a wetland is equal to the length of time and portion of the year the wetland holds ponded water or saturation within 12 inches of the soil surface. This period of time generally varies from year to year based on climatic conditions. Therefore, the judgment of surpassing this threshold would be evaluated considering the monitoring for each wetland conducted during the pre-project time period and data from reference wetlands of similar community types or hydrologic regime.
- A change in vegetation species composition of 25 percent or greater in one or more strata that is inconsistent with vegetation changes in the reference wetlands. For instance, if stinging nettles (*Urtica dioica*) cover changed from 5 to 30 percent, it may indicate changes in wetland hydrology and would be reviewed carefully relative to the hydrology data. Other factors may contribute to changes in vegetation (disturbances or species introductions) that may be unrelated to changes in wetland hydrology or the nearby NorthMet Project area; such factors would be considered as appropriate.
- Loss of wetland area (as defined by the wetland boundary determination) that is inconsistent with wetland area loss at reference wetlands.

The above criteria have been proposed by PolyMet as part of its Section 404 permit application, and permit conditions would indicate the final criteria thresholds if the NorthMet Project Proposed Action were approved. The criteria would also be considered and need to be approved during the WCA permitting process and Section 401 certification process. These criteria or those that are approved during permitting would be evaluated by PolyMet with consideration of the NorthMet Project Proposed Action activities and likelihood that such activities are responsible for the changes. Should adverse, indirect wetland effects be identified during the monitoring program, an estimation of such effects would be included in the monitoring report in the year that they are first detected. The data for hydrology, vegetation, and wetland boundary monitoring would be compiled in a report, including methods, results, and evaluation of potential adverse indirect wetland effects; this report would be submitted to the USACE and MDNR by the end of each monitoring year.

Indirect Effects Mitigation

If it is determined that indirect wetland effects occurred based on the criteria effects threshold levels, PolyMet would work with the appropriate agencies to respond, which could require PolyMet to provide compensatory mitigation for any documented indirect effects. If indirectly affected wetlands require compensatory mitigation, the acreage would be calculated by community type and provided in annual monitoring reports to the appropriate agencies. Compensatory mitigation would be based on WCA requirements and the USACE St. Paul District Policy for wetland mitigation, as well as that identified below.

The excess wetland mitigation credits proposed are expected to be available to compensate for potential indirect wetland effects. PolyMet would follow, if necessary, the general planning approach described above and below for contingencies for unsuccessful mitigation to identify, plan, and receive the USACE and state approval of mitigation plans to develop additional mitigation credits. If additional mitigation credits were needed, site selection would be consistent with USACE and WCA guidance. PolyMet is proposing to mitigate the compensatory loss of wetland areas as a result of potential indirect effects in accordance with the mitigation ratios that were utilized for direct wetland impacts. In addition, PolyMet has proposed in the Section 404 permit application that partial drainage or other changes to the wetlands that do not result in the wetland loss, but exceed the threshold levels identified above, could be mitigated at a lower ratio depending on the extent and degree of the changes to wetland function. The minimum ratio of mitigation credit PolyMet is proposing to use would be 0.25:1.

Wetlands Adaptive Monitoring Plan

PolyMet has, in their Section 404 permit application, proposed utilizing an adaptive monitoring plan approach to evaluate the most effective monitoring strategy for potential indirect effects. Their proposed wetland adaptive monitoring plan outlined below needs to be reviewed and approved prior to permitting:

- The monitoring plan would be updated annually based on results from the previous year.
- Monitoring plan criteria would be included in the Wetland Management Plan, which would contain all criteria and permit conditions.
- If indirect impacts were observed, additional monitoring may be developed to focus in those areas and/or to focus on a specific impact factor.
- Additional monitoring may include new monitoring locations in other wetlands and more detailed delineation and vegetation data collection.

PolyMet's current proposed adaptive monitoring plan includes two phases. Phase I would be broad-based monitoring to identify changes to wetlands or changes that may affect wetlands or surface waters; Phase II monitoring may be implemented to provide a more detailed assessment in a given area to analyze a potential impact factor. If necessary, the Phase II monitoring would be designed and implemented as needed to address the changes identified during Phase I monitoring. Phase II would be used to determine the need for additional mitigation or to develop a plan to control the changes identified during Phase I and minimize future effects on wetlands. The adaptive monitoring plan would be reviewed and approved during permitting.

5.2.3.3.6 Reporting

Reports would be compiled to document pre-project hydrology conditions and restoration outcomes from the three mitigation sites as well as for the hydrology monitoring at the NorthMet Project areas, which would be implemented to fulfill the requirements for compensatory mitigation.

<u>Off-site Monitoring Reports for Wetland Restoration</u>

Reports have been prepared to document the activities that would be conducted at the off-site wetland mitigation sites, which include information regarding existing conditions at the site, construction activities, management activities, wetland restoration goals, performance standards, schedules, and monitoring plans (PolyMet 2014h; PolyMet 2014i; PolyMet 2014j). These plans were developed to comply with WCA rules (*Minnesota Rules*, chapter 8420), Section 404 of the CWA as administered by the USACE, and *Minnesota Rules*, part 7050.0186 (wetland mitigation) as administered by the MPCA.

Project-specific wetland mitigation plans for three mitigation sites were prepared that describes the compensatory wetland mitigation that would be used to replace unavoidable wetland impacts associated with the NorthMet Project Proposed Action. The wetland mitigation plans were updated and submitted to the USACE in May 2014 for the three sites.

PolyMet would submit progress monitoring reports for the wetland mitigation sites as determined during permitting to document restoration outcomes. Wetland restoration construction progress would be tracked along with compliance with permit conditions. The reports would describe the status of the wetland mitigation, summarize the results of the vegetation and hydrology monitoring, discuss management activities and corrective actions conducted during the previous year, and discuss activities planned for the following year. The monitoring report completed after the tenth growing season would assess whether or not the restoration were sufficiently complete and if additional monitoring and reporting were warranted (PolyMet 2015c).

<u>Reporting on Mine Site and Plant Site Wetland Hydrology for Potential Indirect Effects</u>

Pre-project wetland hydrology monitoring reports, generated to meet reporting requirements, have been compiled and document 5 years of pre-project planning and monitoring at the Mine Site (2005 to 2009). PolyMet has continued to conduct wetland hydrology monitoring since 2009 at the Mine Site. Pre-project wetland hydrology monitoring at the Plant Site has also been conducted in 2010, 2011, and 2012 at the Plant Site and is ongoing. Future project wetland hydrology monitoring reports would be submitted in accordance with any permit issued.

Monitoring data would be submitted to the USACE and MDNR annually for the life of the mine. Hydrology data would be presented every year to show monitoring locations, hydrographs, and analysis of wetland hydrologic conditions in the context of precipitation conditions. Vegetation and wetland boundary data would be presented every 5 years and would be used to determine the acreage of impacts and potential indirect effects that were not evident based on hydrologic data. Indirect effects would be assessed in the annual reports to the extent possible. Acreage of indirect effects, if any, would be determined and would be used to determine the requirements for wetland mitigation credits, if such credits were needed. If compensatory mitigation were necessary, credits would be proposed in the annual report as described above (PolyMet 2013o).

5.2.4 Vegetation

This section describes the environmental consequences of the NorthMet Project Proposed Action to vegetation, which include direct effects on land cover types, native plant community types, MBS Sites of Biodiversity Significance, and rare or sensitive plant species, as well as effects from existing or introduced invasive non-native species.

Summary

The NorthMet Project Proposed Action would disturb 1,718.6 acres of the Mine Site and have the greatest effect on upland conifer forest land cover types. Approximately 2,189.7 acres of the Plant Site would be disturbed by the NorthMet Project Proposed Action, with most effects occurring in already disturbed areas and tailings ponds. All land within the Transportation and Utility Corridor would be affected (120.2 acres), the majority of which is already disturbed.

The NorthMet Project Proposed Action would affect approximately 1,719 acres that are mapped by the MDNR as MBS Sites of High Biodiversity Significance. Within these Sites of High Biodiversity Significance, several native plant communities are mapped that would be affected by the NorthMet Project Proposed Action, including 698.2 acres with a conservation status rank of “imperiled-vulnerable” (conservation status rank S2 or S3) or “vulnerable” (conservation status rank S3), 92.6 acres with a conservation status rank of “apparently secure” (conservation status rank S4), and 178.9 acres with a conservation status rank of “widespread and secure” (conservation status rank S5).

Disturbed areas would be reclaimed during operations and at closure. Reclamation objectives would include rapidly establishing a self-sustaining plant community, controlling air emissions, controlling soil erosion, providing wildlife habitat, and minimizing the need for maintenance. Seed mixes and methodologies would be designed to minimize the introduction of invasive species. Reclamation seed mixes would be approved during permitting.

There are no federally listed plant species at the NorthMet Project area. There are 10 state-listed plant species, all at the Mine Site; 8 species would be directly affected and two would potentially be indirectly affected by the NorthMet Project Proposed Action.

Indirect effects from the NorthMet Project Proposed Action could include dust deposition on vegetation, hydrology changes, ore spillage along the Transportation and Utility Corridor, and erosion on the Tailings Basin. Mitigation measures would be in place for each of these potential effects.

5.2.4.1 Methodology and Evaluation Criteria

This section compares the types of data presented in Section 4.2.4 for the NorthMet Project area. Specifically, GIS data were obtained from the MDNR regarding GAP land cover types, native plant communities, MBS Sites of Biodiversity Significance, and listed ETSC plant species within the NHIS. Data were obtained from the USFS regarding MIH types, forest stand age classes, RFSS, invasive non-native species, and landscape ecosystems. Separate NorthMet Project area-specific listed species survey reports were also utilized to supplement MDNR NHIS data and estimate effects on populations.

GIS analysis was used to calculate effects on the data layers mentioned above. The effects were calculated for habitat types, classifications, and species where they overlap the NorthMet Project area footprints.

Direct effects on natural features (e.g., vegetative cover types, plant communities, MBS Sites of Biodiversity Significance, and rare species) occur through clearing, filling, and other construction activities. A direct effect on an ETSC plant species occurs when the action results in the removal or loss (i.e., taking) of an individual plant or entire plant population. Direct effects are those that are a result of the NorthMet Project Proposed Action, that are immediate, and that often last for years.

An indirect effect occurs when a cover type, plant community, Site of Biodiversity Significance, or rare species experiences a change in vegetative composition. Indirect effects can occur over time or after the action is completed and can occur on- or off-site. Indirect effects on vegetation may include changes in hydrology, deposition of particulate matter (dust), changes in successional stage, alteration of microclimate (e.g., tree removal resulting in drier soil conditions), loss of pollinators or loss of fungal associates in the rooting zone, erosion and sedimentation, and invasion of non-native species. Indirect effects were estimated by comparing the proximity of the NorthMet Project area infrastructure footprints to existing natural features (e.g., habitat types, plant species present). Typically, indirect effects are more likely to occur and/or are more likely to be evident in vegetation communities that are closer to NorthMet Project components and other infrastructure (e.g., roads). Indirect effects tend to diminish with increasing distance from NorthMet Project components and other infrastructure.

5.2.4.2 NorthMet Project Proposed Action

This section describes the effects of NorthMet Project Proposed Action construction, operation, and closure on vegetation cover types and plant species. Potential effects from invasive non-native species are discussed separately.

5.2.4.2.1 Mine Site

Effects on Cover Types

Habitat Types

Construction and operation of the NorthMet Project Proposed Action at the Mine Site would directly affect 1,718.6 acres (57 percent of the Mine Site) of land with various MDNR GAP land cover designations as a result of excavating the mine pits and creating overburden and waste rock stockpiles and associated internal haul roads and drainage ditches. As shown in Table 5.2.4-1, these effects would include 62 percent (741.9 acres) of the upland conifer forest at the Mine Site. Other high-acreage directly-affected cover types include lowland coniferous forest (437.2 acres) and upland deciduous forest (354.7 acres). Approximately 1,295.9 acres, or about 43 percent of the Mine Site, would not be disturbed. The wetland field assessment indicated a high level of wetland quality. Section 5.2.3 provides a more detailed discussion of wetland effects.

Table 5.2.4-1 Direct Effects on Cover Types at the Mine Site

Cover Types	Affected Acres	Non-affected Acres[1]	Total Cover Type Acres	Percent of Cover Type Affected
Upland coniferous forest	741.9	453.6	1,195.5	62
Lowland coniferous forest	437.2	344.0	781.2	56
Upland deciduous forest	354.7	293.3	648.0	55
Shrubland	133.0	108.7	241.7	55
Disturbed	44.0	84.0	128.0	34
Aquatic environments	6.0	6.7	12.7	47
Upland conifer-deciduous mixed forest	1.5	0.9	2.4	63
Cropland/grassland	0.2	4.7	4.9	4
Lowland deciduous forest	0.0	0.1	0.1	0
Total[2]	1,718.6	1,295.9	3,014.5	57

Source: MDNR 2006b.

Notes:
[1] Areas of cover types not directly affected by mine pits, stockpiles, roads, or other infrastructure.
[2] Total acres may be more or less than presented due to rounding.

Minnesota Biological Survey

Approximately 353.6 acres of the One Hundred Mile Swamp MBS Site of High Biodiversity Significance and 1,364.9 acres of the Upper Partridge River MBS Site of High Biodiversity Significance would be affected by the NorthMet Project Proposed Action. The portions of these two MBS sites that are within the Mine Site area represent a small portion of the mapped Sites of High Biodiversity Significance in St. Louis County (2 percent) and the State of Minnesota (less than 1 percent). Habitat effects associated with the NorthMet Project Proposed Action would not result in a large percentage decline in statewide areas ranked as high by the MBS (MDNR 2008a).

Approximately 698.2 acres of the “imperiled-vulnerable” or “vulnerable” native plant communities—the black spruce-Jack pine woodlands (FDn32c; 495.5 acres; 20 percent of community within Laurentian Uplands subsection) and rich black spruce swamp (FPn62a; 202.7 acres; 1 percent of community within Laurentian Uplands subsection)—would also be affected. Approximately 92.6 acres of the “apparently secure” native plant communities—i.e., black spruce bog: treed subtype (APn80a1; 77.7 acres; 4 percent of community within Laurentian Uplands subsection) and poor tamarack-black spruce swamp (APn81b; 14.9 acres; less than 1 percent of community within Laurentian Uplands subsection)—would be affected. Approximately 178.9 acres of “widespread and secure” native plant communities would also be affected, including alder (maple-loosestrife) swamp (FPn73a; 42.5 acres; 3 percent of community within Laurentian Uplands subsection), aspen-birch forest: balsam fir subtype (FDn43b1; 101.1 acres; less than 1 percent of community within Laurentian Uplands subsection), and poor black spruce swamp (APn81a; 35.3 acres; less than 1 percent of community within Laurentian Uplands subsection).

Some of the native plant communities identified at the NorthMet Project area are wetlands. WCA rules (including those parts applicable to mining projects under Minnesota Rules 8420.0930) include a special consideration for wetlands that are rare natural communities (Minnesota Rules 8420.0515, subp 3). Guidance developed by MDNR and BWSR on rare natural communities (MDNR and BWSR 2011) identifies that rare natural communities are native plant communities having a conservation status rank of S1, S2, or S3, or any native plant community that is contained within an area mapped or determined by MBS to be eligible for mapping as an area of outstanding or high biodiversity significance ranking. Figure 4.2.4-2 depicts these Sites of Biodiversity Significance.

The Permit to Mine would address special consideration of wetlands that include rare natural communities. Additional information on rare natural communities would be included in the wetland permit application as part of the Permit to Mine process for further refinement of site-specific conditions.

Culturally Important Plants

Potential effects on wild rice as a result of the NorthMet Project Proposed Action would vary by location. The CEC modeling scenario concentrations exceed the sulfate evaluation criterion at PM-13. However, under project conditions, the project would not cause or contribute to an exceedance of the 10-mg/L sulfate evaluation criterion for the Embarrass River at PM-13, since the Tailings Basin containment and seepage collection system would capture seepage presently going to the Embarrass River tributaries. Sulfate concentrations currently exceed 10 mg/L in the Partridge River at SW-005. GoldSim results predict that for all situations where a theoretical impact could be attributed to the NorthMet Project Proposed Action, the expected increase in sulfate concentration at SW-005 (and SW-006) would be less than or equal to 0.1 mg/L, and this would be superimposed on typical annual fluctuations of several mg/L. A practical consequence of this result is that the effects of the NorthMet Project Proposed Action would not be identifiable by even the most robust field monitoring program. Effects, as well as water quality standards, are discussed more thoroughly in Section 5.2.2.

While a distinct list of plant species important to the Bands is not available, Sections 4.2.9.3.3 and 5.2.9.2.2 discuss more broadly the effects on the ecological subsections, large landscapes, and connected ecosystems.

Indirect Effects

In addition to the direct effects mentioned above, potential indirect effects on remaining vegetative cover types at the Mine Site could be associated with dust from road traffic and mining operations and with changes in hydrology. Dust on leaves can affect the rates of photosynthesis and respiration, which both influence plant growth. If sulfide-containing dust is deposited on leaves, it could react with oxygen in the air and water from precipitation to create sulfates over a period of weeks to months. This residual build-up in the soil could inhibit growth by slowly acidifying the soil conditions. The distance dust travels depends on wind speed, antecedent weather conditions, dust particle size, and vegetation density near the source. Section 5.2.7.2.6 states that the NorthMet Project Proposed Action is not expected to have a significant effect on sulfate deposition in the state, and so no threat to sensitive vegetation is expected. PolyMet proposes to implement various dust-control measures such as stabilizing disturbed soils by temporarily establishing vegetation and water spraying during dry periods (consistent with *Minnesota Rules,* part 6132.2800). As Section 5.2.7 further describes, fugitive dust control measures would result in 90 percent control at the Mine Site. These measures, which are standard practice for existing taconite mines on the Mesabi Iron Range, have proven to be adequate to minimize potential indirect effects from fugitive dust. The Mine Site AERA did not assess potential local mercury deposition because potential emissions are less than 1.0 lb/yr (Barr

2011g). However, the mercury deposition on terrestrial environments would be expected to be not significant when compared to variability in background mercury concentrations.

As Section 5.2.3 explains, vegetation located within zones with a high likelihood of hydrology effects would be more likely to have community changes than those with no or low likelihood of effect.

Reclamation

Reclamation activities help to offset a portion of the effects of a project. Reclamation and revegetation at the Mine Site would promote cover development and initiate vegetative succession on stockpiles, the combined East Central Pit, and Mine Site infrastructure footprints. Fertilizer would be applied at rates recommended for each group of species planted, and would be worked into the soil to a depth of 8 inches on the level and 4 inches on all slopes (PolyMet2015g, Attachment A). Soil testing would be completed, as needed, to evaluate fertilizer requirements. On areas to be mulched after seeding, no more seed would be sown than could be mulched the same day. Seed would be sown via mechanical Truax native seed drills or hydrospreading at specified rates of application, unless inaccessible or wet areas dictate the use of hand-operated spreaders. Seedbeds would be firmed using cultipackers, or seeds would be covered before mulching. Six different types of mulch could be applied, depending on the situation. As nutrients and organic matter are returned to the soil, the conditions on the reclaimed areas would become more suitable for migration of nearby native herbaceous and woody species.

The Category 1 Stockpile would be incrementally and progressively reclaimed throughout the life of the mine, starting in year 14, to minimize erosion of the outer slopes, promote post-closure land use, and minimize the need for active site care and maintenance during the post-closure period. Prior to construction of the cover system, the stockpile surfaces would be graded for long-term stability, to promote vegetation growth and erosion control, and to develop a surface drainage network over the stockpile (PolyMet 2015h). After grading, an engineered geomembrane system would be constructed. The geomembrane system would consist of, from top to bottom: 18 inches of rooting zone soil consisting of on-site unsaturated overburden mixed with peat, as needed, to provide organic matter; 12 inches of granular drainage material with drain pipes to facilitate lateral drainage of infiltrating precipitation and snowmelt off the stockpile cover; a 40 mil geomembrane barrier layer; and a 6-inch soil bedding layer below the geomembrane (PolyMet 2015a). The stockpile would then be locally contoured to provide some topographic variety to the surface. Finally, the stockpile would be seeded with a certain selection of grasses/forbs at the top and bench flats and a potentially different group of species for the slopes, depending on the availability and suitability of the species (PolyMet 2015g, Attachment A). The three groups of species designated for the top and benches would include a native, slow-growth mix; a non-native, rapid-growth mix; and a mix of both native and non-native species. The species mix for the stockpile slopes would contain the same native species as the stockpile bench and flats, and a slightly modified group of non-native species. The cover would store precipitation within the loose layer during the period when vegetation is dormant. The trapped water would then be removed from the cover system by transpiration of the plants during the growing season and evaporation. Vegetation would also aid in stabilizing the cover from wind and rain erosion (Polymet 2015h).

Both the Category 2/3 Stockpile and the Category 4 Stockpile would be temporary and would be removed at closure. Temporary stockpile reclamation would begin during operations. The material in these stockpiles would be relocated to the East Pit starting in year 11 (PolyMet 2014b). After removal of the material, the footprint of the Category 2/3 Stockpile and portions of the Category 4 Stockpile that do not become the Central Pit would be reclaimed by subsequent seeding and planting of grass and forb species similar to those planted for the Category 1 Stockpile top and benches (PolyMet 2015g, Attachment A). Depressions in both temporary stockpile footprints with sufficient hydrology and soil conditions would be seeded with a different group of native grasses (e.g., fringed brome, bluejoint, Virginia wild rye, tall manna grass, fowl bluegrass, tussock sedge, pointed broom sedge, dark green bulrush, and woolgrass) and forbs (e.g., Canada anemone, marsh milkweed, flat-topped aster, common boneset, grass-leaved goldenrod, spotted Joe Pye weed, blue monkey flower, giant goldenrod, and Eastern panicled aster) suitable for wet soils. The West Pit would become open water, while the combined East Central Pit would be partially filled with material from the Category 2/3 Stockpile and Category 4 Stockpile to support wetland vegetation with species discussed above for the removed stockpile depressions (see Table 5.2.4-2). The pit wall overburden slopes would be planted with the same mix mentioned for stockpile slopes above (PolyMet 2015g, Attachment A). The acres reclaimed (see Table 5.2.4-2) do not equal the acres disturbed as some haul roads and buildings would remain after cessation of operations.

Following demolition of Mine Site buildings and parking areas, suitable overburden would be placed over the footprint, to a depth of 2 ft., and revegetated (PolyMet 2015g). Mine Site roads deemed unnecessary for future access by the MDNR would be scarified and revegetated, as well. Disturbed areas, building sites, and reclaimed roads would all be seeded with a similar mix of grass and forb species as that planted on the Category 1 Stockpile top and benches (PolyMet 2015g, Attachment A).

Table 5.2.4-2 Proposed Vegetation Types and Acreages for Reclaimed Stockpiles and Pits at the Mine Site

Type	Proposed Reclamation Vegetation	Acres
Category 1 Stockpile	Grassland/herbaceous	526
Category 2/3 Stockpile (Removed)	Wetland; Grassland/herbaceous	180
Category 4 Stockpile (Removed)	Wetland; Grassland/herbaceous	57*
Ore Surge Pile (Removed)	Wetland; Grassland/herbaceous	31
Overburden Storage and Laydown Area (Removed)	Wetland; Grassland/herbaceous	41
Combined East Central Pit	Wetland	207*
West Pit	Open pit lake	321
Roads, Parking Areas, Buildings	Grassland/herbaceous	88

Sources: PolyMet 2015g, Attachment A; PolyMet 2014b; PolyMet 2015h; PolyMet 2014q; Kearney, Barr Engineering, Pers. Comm., February 6, 2013.

*The Central Pit would be mined at the location of the temporary Category 4 Stockpile after it is removed. The reclamation acres for the Category 4 Stockpile and the Combined East Central Pit overlap.

Effects of Invasive Non-native Plants

Disturbances associated with the construction of the Mine Site would result in exposed soil surfaces that would have the potential for colonization by invasive species. PolyMet proposes to temporarily vegetate and stabilize disturbed areas during operation and permanently reclaim during closure by spreading seeds. Species proposed for revegetation on most disturbed areas and the Category 1 Stockpile top and benches include native and non-native species. There are native grass species (e.g., fringed brome, switchgrass, Canada wild rye, bluejoint, poverty oatgrass, slender wheatgrass, fowl bluegrass, and false melic) and native forb species (e.g., common yarrow, pearly everlasting, flat-topped aster, tall cinquefoil, large-leaved aster, stiff goldenrod, smooth wild rose, black-eyed susan, gray goldenrod, upland white aster, Lindley's aster, smooth aster, and American vetch). According to the PolyMet Reclamation Seeding and Mulching procedure (PolyMet 2015g, Attachment A), preference would be given to establishing native plant communities, and the introduction of invasive plant species would be avoided to the extent practicable. Reclamation objectives include rapidly establishing a self-sustaining plant community, controlling air emissions, controlling soil erosion, providing wildlife habitat, and minimizing the need for maintenance.

Non-native species that could be planted include: oats, winter wheat, alfalfa, timothy, redtop, alsike clover, white clover, Canada bluegrass, intermediate wheatgrass, cicer milkvetch, birdsfoot trefoil, perennial ryegrass, smooth brome grass, meadow brome, and red fescue. These species are known to establish quickly and form a nearly complete groundcover, which can help prevent erosion, maintain water quality, and increase soil stability on more susceptible areas. The legume species listed would also fix atmospheric nitrogen into the soil to help re-establish soil nutrients. Generally, these species would be planted as temporary cover crops until the native species developed and could out-compete them. However, some of the proposed species are considered invasive (e.g., birdsfoot trefoil, redtop, smooth brome grass, Canada bluegrass). Section 5.2.4.2.4 discusses suggested mitigation measures for non-native or invasive species.

The proposed Type 1 mulch (hay, straw, and agricultural grass/legume cuttings) would be relatively free of seed-bearing stalks or propagules of noxious weed species, as defined by the rules and regulations of the Minnesota Department of Agriculture (PolyMet 2015g, Attachment A).

The introduction of invasive non-native species would be more detrimental to the relatively high-quality vegetation communities at the Mine Site than to those at the Plant Site, which is already heavily disturbed. Introduction of invasive non-native species could result in decreased diversity of plant species and habitats available to wildlife species. Several ETSC plant species at the Mine Site may be susceptible to increased competition from invasive non-native species. There are already a few occurrences of yellow sweetclover and bladder campion at the Mine Site, which may invade future disturbed areas.

Minnesota's noxious weed law (*Minnesota Statutes* § 18.75-18.91) contains procedures for controlling and eradicating noxious weeds on all lands within the state. None of the species proposed to be potentially planted are considered state-prohibited noxious weeds. The MDNR has made recommendations for non-invasive species for the seed mix and the final seed mix would be approved during permitting.

Effects on Threatened and Endangered Plant Species

The MDNR NHIS and separate rare species surveys were utilized to map known ETSC species locations using GIS data. Updated MDNR Element Occurrence attribute data were used to estimate the NorthMet Project area and statewide population numbers of a species, per MDNR guidance (Joyal, MDNR, Pers. Comm., February 13, 2012). An individual is defined here as a single plant of a species. A colony (observation) is a group of individual plants of one species in a distinct geographic location. A population is a group of individuals or colonies of one species that may be separated geographically, but are close enough geographically to interbreed and persist over time.

No federally listed threatened or endangered plant species occur at the Mine Site. However, the NorthMet Project Proposed Action would have both direct (8 species) and potential indirect (two species) effects on state-listed ETSC plant species at the Mine Site, affecting 1 percent of the known statewide populations for these 10 species. Table 5.2.4-3 summarizes the direct and indirect NorthMet Project Proposed Action effects on each of the ETSC plant species that are located in the vicinity of the Mine Site, which includes some of the Transportation and Utility Corridor. These numbers may overestimate the actual effects as a proportion of the number of actual populations in the state. Intensive surveys, such as those performed at the Mine Site, have not been performed throughout the state; therefore, the actual number of statewide populations may be larger than that identified in the MDNR NHIS.

Rulemaking was conducted with the intent to update the list of ETSC species (*Minnesota Rules*, parts 6134.0100 to 6134.0400), with new listings becoming effective on August 19, 2013 (MDNR 2013h). This FEIS considers any new listings, or changes in the previous listings, associated with the updated list.

Table 5.2.4-3 Effects on Known State-listed ETSC Plant Populations in the Vicinity of the Mine Site, Including the Transportation and Utility Corridor

	Known Mine Site Populations					Known Statewide Populations				
Plant Species (state status/ global status[1])	**Total Populations[2,7]**	**Total Individuals**	**Direct Effects[3] (Populations)**	**Indirect Effects[4] (Populations)**	**Unaffected Populations**	**Total Known Populations[5,7]**	**Average Individuals per Population[6]**	**Percent Directly Affected (Populations)**	**Percent Indirectly Affected (Populations)**	**Total Percent Affected (Populations)**
Botrychium campestre (SC/G3)	1	1	1	0	0	69	unknown	1	0	1
Botrychium pallidum (SC/G3)	1	21	1	0	0	99	15	1	0	1
Botrychium rugulosum (SC/G3)	1	4	1	0	0	72	14	1	0	1
Botrychium simplex (SC/G5)	3	1,580	3	0	0	210	25	1	0	1
Caltha natans (E/G5)	1	56	1	0	0	15	unknown	7	0	7
Eleocharis nitida (SC/G4)	1	~1,562 ft^2	1	0	0	49	450	2	0	2
Juncus stygius var. *americanus* (SC/G5)	1	1	0	1	0	30	unknown	0	3	3
Platanthera clavellata (SC/G5)	1	3	0	1	0	123	unknown	0	1	1
Ranunculus lapponicus (SC/G5)	1	~919 ft^2	1	0	0	83	51	1	0	1
Torreyochloa pallida (SC/G5)	1	~25 ft^2	1	0	0	74	unknown	1	0	1
Total	13	NA	11	2	0	982	NA	NA	NA	NA

Sources: MDNR 2011k; MDNR 2014d.

Notes:

[1] The state status is E – Endangered; T – Threatened; and SC – Species of Special Concern. The global ranks range from G1 to G5. A lower global ranking (e.g., G3) indicates a species at higher global risk than higher ranking (e.g., G5) (NatureServe 2014).

[2] Populations are interpreted from MDNR NHIS data using Element Occurrence, which differs from the DEIS, which used colonies as the population estimate.

[3] Direct effects are expected for those populations that would be removed or buried by mine activities. Effects are calculated for populations rather than individuals because of the large variation and inaccuracies in the estimates of number of individuals per population.

[4] Indirect effects may occur to those populations within or near the Mine Site. These populations may be affected by changes in hydrology, water quality, dust, or inadvertent activities. As above, effects are given for populations rather than individuals.

[5] Statewide population data provided by Lisa Joyal (MDNR) on March 26, 2013.

[6] Population estimates are approximate and used for comparative purposes only. The number of individuals is based upon populations for which data exist.

[7] Data included here were provided by the Division of Ecological Resources, MDNR, and were current as of August 5, 2014. These data are not based on an exhaustive inventory of the state. The lack of data for any geographic area shall not be construed to mean that no significant features are present

The NorthMet Project Proposed Action would directly affect 8 of the 10 state-listed ETSC plant species found at or in the immediate vicinity of the Mine Site (see Table 5.2.4-3). Most of the direct effects would involve the complete loss of colonies within a population as a result of excavation of the mine pits, burial under stockpiles, or disturbance during infrastructure construction.

The NorthMet Project Proposed Action would potentially indirectly affect 2 of the10 state-listed ETSC plant species found at or in the immediate vicinity of the Mine Site (see Table 5.2.4-3). The NorthMet Project Proposed Action may also result in indirect effects on some colonies of the directly affected state-listed ETSC plant species at the Mine Site. These indirect effects may occur as a result of changes in hydrology or water quality, deposition of particulate matter (dust), application of road salts, or weed incursion. Individual species appear to differ in their response to these indirect effects. For example, several of the ETSC plant species typically occur along or in old tailings ponds or along roadsides where disturbance and dust are frequent. To a certain extent, each species' sensitivity to disturbance can be inferred from currently occupied habitats. Habitats were considered "disturbed" if they consisted of tailings ponds, gravel pits, landing pads, logging roads, ditches, or roadsides. Several species may not actually be disturbance-tolerant, as much as they are able to colonize previously disturbed sites. Repeated soil disturbance near these species may have an effect on such populations in the short term. Overall, less than 1 percent of the known statewide populations for these state-listed ETSC species would potentially be indirectly affected by the NorthMet Project Proposed Action. In some cases, potential indirect effects on ETSC plant species that would be near, but outside, the footprint of these facilities could be avoided or reduced by fencing or flagging ETSC populations to prevent disturbance.

Minnesota's endangered species law (*Minnesota Statute,* § 84.0895) and associated rules (*Minnesota Rules,* parts 6212.1800–6212.2300 and 6134) impose a variety of restrictions, permits, and exemptions pertaining to ETSC species. "The law and rules prohibit taking, purchasing, importing, possessing, transporting, or selling" endangered or threatened plants, including their parts or seeds, without a permit (MDNR 2011m). "Taking," as it relates to plants includes picking, digging, or destroying. There is the potential that PolyMet would need to seek a Take Permit from the MDNR for state-listed ETSC plant species. If it is determined by the MDNR that there are no feasible alternatives to taking, the applicant must pursue compensatory mitigation. Transplantation is generally not considered by the MDNR to be acceptable mitigation for taking of endangered or threatened species (MDNR 2011m). The MDNR suggests that typical compensatory mitigation for taking endangered or threatened species in Minnesota include the following:

- Funding state acquisition of another site where the species occurs that is currently unprotected and vulnerable to destruction,
- Funding additional survey work to locate other sites, and/or
- Funding research to improve our understanding of the habitat requirements or protection needs of the species (MDNR 2011k).

A discussion of the effects on each individual ETSC species is provided below.

Prairie moonwort populations are commonly observed on sparsely vegetated mineral soil from sediments of iron mine tailings ponds and grassy railroad embankments (NatureServe 2014). Of the 69 known populations statewide, one colony of one population within the Mine Site area, along Dunka Road, could be directly affected by pipeline construction and road improvements/maintenance as part of the NorthMet Project Proposed Action (1 percent affected) (see Table 5.2.4-3). This species is less tolerant of disturbance than other *Botrychium* species; however, since it prefers sparsely vegetated areas, it may actually expand into disturbed areas along Dunka Road in the future. At the Mine Site, grassland areas would not be affected, but around 34 percent of previously disturbed areas would be affected, resulting in potentially reduced on-site habitat for this species (see Table 5.2.4-1).

Botrychium pallidum (pale moonwort) populations are most commonly observed on mine tailings basins and along roadsides. Of the 99 known populations statewide, three colonies of one population within the Mine Site, along Dunka Road, could be directly affected by pipeline construction and road improvements/maintenance as part of the NorthMet Project Proposed Action (1 percent affected) (see Table 5.2.4-3). One separate colony is located near the railroad track and may be indirectly affected. This species, however, appears to be semi-tolerant of disturbance since sites that are kept open by regular disturbance are particularly suitable (NatureServe 2014). Colonies may actually expand into newly disturbed areas along Dunka Road and at the Mine Site. Grassland areas at the Mine Site would not be affected, but around 34 percent of previously disturbed areas would be affected, resulting in reduced on-site habitat for this species (see Table 5.2.4-1).

Botrychium rugulosum (ternate, or St. Lawrence, grapefern) often occurs on tailings basins, along roadsides, and in shaded wetland forests. Of the 72 known extant populations in Minnesota, one population (with four individuals) occurs along Dunka Road at the Mine Site (1 percent affected) (see Table 5.2.4-3). This population may be directly affected by vehicle operation or road improvements and maintenance as part of the NorthMet Project Proposed Action. This species appears to be semi-tolerant of disturbance and populations. At the Mine Site, around 62 percent of upland conifer forests and around 55 percent of upland deciduous forests would be affected, resulting in much less on-site habitat for this species (see Table 5.2.4-1).

Botrychium simplex (least moonwort) frequently occurs in shrublands, forests, tailings basins, and along roadsides. Of the 210 known populations statewide, three occur at the Mine Site, all of which are expected to be directly affected (see Table 5.2.4-3). Of these populations, 21 colonies are expected to be directly affected—seven from stockpiles and mine pits, and another 14 from construction of the haul roads, water pipeline, ditches, railroad track, or transmission line (1 percent affected). The colonies affected by stockpiles and mine pits would be removed, while the colonies affected by construction of pipelines or ditches may be reduced in the short term. Depending on proximity to construction activities, some of these colonies would likely recover by expanding along Dunka Road and at the Mine Site post-closure, as this species appears to be semi-tolerant of disturbance. At the Mine Site, around 34 percent of disturbed areas and around 55 percent of shrublands would be directly affected, resulting in less on-site habitat for this species (see Table 5.2.4-1).

Caltha natans (floating marsh-marigold) is found primarily in relatively undisturbed habitats and is not likely to be tolerant of disturbance. Of the15 known populations statewide, one population, which consists of 13 colonies, occurs at the Mine Site (see Table 5.2.4-3). One colony is expected to be directly affected by stockpile development. Two other colonies are located close to Dunka Road and could be potentially indirectly affected by road construction or improvements. Ten other colonies are located in the vicinity of, but outside, the Mine Site, several of which occur along the Partridge River. Since water from the West Pit would be discharged downstream of these colonies, it is unlikely there would be indirect effects on them. Effects would not occur to all thirteen colonies of the Mine Site population as indicated in Table 5.2.4-3 because direct and indirect effects due to the NorthMet Project Proposed Action would be limited to three of the thirteen colonies. All known Minnesota populations occur in St. Louis County; one in the northern third of the county, two in the southern third, and twelve in the central third. A few of the statewide populations contain many more individuals (thousands) than the population at the Mine Site. Since the known statewide population for this species is smaller than the other species present, the effect on its population in Minnesota would be correspondingly larger (seven percent affected). As mentioned, however, due to the size of other statewide populations, and since three out of thirteen colonies of the Mine Site population could be affected, the actual percent affected would be smaller than seven percent (using available data, approximately less than one percent). The mitigation measures mentioned above, particularly the purchase of an unprotected site with a population of the species, should be assessed. At the Mine Site, around 47 percent of aquatic environments would be directly affected, resulting in reduced on-site habitat for this species (see Table 5.2.4-1).

Eleocharis nitida (neat spike-rush) at the Mine Site is primarily observed in roadside ditches along Dunka Road with gravel or sandy substrates. Of the 49 known populations in the state, one occurs on the Mine Site (2 percent affected) (see Table 5.2.4-3). Of this population, eight colonies are found along Dunka Road, and three colonies are located along the railroad tracks. All of the eight Dunka Road colonies are likely to be directly affected by ditch construction. The other three colonies may be potentially indirectly affected by changes in hydrology or water quality. This species seems to be semi-tolerant of disturbance since it has inhabited roadside ditches. At the Mine Site, around 47 percent of aquatic environments and 34 percent of disturbed areas would be directly affected, resulting in less on-site habitat for this species (see Table 5.2.4-1).

Juncus stygius var. *americanus* (bog rush) has 30 known populations in the state, none of which occur at the Mine Site; however, one population is located upgradient of the Mine Site within the One Hundred Mile Swamp (see Table 5.2.4-3). This population would not be directly affected, but it may be potentially indirectly affected by changes in hydrology (3 percent affected). However, Section 5.2.3 indicates there would likely be no wetland hydrology effects in this area. At the Mine Site, around 56 percent of lowland coniferous forests would be directly affected, resulting in reduced habitat nearby for this species (see Table 5.2.4-1).

Platanthera clavellata (club-spur orchid) has 123 known populations in the state, none of which occur at the Mine Site; however, one population is located upgradient of the Mine Site within the One Hundred Mile Swamp (see Table 5.2.4-3). This population would not be directly affected, but three colonies may be potentially indirectly affected by changes in hydrology, since the species is sensitive to this type of change (1 percent affected). However, Section 5.2.3 indicates there would likely be no wetland hydrology effects in this area. At the Mine Site, around 56 percent of lowland coniferous forests would be directly affected, resulting in reduced habitat nearby for this species (see Table 5.2.4-1).

Ranunculus lapponicus (lapland buttercup) is found in conifer/sphagnum bogs on the Mine Site. Of the 83 known populations statewide, one population occurs at the Mine Site (1 percent affected) (see Table 5.2.4-3). Of this population, three colonies are expected to be directly affected by construction of a waste rock stockpile. The other four colonies may be potentially indirectly affected by changes in hydrology, water chemistry, or dust. This species may face short- and long-term effects at the Mine Site since it is most likely intolerant of disturbance. At the Mine Site, around 56 percent of lowland coniferous forests would be directly affected, resulting in much less on-site habitat for this species (see Table 5.2.4-1).

Sparganium glomeratum (clustered bur-reed) has been observed along roadsides and in lowland forests. Of the 158 known populations statewide, one population occurs at the Mine Site (1 percent affected) (see Table 5.2.4-3). Of this population, eight colonies would be directly affected—three colonies by construction of the mine pits and stockpiles, and five colonies along Dunka Road by construction of the water pipeline, railroad track, or transmission line. The remaining five colonies may be indirectly affected by changes in hydrology, water quality, or dust. This species may be slightly tolerant of some disturbance, since it can be found along disturbed wetland edges; however, short-term effects may be more pronounced than long-term effects. At the Mine Site, around 47 percent of aquatic environments and 56 percent of lowland coniferous forests would be directly affected, resulting in much less on-site habitat for this species (see Table 5.2.4-1).

Torreyochloa pallida (Torrey's manna-grass) is often seen along roadsides and may be semi-tolerant of disturbance. Of the 74 known populations statewide, one occurs at the Mine Site (1 percent affected) (see Table 5.2.4-3). Of this population, one colony along Dunka Road may be directly affected by construction of a transmission line. The remaining three colonies are located away from any proposed construction and may be sufficiently removed from potential direct and indirect effects of the NorthMet Project Proposed Action. At the Mine Site, around 47 percent of aquatic environments and 56 percent of lowland coniferous forests would be directly affected, resulting in less on-site habitat for this species (see Table 5.2.4-1).

Regional Foresters Sensitive Species

The USFS RFSS data layer indicates there are no known RFSS plants on the federal lands, which include the majority of the Mine Site. However, several state-listed ETSC plant species known to exist on the Mine Site are also listed as RFSS plants in the Superior National Forest. Six of these species would be affected by the NorthMet Project Proposed Action, including *Botrychium pallidum*, *Botrychium rugulosum*, *Botrychium simplex*, *Caltha natans*, *Eleocharis nitida*, and *Juncus stygius* var. *americanus*.

MIH types are not fully mapped for the Mine Site since not all of it consists of federal land, but MIH types are mapped for the federal lands located within the Mine Site. On this portion of the Mine Site, upland forest (MIH 1; approximately 531 acres affected) would be affected the most of all MIH types, which means RFSS plant species listed under the upland forest category (see Table 4.2.4-5) could be most affected by the NorthMet Project Proposed Action. However, since there are suitable habitats for each RFSS species within each MIH type, a direct correlation between loss of MIH and loss of RFSS plants cannot be made. Upland conifer forest (MIH 5; approximately 505 acres affected) lands would be the next group most affected, though there is overlap of this category with upland forest since upland conifer forest occurs within upland forest types. Some RFSS species that occupy upland forest may also be affected by this category. Lowland black spruce-tamarack forest (MIH 9; approximately 483 acres affected) would be subject to effects comparable to upland conifer forest, and some of the RFSS species listed in this category would be affected similarly. The lowland emergent wetland type would be affected (approximately 11 acres affected), but likely only one of the five RFSS plant species listed for that type may be minimally affected. Aquatic habitat (MIH 14) is not mapped at the Mine Site; however, there are some aquatic habitats on the parcel that would be affected and, thus, some of the RFSS species listed in this category may be affected. Section 5.2.6 provides further discussion of effects on aquatic habitats and species.

The one RFSS plant not listed as an ETSC species but that is known to occur on the Mine Site, according to MDNR NHIS data, is *Botrychium michiganense*, which is very closely related to *Botrychium hesperium. B. hesperium* typically occurs in western states, while *B. michiganense* typically occurs around the Great Lakes states. One population is known to occur on the Mine Site, of which five colonies would be affected by stockpile development, haul road placement, or the Transportation and Utility Corridor immediately adjacent to the Mine Site (MDNR 2014d). It often occurs in grassy roadsides and fields, and requires at least somewhat open habitat created by natural disturbance events. While anthropogenically disturbed areas have been observed to harbor reasonably large numbers of individuals, habitat created in this way has not been proven to support long-term viable populations (NatureServe 2013). At the Mine Site, grassland areas would not be affected, but around 34 percent of previously disturbed areas would be affected, resulting in potentially reduced on-site habitat for this species (see Table 5.2.4-1).

The USFS determined that the NorthMet Project Proposed Action would not affect 20 RFSS plants on the Superior National Forest. These 20 species include: alpine milkvetch, *Arctoparmelia centrifuga*, *Arctoparmelia subcentrifuga*, Braun's holly fern, creeping rush, Chilean sweet-cicely, Douglas' hawthorn, white mountain saxifrage, largeleaf sandwort, little goblin moonwort, Northern arnica, maidenhair spleenwort, muskroot, nodding saxifrage, Oakes' pondweed, Scotch false asphodel, short sedge, smooth woodsia, triangle grapefern, and Wain's cup lichen. In addition, the NorthMet Project Proposed Action may affect individuals, but are not likely to cause a trend to federal listing or loss of viability for the remaining 38 RFSS plants on the Superior National Forest. Please see the Biological Evaluation listed on the USFS website (http://www.fs.usda.gov/goto/superior/northmet) for more information about effects on RFSS plants.

5.2.4.2.2 Transportation and Utility Corridor

<u>Effects on Cover Types</u>

Habitat Types

Construction and transportation activities within the Transportation and Utility Corridor, as part of the NorthMet Project Proposed Action, would affect all 120.2 acres of the MDNR GAP land cover designations (see Table 5.2.4-4). The majority of effects would be on formerly disturbed (94.4 acres) and grassland areas (9.8 acres).

Table 5.2.4-4 Direct Effects on Cover Types along the Transportation and Utility Corridor

Cover Types	Affected Acres	Non-affected Acres	Total Cover Type Acres	Percent of Cover Type Affected
Disturbed	94.4	0	94.4	100
Cropland/grassland	9.8	0	9.8	100
Shrubland	7.7	0	7.7	100
Aquatic environments	2.7	0	2.7	100
Upland deciduous forest	2.7	0	2.7	100
Upland coniferous forest	2.6	0	2.6	100
Lowland coniferous forest	0.2	0	0.2	100
Lowland deciduous forest	0.0	0	0.0	100
Upland conifer-deciduous mixed forest	0.0	0	0.0	100
Total[1]	120.2	0	120.2	100

Source: MDNR 2006b.

Note:
[1] Total acres may be more or less than presented due to rounding.

Minnesota Biological Survey

The NorthMet Project Proposed Action would affect 22.5 acres of MBS Sites of High Biodiversity Significance (2.9 acres of the One Hundred Mile Swamp and 19.6 acres of the Upper Partridge River) within the Transportation and Utility Corridor. Similar to the Mine Site, this 22.5-acre area represents a very small portion of the mapped Sites of High Biodiversity Significance in St. Louis County (less than 1 percent) and the State of Minnesota (less than 1 percent). Habitat effects associated with the NorthMet Project Proposed Action would not result in a large percentage decline in those areas ranked as high by the MBS.

NorthMet Project Proposed Action activities within the corridor would also affect approximately 2 acres of "widespread and secure" native plant communities, including 2 acres of the aspen-birch forest: balsam fir subtype (FDn43b1; less than 1 percent of community within Laurentian Uplands subsection), and less than 0.1 acre of the low shrub poor fen (APn91a; less than 1 percent of community within Laurentian Uplands subsection).

Indirect Effects

Potential indirect effects on vegetative cover types remaining along the Transportation and Utility Corridor could include those caused by dust from road traffic or spillage from rail cars. Section 5.2.4.2.1 provides further discussion on the effects of dust. PolyMet plans to use the existing but currently decommissioned fleet of LTVSMC side-dump rail ore cars. These cars are a different design than the bottom-dump rail pellet cars that are used across the Iron Range and during past LTVSMC operations. Prior to the start of operations, PolyMet would refurbish these ore cars, which would include tightening or replacement of the couplings and linkages to minimize gaps along the hinges and joint areas where spillage could occur. Refurbishment of these cars would largely reduce the potential for spillage along the Transportation and Utility Corridor (PolyMet 2014a). Larger pieces of ore that are spilled from the cars would be recovered during routine maintenance of the track, thus minimizing indirect effects. As Section 5.2.7 further describes, no significant reactive airborne fugitive dust from the rail transport is expected. Smaller effects in already-disturbed areas could occur along Dunka Road near the

Mine Site. A water pipeline for treated water and a transmission line would be constructed along Dunka Road on previously disturbed land. Construction of the pipeline and transmission line would expose soil during construction and could bury vegetation under rock fill.

Reclamation

Dunka Road would not be reclaimed after the NorthMet Project area is closed, since it is an existing private road. Railroad track and ties that are not used by common carriers would be removed and recycled (PolyMet 2015a). The Treated Water Pipeline between the Mine Site and Plant Site would be removed (PolyMet 2015g).

Effects of Invasive Non-native Plants

The Transportation and Utility Corridor is already disturbed, and contains several non-native and/or invasive species. Disturbance associated with the widening of Dunka Road and installation of the water pipeline, transmission line, and rail line would result in exposed soil surfaces that would have the potential for colonization of invasive species. Therefore, the general effects of invasive non-native plant species along the Transportation and Utility Corridor would be the same as the Mine Site or Plant Site.

Effects on Threatened and Endangered Plant Species

No federally listed threatened or endangered plant species occur within the .Transportation and Utility Corridor. The NorthMet Project Proposed Action would have both direct and potential indirect effects on the same state-listed ETSC plant species as those found at the Mine Site. Since some of the populations occur along Dunka Road near or overlapping the Mine Site, they are discussed in Section 5.2.4.2.1 along with the effects on plant populations at the Mine Site. Table 5.2.4-3 summarizes the direct and indirect effects of the NorthMet Project Proposed Action on each of those ETSC plant species. For the ETSC species located within the Transportation and Utility Corridor not adjacent to the Mine Site (*Botrychium pallidum*), effects are discussed below (see Table 5.2.4-5). As mentioned for the Mine Site, these numbers may overestimate the actual effects as a proportion of the number of actual populations in the state.

Rulemaking was conducted with the intent to update the list of ETSC species (*Minnesota Rules*, parts 6134.0100 to 6134.0400), with new listings becoming effective on August 19, 2013 (MDNR 2013h). This FEIS considers any new listings, or changes in the previous listings, associated with the updated list.

Table 5.2.4-5 Effects on Known State-listed ETSC Plant Populations in the Transportation and Utility Corridor

	Known Mine Site Populations					Known Statewide Populations				
Plant Species (state status/ global status[1])	**Total Populations**	**Total Individuals**	**Direct Effects[2] (Populations)**	**Indirect Effects (Populations)**	**Unaffected Populations**	**Total Known Populations[3]**	**Average Individuals per Population[4]**	**Percent Directly Affected (Populations)**	**Percent Indirectly Affected (Populations)**	**Total Percent Affected (Populations)**
Botrychium pallidum (SC/G3)	3	16	3	0	0	99	15	3	0	3
Total	3	16	3	0	0	99	NA	NA	NA	NA

Source: Barr 2012n.

Notes:
[1] The state status is E – Endangered. The global ranks range from G1 to G5. A lower global ranking (e.g., G3) indicates a species at higher global risk than higher ranking (e.g., G5) (NatureServe 2014).
[2] Direct effects are expected for those populations that would be removed or buried by road improvement activities. Effects are calculated for populations rather than individuals because of the large variation and inaccuracies in the estimates of number of individuals per population.
[3] Statewide population data provided by Lisa Joyal (MDNR) on March 26, 2013. Statewide population data does not include the three populations of *B. pallidum* found during NorthMet Project Proposed Action-specific survey (Barr 2012w), as these were not included in NHIS data, thus inflating effects on statewide population.
[4] Population estimates are approximate and used for comparative purposes only. The number of individuals is based upon populations for which data exist.

The NorthMet Project Proposed Action would directly affect the one state-listed ETSC plant species (*Botrychium pallidum*) found within the Transportation and Utility Corridor not adjacent to the Mine Site (see Table 5.2.4-5). The direct effects would involve the complete loss of populations as a result of disturbance during road construction and improvement activities. Section 5.2.4.2.1 above discusses Minnesota's endangered species law, as well as permits and mitigation for ETSC species.

Botrychium pallidum (pale moonwort) populations are most commonly observed on mine tailings basins and along roadsides. Of the 99 known NHIS populations statewide, six colonies of three populations along Dunka Road could be directly affected by road improvements or maintenance as part of the NorthMet Project Proposed Action (3 percent affected) (see Table 5.2.4-5). These populations were found during a separate species survey and are not included in the NHIS data. In addition, without the NHIS element occurrence attribute, it was estimated that there are three distinct populations by virtue of three separate locations of the six colonies. Thus, the effects on statewide populations are slightly inflated. All of the grassland and previously disturbed areas along the Transportation and Utility Corridor would be affected, resulting in reduced on-site habitat for this species (see Table 5.2.4-4).

5.2.4.2.3 Plant Site

<u>Effects on Cover Types</u>

Habitat Types

Construction, operation, and closure of the NorthMet Project area at the Plant Site would have fewer effects on native vegetation than at the Mine Site because much of the Plant Site (61 percent) has already been heavily disturbed or is barren (see Table 4.2.4-8). Most of the effects of the NorthMet Project Proposed Action are on disturbed areas or tailings ponds, but other affected areas include isolated stands of forest or shrublands (see Table 5.2.4-6). Other effects on MDNR GAP land cover types at the Plant Site are smaller. Approximately 2,189.7 acres (48 percent) of the Plant Site would be affected by NorthMet Project Proposed Action activities. A description of the potential effects on wetlands north of the Tailings Basin is presented in Section 5.2.3.

Table 5.2.4-6 Direct Effects on Cover Types at the Plant Site[1]

Cover Types	Affected Acres	Non-affected Acres [2]	Total Cover Type Acres	Percent of Cover Type Affected
Disturbed	1,104.0	1,651.5	2,755.5	40
Aquatic environments	573.0	63.8	636.8	90
Upland deciduous forest	295.1	352.5	647.6	46
Shrubland	144.9	188.9	333.8	43
Upland coniferous forest	52.0	47.8	99.8	52
Lowland coniferous forest	20.7	21.2	41.9	49
Cropland/grassland	0.0	0.0	0.0	0
Lowland deciduous forest	0.0	0.0	0.0	0
Upland conifer-deciduous mixed forest	0.0	0.0	0.0	0
Total	2,189.7	2,325.8	4,515.4	48

Source: MDNR 2006b.

Notes:
[1] This table reflects only those effects on plant communities occurring within the boundaries of the Plant Site. The table does not include the potential indirect effects on the wetlands north of the Tailings Basin due to hydrology changes.
[2] Areas of cover types not within a 50-ft buffer of buildings, Tailings Basin/spillway reclamation area, or railroad connection.

Minnesota Biological Survey

There are no MBS Sites of Biodiversity Significance or native plant communities identified at the Plant Site.

Indirect Effects

In addition to the direct effects mentioned above, potential indirect effects on vegetation at and surrounding the Plant Site could include dust or erosion. Vegetation would be established on tailings dams during construction to minimize erosion and fugitive dust (PolyMet 2015n). Water level would be managed in the Tailings Basin to limit the amount of exposed beach, which would minimize dust. Additionally, other fugitive dust control measures (e.g., mulching, temporary seeding, and dust suppressants) would be applied to inactive beaches. As Section 5.2.7 further describes, fugitive dust control measures would result in an 80 percent reduction of emissions at the Plant Site. Section 5.2.7.2.6 states that the NorthMet Project Proposed Action is not expected to have a significant effect on sulfate deposition in the state, and so no threat to sensitive vegetation is expected. Potential mercury emissions at the Plant Site are expected to be 4.6 lb/yr. Overall, about 95 percent of the mercury originating in the ore is expected to remain within—or be adsorbed to—the tailings and the hydrometallurgical residue, where it would remain isolated from further transport to the environment. The mercury deposition on terrestrial environments would be expected to be not significant when compared to variability in background mercury concentrations._In the event erosion occurs on the Tailings Basin, it would be corrected and re-vegetated; if necessary for repetitive or excessive erosion, channels or outfall structures would be designed to address the issue.

Reclamation

At closure, the buildings and other infrastructure at the Plant Site would be removed, and foundations would be razed and buried to a minimum depth of 2 ft. with overburden material suitable for vegetation. Plant Site roads that are not deemed necessary for access by the MDNR would be scarified and vegetated, and asphalt from paved surfaces would be removed and recycled. These disturbed areas would be seeded with the same potential three mixes (native, non-native, or mixed) as those mentioned for disturbed areas in Section 5.2.4.2.1 (PolyMet 2015g, Attachment A).

The Tailings Basin would be incrementally reclaimed by a qualified professional pursuant to *Minnesota Rules*, part 6132.2700. As dams are constructed, exterior slopes would be stabilized and vegetated in accordance with requirements in the Fugitive Emissions Control Plan (PolyMet 2015l). Inactive interior beach areas would be temporarily vegetated as necessary for fugitive dust control, using oats, winter wheat, annual ryegrass, white clover, redtop, and alsike clover, or some combination of these species for various times of the year (PolyMet 2015g, Attachment A). The exterior dam faces would be permanently vegetated by a qualified reclamation contractor according to requirements of the Reclamation Seeding Plan. Upland areas would be planted with permanent vegetation and mulched to control potential fugitive dust in accordance with requirements in the Fugitive Emissions Control Plan. Upland beach areas would be planted with the same potential three mixes (native, non-native, or mixed) as that mentioned for disturbed areas in Section 5.2.4.2.1, while the dam slopes and benches would be planted with the same mix as that mentioned for the slopes of the Category 1 Stockpile (PolyMet 2015g, Attachment A). Interior portions would be graded to provide a gently sloping surface that effectively routes storm water runoff to the interior of the Tailings Basin and promotes wetlands creation between the beach and pond areas. Exposed beach areas would be amended with bentonite to limit oxygen infiltration into the tailings. The cover layer of tailings would be replaced and vegetated in accordance with requirements of the Reclamation Seeding Plan (PolyMet 2013l). Wet soils near the Tailings Basin pond would be planted with the same mix as that mentioned for the East Pit backfill and depressions in the temporary stockpile footprints (see Section 5.2.4.2.1) (PolyMet 2015g, Attachment A). Establishment of dense vegetative cover and root mass is among the most effective methods to minimize erosion, so the quality and density of the vegetation would be periodically reviewed after final reclamation construction is complete. Areas where vegetation does not become well established would receive additional seeding and/or fertilizer and other amendments in accordance with requirements of the Reclamation Seeding Plan. Reclamation areas would be inspected in spring and fall to repair erosion areas and failed seeding areas, until MDNR determines that the areas are stable and self-sustaining.

Reclamation of the Hydrometallurgical Residue Facility would include removal of ponded water from the cell surface, removal of pore water from the residue, construction of the cell cover system, and establishment of vegetation and surface water runoff controls. The exterior slopes of the Hydrometallurgical Residue Facility dams would be incrementally reclaimed throughout the life of the mine. This would include stabilization and vegetation in accordance with *Minnesota Rules*, part 6132.3200. Final reclamation would generally consist of grading the cell area into a gently sloping surface. The cover would consist of a layer of LTVSMC tailings immediately above the drained residue. This would be topped, if necessary, with a non-woven needle-punched geotextile fabric. Next, a geosynthetic clay barrier layer and a 40 mm LDPE or similar MPCA-approved geomembrane barrier layer would be placed (PolyMet 2015a). Additional LTVSMC coarse tailings and/or common borrow and cover soils would be placed on top of the barrier layer to create a surface capable of sustaining a vegetated cover (PolyMet 2012e). The Hydrometallurgical Residue Facility dam slopes and benches would be planted with the same mix as that mentioned for the Category 1 Stockpile slopes in Section 5.2.4.2.1 (PolyMet 2015g, Attachment A). Turf and final cover would be inspected and maintained by mowing once per year or as needed, fertilizing when visual inspection indicates poor vegetation growth, and implementing repairs.

The Colby Lake Water Pipeline Corridor would not be subject to any additional disturbance or effects as a result of the NorthMet Project Proposed Action. Maintenance activities would likely continue to occur on the pipeline.

Effects of Invasive Non-native Plants

The revegetation plan following closure at the Plant Site is similar to what is planned at the Mine Site as described above. Use of the proposed seed mix could introduce invasive non-native species, depending on which species are included in the mix, to an area of primarily native vegetation that surrounds the Plant Site. However, the existing LTVSMC Tailings Basin and most of the Plant Site are already heavily disturbed, and several invasive non-native species currently inhabit these areas (e.g., smooth brome grass, reed-canary grass, yellow sweetclover). These species, once introduced, are difficult to remove and could spread to and colonize susceptible areas following future disturbance (e.g., blowdown, logging, fire). These species may reduce diversity, out-compete native vegetation, and provide lower quality habitat for some specialist animal species. Generally, dominance by invasive non-native species would reduce the quality of native cover types and habitat remaining at the Plant Site. The MDNR has made recommendations for non-invasive species for the seed mix and the final seed mix would be approved during permitting.

Effects on Threatened and Endangered Plant Species

The NorthMet Project Proposed Action would likely have no effect on federal or state ETSC plant species at the Plant Site or Colby Lake Water Pipeline Corridor because none are known to occur within the boundaries of these areas, according to MDNR NHIS data. However, no site-specific studies have been conducted at the Plant Site and so potential species not reported in the NHIS data may not be represented.

5.2.4.2.4 Potential Mitigation Measures

Mine Site Mitigation Measures

A preferred mitigation measure would be to reseed with the native species, provided they can perform as effectively as the non-native species. In some areas where erosion control would be critical to prevent slope failures, non-native species may be needed. Temporary stabilization efforts using non-native species should use non-invasive plant species to minimize the long-term risk to surrounding plant communities. In the event invasive non-native species are introduced, an additional mitigation measure would be to implement a monitoring and control program for invasive species (including noxious weeds) to ensure these species do not overtake surrounding native communities. Additionally, the purchase of an unprotected site with a population of *Caltha natans* should be assessed as mitigation, since the statewide population is lower than the other ETSC species affected.

Plant Site Mitigation Measures

The measures outlined in the Mine Site Mitigation Measures section above should be applied to the Plant Site as well. Another recommended mitigation measure may also benefit vegetation at the Plant Site specifically. The addition of organic amendments (peat) to the top foot of the Tailings Basin would improve soil and water quality and promote the development of shoreline and near-shore wetland vegetation.

5.2.4.3 NorthMet Project No Action Alternative

5.2.4.3.1 Effects on Cover Types

Under the NorthMet Project No Action Alternative, the Mine Site would not be developed, the Transportation and Utility Corridor would not be disturbed beyond routine maintenance, and the Plant Site would have no additional tailings added to the existing LTVSMC Tailings Basin. Forest-harvesting would continue to occur on the federal land portions of the Mine Site under the Forest Plan. While timber harvests would result in the immediate loss of some habitat types, permanent changes are not expected. The Forest Plan calls for an increase in older-age stands, which would likely come at the expense of younger-age stands in the long term. The majority of the federal lands are designated as General Forest – Longer Rotation Management Area, which correlates with the increase in older-age stands overall. The former LTVSMC processing plant would be reclaimed and revegetated in accordance with its separate closure plan sooner than under the NorthMet Project Proposed Action. Direct and indirect effects of the NorthMet Project No Action Alternative on cover types are considered minimal, as the Mine Site and portions of federal lands would continue to be managed in the same way they have been, and the Transportation and Utility Corridor and Plant Site have been disturbed in the past.

5.2.4.3.2 Effects of Invasive Non-native Plants

Invasive or non-native species may still invade the Mine Site as a result of logging, mineral exploration, vehicle traffic, and natural disturbances, but are likely to do so much more slowly than under the NorthMet Project Proposed Action. Invasive non-native species already exist along the Transportation and Utility Corridor and Plant Site, but they would likely spread more slowly under the NorthMet Project No Action Alternative than under the NorthMet Project Proposed Action due to less disturbance.

5.2.4.3.3 Effects on Threatened and Endangered Plant Species

Under the NorthMet Project No Action Alternative, colonies of state-listed ETSC plant species would not be affected. Timber harvests are expected to continue to occur on the federal land portions of the Mine Site. The NorthMet Project area has historically been logged and the state-listed ETSC plant species present on site have persisted. It is unlikely that continued logging, which now is more likely to employ best management practices to minimize detrimental effects, would affect the species in the long term. Potential indirect effects under the NorthMet Project No Action Alternative could come from increased competition as succession proceeds to older-age forest stands or with invasive non-native species. Effects of increased competition could include reduced spore production and consequently reduced population size in the early successional plant species (e.g., *Botrychium* spp.). Continued maintenance would likely occur along Dunka Road and the railroad where several of the *Botrychium* populations occur. Long-term succession at these locations is unlikely due to this maintenance, and these populations could persist given available habitats. The Transportation and Utility Corridor and Plant Site contain no occurrences of state-listed ETSC plant species and so the NorthMet Project No Action Alternative is not expected to have any effects.

The USFS determined that the NorthMet Project No Action Alternative would have no effect on all 58 RFSS plants on the Superior National Forest. A Biological Evaluation has been prepared that contains further information about RFSS. The Biological Evaluation is included in Appendix D and is posted on the USFS website (http://www.fs.usda.gov/goto/superior/northmet).

5.2.5 Wildlife

This section describes the environmental consequences of the NorthMet Project Proposed Action to wildlife including direct effects such as the loss of individuals/ populations of affected species or a decrease in habitat, as well as indirect effects such as displacement, competition, or changes in the greater regional area.

Summary

The NorthMet Project Proposed Action is expected to affect three federally listed species, the Canada lynx, gray wolf, and northern long-eared bat. The Canada lynx would likely be affected through localized direct decrease and fragmentation of designated critical habitat and the increased potential (albeit low) for incidental take resulting from vehicular collisions due to increased NorthMet Project Proposed Action-related traffic. Restoration of disturbed areas as part of mine closure would potentially create lynx habitat, although this successional process could take decades. The gray wolf would likely be affected through loss of habitat and the increased potential (albeit low) for incidental take resulting from vehicular collisions due to increased NorthMet Project Proposed Action-related traffic. The northern long-eared bat would likely be affected through loss of potential summer roost habitat and foraging areas. The NorthMet Project Proposed Action is not likely to affect the bald eagle, which is also protected under federal law (although not a federally listed endangered or threatened species). Eight additional state-listed and special concern species, which include eastern heather vole, moose, little brown bat, eastern pipistrelle, northern goshawk, boreal owl, wood turtle, and yellow rail, may be affected by the NorthMet Project Proposed Action. It is expected that the Laurentian tiger beetle, taiga alpine butterfly, Freija's grizzled skipper butterfly, Nabokov's blue butterfly, and Quebec emerald dragonfly would not be affected. SGCN, RFSS, and other wildlife species, including those considered tribally or culturally significant, may be affected by human activity, noise and vibration, rail and vehicle traffic, and decrease of habitat.

5.2.5.1 Methodology and Evaluation Criteria

This section uses data presented in Section 4.2.5 to analyze effects on wildlife. Specifically, survey reports and GIS data were obtained regarding land cover and habitat types, forest stand age classes, listed ETSC, SGCN, RFSS, and other wildlife species. GIS analysis was used to calculate direct and indirect effects on these resources.

The analysis of direct effects included the potential of a take of federally or state-listed species. Pursuant to the federal ESA, *take* is defined as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct." Take of an individual or population could occur for various reasons such as traffic collisions, habitat destruction, or change in an individual or population's habitat use due to noise, other disturbance, or contamination of food or water sources. Take of a listed species would be considered a significant effect. The USFWS can issue a permit for the incidental take of a federally listed wildlife species consistent with the goal of conservation of the species. Permit applicants must design, implement, and demonstrate availability of funding for a conservation plan that minimizes and mitigates harm to the affected species during the proposed project. Without a permit, the take of a federally listed protected species is punishable by fines or imprisonment. Permitting for taking of a state-listed species is regulated by the MDNR.

Analysis was also conducted for potential indirect effects on federally or state-listed species, such as increased competition for resources or habitat due to displacement of individuals from the affected area into the territory of other animals, or other indirect effects that cause mortality or reduced breeding and recruitment in the future population.

In addition to listed species, analysis was completed of potential direct and indirect effects on habitat types that affect population size and long-term viability for other species potentially at risk (SGCN, RFSS, and species of cultural concern). Direct effects could include vegetation removal by clearing, burial, or other destructive activity. Indirect effects could include changes within larger ecological units (e.g., the Laurentian Uplands or Partridge River Watershed), but not necessarily at the Mine Site or Plant Site, that could occur at a later point in time, such as a change in long-term vegetation composition or dominance, habitat conversion due to hydrologic changes, invasion by non-native species, or disruption of natural disturbance regimes (e.g., the annual natural hydrological cycle). Depending on the magnitude of the effect, direct effects may require mitigation.

5.2.5.2 NorthMet Project Proposed Action

This section describes the effects on wildlife due to construction and operation activities.

5.2.5.2.1 Federally Listed Species

As required under Section 7 of the ESA, the USACE and the USFS have initiated consultation with the USFWS regarding potential effects on federally listed species to ensure that actions they authorize or permit would not jeopardize listed species or designated critical habitats. Consultation is currently ongoing and will continue throughout the EIS process.

A Biological Assessment has been prepared that contains further information about federally listed species. The Biological Assessment is included in Appendix D and is posted on the USFS website (http://www.fs.usda.gov/goto/superior/northmet). The Biological Assessment analyzes effects on the Canada lynx, gray wolf, and northern long-eared bat. The organization of the methodologies and discussion in the Biological Assessment may be different from the FEIS. The Biological Assessment also contains a determination of effects for the three species.

The Co-lead Agencies met with the USFWS several times during informal consultation. The USACE, USFS, and USFWS initiated informal consultation on February 26, 2010, when the agencies met to discuss the NorthMet Project. The USACE subsequently met with the USFWS on May 3, 2011, September 1, 2011, and February 28, 2013 to discuss it further. The USACE, USFS, and USFWS met on July 9, 2014 to identify tasks to be accomplished in the development of the Biological Assessment. Specifically, the northern long-eared bat and habitat were discussed, which led to further USFS bat survey work being proposed. The USACE, USFS, and USFWS met on October 29, 2014 to discuss comments received on the draft Biological Assessment and potential mitigation measures.

Canada Lynx

In 2009, it was estimated that there were likely fewer than 200 lynx in Minnesota (Moen 2009). However, individuals can travel well beyond their home range, specifically when prey is scarce, at times more than 1,000 km (Moen 2010). Three individual lynx have been harvested in Ontario, approximately 400 road miles from their known locations in Minnesota. Of the 55 incidental take records the USFWS has documented from 2001 through 2013, two of the records involved lynx killed by trains, and seven of the records involved lynx struck by vehicle traffic along roads (USFWS 2013).

The NorthMet Project area is currently within the 8,065 square mile designated critical habitat for the Canada lynx (USFWS 2009), which includes much of St. Louis, Lake, and Cook counties. Surveys identified at least 20 different individual lynx were identified within 18 miles (ENSR 2006), and lynx sign was observed on the Mine Site in 2010. A collared and studied lynx, L11, was identified adjacent to the NorthMet Project area, south of Dunka Road. This animal may have been using the NorthMet Project area for forage and travel as part of her home range between when she was collared in early 2004 and when she was trapped in Ontario, Canada in 2006. Lynx tracks were observed at the Mine Site in 2010, and there have been multiple observations of lynx sign within 5 miles of the federal lands (USFS 2013).

Site clearing and mining activities associated with the NorthMet Project Proposed Action would potentially affect lynx by reducing available habitat and increasing habitat fragmentation. The total effect from increased activity is not known, as lynx have been known to habituate to increased human activity (Sunde et al. 1998). The NorthMet Project Proposed Action mining activities would disturb approximately 2 square miles (1,454.0 acres) of suitable lynx habitat, currently a mix of upland forest and lowland forest and bog. Restoration of disturbed areas as part of mine closure would eventually create potential lynx habitat, although this successional process could take decades. Potential lynx habitat would be lost for the duration of mine operations (over 20 years) and an additional 20 years or more after closure before suitable lynx habitat would again occur at the Mine Site (ENSR 2006).

Assuming that the territory of a resident lynx is 58 square miles for males and 28 square miles for females, the reduction of habitat at the Mine Site corresponds to a reduction of three to seven percent of an individual's territory (ENSR 2006). Territory size expands in response to periods of reduced snowshoe hare density, and the related lynx and snowshoe hare populations tend to loosely follow a 10-year cycle, though other factors contribute to lynx population shifts. ENSR 2006 surveys for the NorthMet Project Proposed Action were done during a low point in the lynx/snowshoe hare density cycle.

Though no lynx were identified during the ENSR 2006 surveys, those that may currently be using the Mine Site could expand their territory into surrounding areas. Surveys conducted in 2006 by Moen et al. found evidence of at least 20 individuals within 18 miles of the NorthMet Project area, and lynx sign has been observed on the Mine Site by the USFS. Lynx density in the vicinity is considered low relative to the rest of the Minnesota lynx range (ENSR 2006). Individuals displaced from the Mine Site may be affected by increased stress and potential mortality due to utilization of unfamiliar territory and competition with other lynx or predator species. Although the NorthMet Project Proposed Action would result in a reduction and fragmentation of lynx habitat at the Mine Site, little to no effect on statewide lynx populations would occur as it is unlikely that an individual lynx or pair of lynx would be affected by the habitat decrease.

According to the USFS, LAUs are land areas identified for purposes of analysis and development of conservation measures for lynx (USFS 2004b). They range in size from just under 17,000 acres up to more than 91,000 acres. As discussed in Section 4.2.5.2.1, the federal lands (including the Mine Site) are located within LAU 12.

The USFS determined that approximately 2,737 acres, or 4.0 percent of LAU 12 is currently unsuitable for lynx use (USFS 2013). As noted above, the NorthMet Project Proposed Action would disturb 1,454 acres of lynx habitat, making them unsuitable for lynx. The percent of LAU 12 unsuitable for lynx would increase to 6.1 percent. This percentage is well within the Forest Plan guideline (G-WL-3) that unsuitable habitat is not exceed 30 percent of the LAU.

The increased vehicle traffic associated with the NorthMet Project Proposed Action mining activities could affect species such as the lynx. An average of 2,066 miles per day of vehicular traffic is expected within the Mine Site, primarily to haul ore to the rail siding and waste rock to the stockpiles (see Table 5.2.5-1).

Table 5.2.5-1 Vehicle Traffic within the Mine Site Only

Vehicle type	Vehicle Weight (Tons)	Speed (Average MPH)	Total Road Miles in Mine Site	Annual Vehicle Miles Traveled (Estimated)	Estimated Average Total Miles Per Day (Estimated)
Haul Trucks and Construction Vehicles	81.5-425	12-14	15.3	61,400-979,000	2,066.0

Source: Barr 2012g.

Although there is the potential for incidental take as a result of vehicle collisions with lynx, haul traffic at the Mine Site would likely have little direct effect on lynx. Current lynx use of the Mine Site appears to be very low; in the future, the area would be heavily affected by mining operations and not likely to be used by lynx.

The NorthMet Project area is currently within designated critical habitat for the Canada lynx (USFS 2008a). Lynx may be affected by increased vehicle and train traffic. Lynx are highly mobile and lynx habitat can be found immediately adjacent to the corridor. The increased vehicle traffic associated with the NorthMet Project Proposed Action, including train and small vehicle traffic between the Mine Site and Plant Site, could potentially result in vehicle collisions with lynx (see Table 5.2.5-2). The NorthMet Project Proposed Action would generate 1,734.9 miles of vehicle traffic between the Mine Site and Plant Site each day. This traffic would consist primarily of light trucks and maintenance vehicles traveling 30 to 45 mph and a few large fuel trucks, waste/supply trucks, and trains traveling 15 to 40 mph.

Table 5.2.5-2 Vehicular and Train Traffic Volume along the Transportation and Utility Corridor

Vehicle Type	Vehicle Weight (Tons)	Speed (Min – Max MPH)	Total Miles (Per Day)
Light Cars, Trucks, and Vans – primarily Mine Site to Area 2 Shops	2	30-45	961.1
Fuel Trucks, Supply and Waste Trucks	40	25-40	346.7
Haul Trucks	81.5 – 240	35	9.1
Trains	3,000	15-25	418.0
Total			1,734.9

Source: Barr 2012g.

Though vehicle traffic increases the chance of incidental lynx mortality, this species does not rely strictly upon roads for long-distance travel, though they use less energy doing so (Moen 2010). Straight-line movement of collared lynx through the roadless BWCAW suggests that when roads are not available, lynx will still travel in a line where possible. As such, while lynx may be affected by vehicle traffic along the Transportation and Utility Corridor, the flat terrain near the NorthMet Project area would allow lynx to travel through the area.

Evidence of lynx was not found during surveys of the Plant Site. Approximately 76 percent of the Plant Site cover/habitat type is disturbed or aquatic, which is considered unsuitable lynx habitat. Lynx are unlikely to utilize the Plant Site, but may forage in the surrounding area. As such, activities at the Plant Site are unlikely to affect the Canada lynx.

State and federal forest lands near the Mine Site or Plant Site would continue to provide refuge for lynx, and it is likely lynx would favor these areas over those affected by mining for the duration of mine operations. Overall, the effects on the Canada lynx described above would result in the localized direct decrease and fragmentation of habitat, including designated critical habitat, and the increased potential (albeit low) for incidental take resulting from vehicular collisions; however, these effects are not anticipated to threaten the overall species population level and abundance in Minnesota. The Biological Assessment concludes that the NorthMet Project Proposed Action would be likely to adversely affect the Canada lynx and may affect but is not likely to adversely affect Canada lynx critical habitat.

Gray Wolf

As noted in Section 4.2.5, the Mine Site and Plant Site are likely part of a territory occupied by a single pack of wolves. The footprint of the Mine Site would remove approximately two square miles (1,454 acres) of habitat, or one percent to a maximum of ten percent of a single wolf pack territory. This reduction in available habitat is small and is not expected to affect the highly mobile wolf population in the region, which is considered healthy by the MDNR. After closure, this area would again be available and suitable as wolf habitat, but, as described above for the lynx, this would not occur for 40 to 45 years.

Vehicle collisions are a cause of wolf mortality (Fuller and Harrison 2005). The increased vehicular activity associated with the NorthMet Project Proposed Action could potentially result in vehicle collisions with wolves. The haul road network would increase the road density (linear miles of road per square mile of habitat) at the Mine Site; however, mining operations would disturb the Mine Site such that it would reduce habitat availability for the gray wolf. Therefore, the haul road network itself would not influence the overall effects of the NorthMet Project Proposed Action on the gray wolf.

State and federal forest lands near the Mine Site or Plant Site would continue to provide refuge for wolves, and it is likely wolves would favor these areas over those affected by mining for the duration of mine operations. The gray wolf population in Minnesota (estimated at 2,922423 gray wolves) is considered fully recovered by the MDNR as it has surpassed the federal delisting goal of 1,251 to 1,400 wolves. However, the gray wolf was re-listed as federally threatened by the U.S. District Court on December 19, 2014.

Overall the effects described above would result in the direct decrease and fragmentation of habitat suitable for the gray wolf, the increased potential for incidental take from vehicular collisions, and indirect decline in prey species due to habitat decrease. Together these factors are not anticipated to threaten the overall species population level and abundance in Minnesota. The Biological Assessment concludes that the NorthMet Project Proposed Action would be likely to adversely affect the gray wolf but is not likely to jeopardize the continued existence of gray wolves. It also concluded that the NorthMet Project Proposed Action and may affect but is not likely to adversely affect gray wolf critical habitat.

Northern Long-Eared Bat

Northern long-eared bats were detected in surveys throughout much of northeastern Minnesota (USFS 2014; Grandmaison et al. 2013; USFS 2014c). The most prominent threat to the northern long-eared bat is white-nose syndrome. The fungus known to cause white-nose syndrome, *Pseudogymnoascus destructans*, has been observed in the Tower/Soudan Mine, a hibernacula for several bat species located about 15 miles northwest of the NorthMet Project area. White-nose syndrome has advanced geographically from New York in 2006, causing 99 percent decreases in population numbers in the northeast United States (USFWS 2013b).

Bats may forage along the forest edge habitat along the Transportation and Utility Corridor, but there are no caves or mine shafts present that may be used for hibernation. Abel (2011) generally found that bat foraging activity is highest near aquatic features. Forest edges along utility corridors are also used for bat foraging, and they may forage along these features more frequently than in interior forest habitat. Generally, the West Pit, water treatment ponds, and Tailings Basin pond would not offer suitable habitat for emerging insects. Bats would be more likely to forage above natural wetlands that support more insect activity. Bats have been observed in Plant Site buildings, but do not hibernate or roost in great numbers at the Plant Site. Approximately eight percent of the Plant Site also contains possible tree roosting habitat that would be affected.

At the Mine Site, 1,718.6 acres would be disturbed due to the NorthMet Project Proposed Action, of which approximately 90 percent would be upland or lowland deciduous/coniferous forests and aquatic areas that could be utilized by the northern long-eared bat. Forest clearing activities at the Mine Site are likely to affect northern long-eared bat individuals as there would be a loss of potential summer roost habitat and foraging areas. The interim 4(d) rule (50 CFR Part 17, April 2, 2015) specifies that forest clearing activities may not occur within the summer maternity roosting season within one quarter mile of known occupied roost trees. Tree removal outside of the summer maternity roosting season (June 1 through July 31) would help mitigate and reduce lethal take of northern long-eared bat individuals.

Resuming operations at the Plant Site buildings would likely disrupt the bat's use of them for roosting. The NorthMet Project Proposed Action is not expected to affect bat hibernacula, as none have been observed on the Mine Site, Transportation and Utility Corridor, or Plant Site, but would reduce potential roosting and foraging habitat. The Biological Assessment concludes that the NorthMet Project Proposed Action may affect but is not likely to adversely affect the northern long-eared bat. The Biological Assessment contains additional details on effects to the northern long-eared bat.

5.2.5.2.2 State-listed Species

Rulemaking was conducted with the intent to update the list of ETSC species (*Minnesota Rules*, part 6134.0100 to 6134.0400), with new listings becoming effective on August 19, 2013 (MDNR 2013h). This FEIS considers any new listings, or changes in the previous listings, associated with the updated list.

Moose

There is habitat available for the moose on the Mine Site, and individuals and their sign (e.g., tracks, droppings, browsing evidence, etc.) have been observed on it. This is in close proximity to the Transportation and Utility Corridor and Plant Site. Due to the primarily disturbed nature of these latter areas, it is likely that moose occur but unlikely that they utilize the areas often. Habitat fragmentation and loss, climate change, disease, and predation are all potential factors in moose population decline (MDNR 2013d). The key habitat types considered moose habitat include mature forest, grassland/brushland, and aquatic environments. A total of 2,785.9 acres of these key habitat types would be directly affected by the NorthMet Project Proposed Action (see Table 5.2.5-3). As such, the NorthMet Project Proposed Action would likely affect moose individuals in the vicinity through habitat loss and fragmentation, though not likely at a population level.

Little Brown Bat

The little brown bat is known to occur at the Mine Site, Transportation and Utility Corridor, and Plant Site. As a habitat generalist, it has suitable foraging and potential roosting habitat in these three areas. Of the bats observed in the NorthMet Project area and in northeastern Minnesota, the majority are little brown bat (USFS 2014; Grandmaison et al. 2013; USFS 2014c). The most prominent threat to the little brown bat is white-nose syndrome. The fungus known to cause white-nose syndrome, *Pseudogymnoascus destructans*, which has been observed in the Tower/Soudan Mine, a hibernacula for several bat species located about 15 miles northwest of the NorthMet Project area. As discussed above in Section 5.2.5.2.1 for the northern long-eared bat, white-nose syndrome has caused 99 percent decreases in bat populations throughout the northeast U.S. where it originated (USFWS 2013b). No known hibernacula sites would be disturbed as a result of the NorthMet Project Proposed Action. It is expected that the reduction of foraging and potential summer roosting habitat would affect individuals, but likely not at a population level.

Eastern Pipistrelle

Potential summer roosting habitat is available for the eastern pipistrelle at the Mine Site, Transportation and Utility Corridor, and Plant Site. However, no individuals have been observed or detected within any of these areas during field surveys. USFS surveys from the Kawishiwi District in 2013 and St. Louis/Lake counties in 2014 did not detect eastern pipistrelle (Grandmaison et al. 2013; USFS 2014c). As with the bats discussed above, the most prominent threat to the eastern pipistrelle is white-nose syndrome. It is unlikely that the species would be affected by the NorthMet Project Proposed Action, as none are known to occur in the area, and no known hibernacula sites would be disturbed.

Northern Goshawk

The northern goshawk may occasionally be present at the Mine Site, since nest sites have been identified by the USFS approximately 0.75 mile west of the Mine Site and near the proposed East Pit and Central Pit areas. Two northern goshawk territories have been identified at or near the Mine Site, as they have nested on the Mine Site and adjacent federal lands in 2000, 2009, 2011, and 2013 (USFS 2013). The One Hundred Mile Swamp northern goshawk territory, which is within the Mine Site, is no longer considered active. The Wetlegs Creek northern goshawk territory, located on the federal lands adjacent to the Mine Site, is still considered active and is being monitored. The NorthMet Project Proposed Action would directly affect one of the two known nest site areas. The northern goshawk may be occasionally present along the Transportation and Utility Corridor, due to the proximity of the active northern goshawk territory. No nests are known to occur at the Plant Site. Because the northern goshawk has nested in the NorthMet Project area and was identified during calling surveys, activities at the Mine Site may affect the northern goshawk due to loss of habitat.

Boreal Owl

There is suitable habitat available for the boreal owl at the Mine Site and along the Transportation and Utility Corridor. An individual was heard along Dunka Road in 1988 to 1989, but none were observed in subsequent surveys. Since the Minnesota NHIS does not contain any occurrences within 10 miles of the NorthMet Project area, and they have not been observed since 1988 to 1989, it is unlikely that boreal owls utilize the Mine Site, Transportation and Utility Corridor, or Plant Site often. The NorthMet Project area is located at the southern edge of its range. The removal of mixed forest habitats at the Mine Site and along the Transportation and Utility Corridor is unlikely to jeopardize the boreal owl's presence in Minnesota.

Wood Turtle

There is no habitat suitable for wood turtles at the Mine Site and no individuals are known to occur. Individuals could potentially use the southern riparian fringe of the Mine Site though no wood turtles are currently known to occur in the fringe areas that would be affected by the project. The fringe areas would also not be affected by activities at the Transportation and Utility Corridor. There is no suitable habitat for wood turtles at the Plant Site and no individuals are known to occur.

The predicted small decrease in Upper Partridge River flow during active mining is not likely to negatively affect the wood turtle. The most likely effect of a decrease in water level would be to expose additional nesting areas. Over the long term, the exposed soil on the lower bank would be overtaken by vegetation from the upper bank and become less suitable habitat for the wood turtle.

Wood turtles are not likely to be affected by project activities because there would be no direct loss of individuals, populations, or suitable habitat and the NorthMet Project Proposed Action would have no indirect effects on downstream habitat.

Eastern Heather Vole

The eastern heather vole has not been observed within 10 miles of the Mine Site nor has it been found in small mammal surveys in the region (Christian 1993; Jannett 1998). The NorthMet Project area is at the southern edge of its range. Approximately 1,445 acres of potentially suitable habitat exist at the Mine Site (see Table 4.2.4-1), and there is potentially suitable habitat for the species along the Transportation and Utility Corridor. Additionally, there is potentially suitable habitat for the eastern heather vole at the Plant Site, 45 percent of which may be affected by the NorthMet Project Proposed Action (see Table 5.2.4-6). The eastern heather vole could be present at the NorthMet Project area, but, if so, it is likely to be in very small numbers. Given the lack of known occurrences of eastern heather vole in the area, the habitat effects are unlikely to jeopardize the presence of eastern heather vole in Minnesota.

Yellow Rail

The yellow rail was not found during PolyMet's surveys at the Mine Site and was not reported in the NHIS database within 10 miles of the NorthMet Project area. Small, scattered areas of its preferred habitat, sedge/wet meadow, are present at the Mine Site, but the minimum nesting patch size used by rails (54 acres) (Goldade et al. 2002) exceeds the total amount of suitable habitat available (39.5 acres at the Mine Site and 1.5 acres at the Plant Site; refer to Section 4.2.3). Since the yellow rail was not detected in surveys and patches of its preferred habitat are smaller than the reported minimum patch size for nesting, it is not expected that the NorthMet Project Proposed Action would affect the yellow rail.

Laurentian Tiger Beetle

The lack of suitable habitat and any NHIS recorded observations in the NorthMet Project area for the tiger beetle suggest that the species does not occur at the Mine Site, Plant Site, or Transportation and Utility Corridor. Therefore, the NorthMet Project Proposed Action should have no effect on the tiger beetle.

Taiga Alpine

The taiga alpine butterfly was not observed during surveys and the NHIS has no records of one occurring within 10 miles of the NorthMet Project area. The preferred habitat types (black spruce bogs and swamps) do occur on the Mine Site and in proximity to the Transportation and Utility Corridor and Plant Site. The NorthMet Project Proposed Action may affect individuals but would not likely have any effect on the species at a population level.

Freija's Grizzled Skipper

The Freija's grizzled skipper butterfly was not observed during surveys and the NHIS has no records of the species occurring within 10 miles of the NorthMet Project area. The only known Minnesota occurrence is in Lake County. The preferred habitat types (forest openings bordered by black spruce and tamarack swamps) do occur on the Mine Site and in proximity to the Transportation and Utility Corridor and Plant Site. The NorthMet Project Proposed Action may affect individuals but would not likely have any effect on the species at a population level.

Nabokov's Blue

The Nabokov's blue butterfly was not observed during surveys and the NHIS has no records of one occurring within 10 miles of the NorthMet Project area. The preferred habitat type for the larval butterfly (open woodlands with abundant dwarf bilberry) potentially occurs on the Mine Site, Transportation and Utility Corridor, or Plant Site. The NorthMet Project Proposed Action may affect individuals but would not likely have any effect on the species at a population level.

Quebec Emerald

The Quebec emerald dragonfly inhabits poor fens, a wetland type not identified at the Mine Site but similar to the sedge/wet meadow that is present. Approximately 38.2 of the existing 39.5 acres of wet meadow/sedge meadow at the Mine Site would be affected by mining activities. There are no poor fens found along the Transportation and Utility Corridor or Plant Site, though approximately 1.5 acres of sedge/wet meadow are present at the Plant Site, and 1.4 acres would be affected by activities. There has only been one documented occurrence of this species in

Minnesota (Lake County in 2006, more than 20 miles east of the NorthMet Project area) (Minnesota Odonata Survey Project 2012); therefore, the likelihood of observing Quebec emerald dragonfly individuals or populations within the vicinity of the NorthMet Project area is low. As such, this species is not expected to be affected.

5.2.5.2.3 Species of Greatest Conservation Need

Along with federally and state-listed species, the NorthMet Project Proposed Action would affect SGCN at the Mine Site as a result of increased human activity and noise, collisions with vehicular and rail traffic, and decrease of habitat. Due to the number of SGCN species identified (see Table 4.2.5-1) effects are classified below by the type of disturbance.

Increased Human Activity

SGCN would be directly affected through increased human activity due to mining activities. Factors such as noise, dust, light, and vehicle traffic may frighten some species and discourage their use of otherwise suitable habitat. In general, suitable habitat is available in the area adjacent to the NorthMet Project area and most mobile wildlife species would be displaced. Following migration to new areas, displaced individuals could increase the competition for resources in their new habitat. Displaced species could also suffer increased mortality due to foraging in new areas. Less mobile species, such as herptiles (e.g., frogs, turtles), would likely incur relatively high mortality rates since they cannot quickly migrate from the area and would be more susceptible to changing habitat conditions. During the winter, a combination of plowing and sand, gravel, or salt (magnesium chloride) applications would be used to keep roadways passable. The potential exists for sand and salts to accumulate in the trenches adjacent to the roadways and affect less mobile species. These areas are not considered high quality habitat and are not likely to affect wildlife.

Effects on wildlife due to trapping and hunting are minimal because public access would be restricted. Through the Land Exchange Proposed Action, NorthMet Project area lands would enter into private ownership and would not be accessible for public use. As discussed in Section 5.2.11.2.1, public access is limited and would remain limited during mining operations and following mine closure. As such, wildlife species are not likely to be affected by changes in hunting and trapping activity.

Ground-nesting bird species and some raptor species have been known to utilize cliff areas for nesting and foraging. The SGCN include the northern goshawk, common nighthawk, and northern harrier. These birds could be affected by disturbance if they were to nest along the cliffs created by the pit rims.

Noise Effects

The Biological Assessment concludes that noise effects on wildlife are largely unknown and the assessment of effects is subjective. However, noise associated with mining activities, including noise from vehicle and rail traffic, would likely affect wildlife. Mammals can be sensitive to sound levels below the range of human hearing, which is 20-16,000 hertz. The sensitivity thresholds for animals are generally lower, some below 20 hertz (US FHWA 2011). Effects due to acute noise (such as blasting) are not well studied, but would likely cause animals to startle and would interrupt forage or nesting activities (Larkin 1994). Noise does not appear to seriously affect invertebrates or fish, but does result in some disturbance to mammals (such as startling, forage interruption, and avoidance of the area of potential effect [Larkin 1994]). Bird communication would be masked by noise if the vocalizations are less than 18-20 dB above noise levels in the environment (US FHWA 2011). Changes in communication have been known to result in decreased reproduction and anomalies in learned vocalizations (Larkin 1994). Songbird populations have been shown to decrease with noise levels as low as 35 dB (Forman and Alexander 1998). Section 5.2.8 provides further discussion on the noise modeling predictions for the NorthMet Project area. Though wildlife species are likely to be sensitive to changes in noise levels, there are no local, national, or international standards or limits that are applicable to the NorthMet Project Proposed Action. Wildlife species may be affected by noise in the NorthMet Project area, though adjacent habitat is available.

Vehicular and Rail Traffic Effects

Wildlife mortality generally increases with increasing traffic volumes and vehicle speed. In general, highly mobile species and habitat generalists (species that utilize a wide variety of habitats) are known to have higher road mortalities.

As discussed above, vehicular traffic would average 2,066 miles per day within the Mine Site (see Table 5.2.5-1). Traffic effects from collisions with wildlife depend upon factors such as traffic volume, traffic speed, and the species involved. The potential for road effects increases if the roads are bordered by high-quality habitat or are crossed by wildlife travel corridors. The high density of affected wetlands at the Mine Site bordering the haul roads may result in a relatively high rate of amphibian and reptile effects. Shrubs and trees near roadsides can increase road crossings by deer and birds. The barrier effect of roads is greater for small mammals, amphibians, and reptiles than for birds and large mammals (Kaseloo 2004). Species that utilize the small preserved forest island remnants between haul roads at the Mine Site would be most affected. Indirect effects from vehicle activities are expected locally at the Mine Site for SGCN species but would not be measurable at the scale of the Nashwauk and Laurentian Uplands or the Partridge River Watershed.

Effects at the Transportation and Utility Corridor are primarily related to vehicle and rail traffic. Travel between the Mine Site and Plant Site is expected to average 1,735 miles per day with travel speeds averaging between 15 and 45 mph, with trains, fuel, and waste/supply trucks traveling somewhat slower (see Table 5.2.5-2). SGCN may be affected by noise and light associated with vehicle and rail traffic, and by collisions with vehicles or trains.

Transportation effects at the Plant Site are primarily related to vehicle traffic associated with construction of the NorthMet Project Proposed Action. Typical daily operations at the Plant Site would generate approximately 828 miles of vehicle traffic, primarily light trucks. Though noise and light may affect SGCN at the Plant Site, the disturbed nature of the area would mean that effects would be negligible.

Wildlife Habitat Effects

The direct effect on wildlife habitat (and by inference on SGCN species) was assessed by evaluating the acres of habitat types that would be lost under the NorthMet Project Proposed Action (see Figure 4.2.4-3). The changes in cover type are summarized in Table 5.2.5-3.

Table 5.2.5-3 Direct Effects on Key Habitat Types

Key Habitat Types	Total Acres[1] of Cover Type Present at Mine Site (Total Acres[1] of Cover Type Directly Affected)	Total Acres[1] of Cover Type Present at Transportation and Utility Corridor (Total Acres[1] of Cover Type Directly Affected)	Total Acres[1] of Cover Type Present at Plant Site (Total Acres[1] of Cover Type Directly Affected)
Mature Upland Forest, Continuous Upland/Lowland Forest (MIH1-13)	2,627.2 (1,535.3)	5.5 (5.5)	789.3 (367.8)
Open Ground, Bare Soils (no MIH)	128.0 (44.0)	94.4 (94.4)	2,755.5 (1,104.0)
Grassland and Brushland, Early Successional Forest (no MIH)	246.6 (133.2)	17.5 (17.5)	333.8 (144.9)
Aquatic Environments (MIH 14)	12.7 (6.0)	2.7 (2.7)	636.8 (573.0)
Total	**3,014.5 (1,718.6)**	**120.1 (120.1)**	**4,515.4 (2,189.7)**

Data from Tables 5.2.4-1, 5.2.4-4, and 5.2.4-6.

Note:
[1] Total acres may be more or less than presented due to rounding.

Mature Upland/Lowland Forest

At the Mine Site, approximately 1,535 acres (58 percent) of the mature forest would be lost as a result of the NorthMet Project Proposed Action. All of the SGCN found in this mature upland forest habitat are birds (see Table 4.2.5-1), which would be displaced, but likely not injured or killed, during mine construction and operation. Nesting birds could be affected during the breeding season, especially during brooding and until fledglings become independent. Reclamation of the Mine Site would include revegetating nearly all disturbed ground according to *Minnesota Rules*, part 6132.2700.

Of the 5.5 acres of mature upland/lowland forest along the Transportation and Utility Corridor, all 5.5 acres would be affected. As such, activities would affect SGCN in mature upland/lowland forest habitat along the Transportation and Utility Corridor, though effects would be narrow and primarily located along the corridor.

Most of the Plant Site is developed or disturbed with only approximately 17 percent (789 acres) consisting of forest habitat (see Table 5.2.5-3). Approximately 368 acres of this forest habitat at the Plant Site would be disturbed, most of which is in small or isolated patches of aspen-birch forest that are in poor to fair condition (MDNR 2013a). Therefore, activities at the Plant Site would not have an effect on SGCN using mature upland/lowland forest habitat.

Reclamation and revegetation of the NorthMet Project area would initiate vegetative succession on stockpiles, the East Pit and Central Pit, and Mine Site infrastructure (PolyMet 2015h). The Category 1 Stockpile would be incrementally and progressively reclaimed throughout the life of the mine through contouring the stockpile to provide topographic variety, covering with a layer of evapotranspiration soil, and finally seeding of grasses and forbs.

Reclamation and re-vegetation of the NorthMet Project area would improve wildlife habitat relative to conditions during mine operations; however, the quality of habitat for SGCN is likely to remain degraded for some decades after closure relative to pre-mining operations due to conversion of high-quality habitat to lower-quality habitat.

Open Ground/Bare Soils

The likelihood of SGCN using open ground or bare soils at the Mine Site, Transportation and Utility Corridor, or Plant Site is small. These areas were the result of past mining activity, are generally of low-quality, and are expected to decrease after mine closure as a result of reclamation.

Therefore, NorthMet Project Proposed Action effects on open ground/bare ground habitat should result in little effect on wildlife.

Brush/Grassland

Approximately 133 of the 247 total acres (54 percent) of brush/grassland at the Mine Site would be directly affected by the NorthMet Project Proposed Action. Brush and grassland (including early successional forest) at the Mine Site and Plant Site consist of small vegetative patches that are generally not suitable for SGCN. Young trees (less than 4 inches dbh) make up most of this habitat type (ENSR 2005). One SGCN associated with this habitat type, the American woodcock, was observed by USFS personnel at the Mine Site. The least weasel may occur as well. Most of the other SGCN (see Table 4.2.5-1) are associated with large patches of grassland and savanna habitats, which are not present at the Mine Site.

Stands of brush/grassland (including early successional forest) along the Transportation and Utility Corridor consist of small vegetative patches that are generally not suitable to SGCN. Young trees (less than 4 inches dbh) make up most of this habitat type (ENSR 2005). Most of the other SGCN (see Table 4.2.5-1) are associated with large patches of grassland and savanna habitats. Though all 17.5 acres of brush/grassland along the Transportation and Utility Corridor would be directly affected, activities along the Transportation and Utility Corridor would not affect grassland/brush SGCN based on the fragmented nature of this habitat.

Similar to the Mine Site, brush/grassland (including early successional forest) at the Plant Site consists of small vegetative patches that are generally not suitable to SGCN. Young trees (less than 4 inches dbh) make up most of this habitat type (ENSR 2005). Most of the other SGCN (see Table 4.2.5-1) are associated with large patches of grassland and savanna habitats. Approximately 145 of the 334 acres of brush/grassland at the Plant Site would be directly affected by the activities at the Plant Site. The reclaimed Plant Site, specifically the Tailings Basin, would be revegetated with grassland vegetation species. Overall, the NorthMet Project Proposed Action would have no adverse effects on grassland/brush SGCN.

During reclamation, PolyMet would remove or cover portions of the existing road, railroad, and ditch and dike systems and restore them. Reclamation of these areas, which currently constitute poor wildlife habitat, would ultimately enhance wildlife habitat when compared to current conditions. Some SGCN, such as the eastern meadowlark, northern harrier, and common nighthawk would most likely use the grasslands until they are replaced by early successional forest about 20 to 50 years after closure. Early successional forests are likely to support the two following SGCN: white-throated sparrow and American woodcock.

Open Water

SGCN such as the black duck, American bittern, and swamp sparrow utilize open water habitats. The NorthMet Project Proposed Action would create approximately 321 acres of open water at the Mine Site by eventually flooding the West Pit, which is estimated to fill between year 40 and 45. The West Pit would be fenced as a deterrent to wildlife species even though this habitat is not likely to provide high quality foraging habitat for waterfowl because of a lack of emergent or submerged vegetation along the pit fringes. Ponds at the wastewater treatment facilities would also be fenced to prevent wildlife from using the water. At the Plant Site, open water habitat primarily occurs in the existing LTVSMC Tailings Basin. None of the SGCN targeted during a 2005 survey were observed on open water during the survey (ENSR 2005); however, common waterfowl and water birds were observed at the Tailings Basin during migration, in particular Canada goose and ducks. Existing open water habitat would be maintained during operations, though the acreage of open water would fluctuate according to processing needs.

Wildlife, specifically aquatic birds, may utilize open water habitat created by the NorthMet Project Proposed Action. Wildlife species have been observed utilizing the existing LTVSMC Tailings Basin, as well as other Mesabi Iron Range tailings basins, specifically during migration. Unlike arid states such as Nevada, pit lakes and tailings basins are not the only readily available source of open water for wildlife use. Minnesota has over 13 million acres of lakes and wetlands, and the NorthMet Project Proposed Action would result in less than one hundredth of a percent increase in habitat. Though adjacent habitat is readily available, wildlife species may still utilize the Tailings Basin.

Some wildlife species, specifically those that feed on aquatic prey, may be susceptible to mercury exposure (USEPA 1997) directly from open water sources such as the pit lake and Tailings Basin pond, and indirectly at the Partridge River and Embarrass River. Effects to aquatic species are discussed in Section 5.2.6.2. Specific species such as loons, osprey, mink, and otter may be affected. As discussed in Section 5.2.5.2.2, eagles may be less likely to be affected by mercury. While wildlife use of open water created by the NorthMet Project Proposed Action may be limited due to fencing and available habitat, wildlife species may be affected.

Surface water quality standards do not apply to the pit lake or Tailings Basin. Any discharge water, such as the pit lake overtopping, would be treated in order to meet water quality standards and, as such, would not likely affect wildlife species.

Wetlands

Of the wetland-related SGCN, the marbled godwit and olive-sided flycatcher were surveyed for, but not found (ENSR 2005). The bog copper butterfly also was not found during surveys and there are no known NHIS records of any sightings within 12 miles of the Mine Site. As discussed above, the black duck, American bittern, and swamp sparrow are not likely to be present because they require open water and non-forested wetlands, which are relatively scarce at the Mine Site. The red-backed salamander is primarily an upland species, but may be present along the edges of mixed hardwood swamps. The taiga alpine butterfly may inhabit the black spruce bogs of the Mine Site and is historically known to occur in the Laurentian and Nashwauk Uplands (MDNR 2006d).

Based on the site-specific wetland delineation, the NorthMet Project Proposed Action would directly affect 758.2 acres of wetlands at the Mine Site, primarily coniferous bog (508.3 acres directly affected), shrub swamp (97.8 acres directly affected), and coniferous swamp (70.3 acres directly affected). These wetland types are common in the Partridge River Watershed. Consequently, the decrease of this habitat at the Mine Site is expected to displace wildlife into surrounding similar habitat, which would be large enough to absorb the displaced wildlife.

There are 7.2 acres of wetlands/open water along the Transportation and Utility Corridor, and those 7.2 acres would be affected by activities along the corridor. There are 148.4 acres of affected wetland at the Plant Site. On-site wetland use by the SGCN described above may be limited, and these wetlands are generally considered to be of low quality.

Wetland mitigation is proposed off-site at three mitigation sites (see Section 5.2.3). Off-site mitigation would consist of 1,602.7 acres of wetland restoration and preservation and 197.1 acres of upland buffer areas of various habitat types at the three sites. In addition, approximately 101.8 acres of wetland may be restored on-site; however, this would not result in mitigation credits at this time.

Multiple Habitats

Species using multiple habitats and known to occur on or near the NorthMet Project area (e.g., gray wolf, Canada lynx, least flycatcher, Connecticut warbler) are discussed above. Most multiple-habitat SGCN use mature/continuous and early successional forest. NorthMet Project Proposed Action effects are therefore largely limited to the mature/continuous forest habitats described above.

Wildlife Corridors

There is one wildlife corridor located approximately 0.5 mile northwest of the Mine Site (see Figure 6.2.5-2). Mine Site operations, which provide a source of disturbance from noise and mining activity, would indirectly affect the corridor by reducing the effective, undisturbed size of the large habitat block southeast of the corridor. These activities would limit access to the corridor in the vicinity of the Mine Site; however, the corridor would continue to be accessible north of the Mine Site and from south and southwest of the corridor. Vegetative restoration of the stockpiles and disturbed areas, as proposed during closure, would mitigate some of the effects of habitat loss in this large habitat block in the long term. Not all of the Mine Site would be available for habitat restoration due to fencing around the mine pits and the open water in the West Pit.

Rail and vehicular traffic between the Mine Site and Plant Site would increase as a result of the NorthMet Project Proposed Action. While the Transportation and Utility Corridor is outside of wildlife corridors, they run parallel and perpendicular to the wildlife corridors and would potentially affect wildlife use. Tepper (2011) demonstrates the importance of road ecology, which studies the barrier effect of roads on plant and animal ecology. Tepper cites several examples of road underpasses or overpasses to provide corridors for plant and wildlife movement without having to cross the roadways. However, these wildlife crossings generally require a large financial cost to construct. Leete and Alcott (2011) stated that Minnesota's relatively flat topography would not be suitable for large wildlife crossings, and suggested instead utilizing multiple low cost wildlife-friendly mitigation designs rather than one large crossing. Mitigation measures for wildlife species would be considered during the Endangered Species Act Section 7 consultation process.

Additionally, there is one wildlife corridor located approximately 1 mile southeast of the existing Plant Site. The existing LTVSMC Tailings Basin provides poor habitat, is not likely to be heavily used by wildlife, and currently obstructs animal movement. Because current use is already limited, increased activity at the Tailings Basin would likely have minimal effect on wildlife movement through the corridor. The proposed vegetative restoration of the Tailings Basin and adjacent processing plant at closure may increase the value of the corridor by improving habitat to the northwest. The mining features surrounding this corridor would not be complete barriers to wildlife movement (Barr 2009a).

5.2.5.2.4 Regional Forester Sensitive Species

A Biological Evaluation has been prepared that contains further information about RFSS. The Biological Evaluation is included in Appendix D and is posted on the USFS website (http://www.fs.usda.gov/goto/superior/northmet). Similar to the Biological Assessment, the organization of the methodologies and discussion in the Biological Evaluation may be different from the FEIS. The Biological Evaluation also contains determinations of effect for RFSS species.

The USFS determined that the NorthMet Project Proposed Action may affect individuals but is not likely to cause a trend to federal listing or loss of viability for 18 RFSS terrestrial wildlife species on the Superior National Forest.

Of the 18 terrestrial RFSS on the 2011 list for the Superior National Forest, 12 of these are also federally- or state-listed ETSC species (gray wolf, eastern heather vole, northern long-eared bat, little brown bat, eastern pipistrelle, northern goshawk, boreal owl, wood turtle, taiga alpine butterfly, Freija's grizzled skipper butterfly, Nabokov's blue butterfly, and Quebec emerald) and are discussed above. Three other RFSS (the olive-sided flycatcher, bay-breasted warbler, Connecticut warbler) are on the SGCN list and are discussed by habitat type or disturbance type in Section 5.2.5.2.3 above. Three other species, including the bald eagle, great gray owl, and three-toed woodpecker are discussed below.

Bald Eagle

Bald eagles typically nest in large trees within 500 ft of lakes or rivers (Guinn 2004). There are no large lakes or rivers at the Mine Site that would provide optimal nesting/ foraging habitat, though the Partridge River (approximately 0.5 mile south of the Mine Site) would provide some, though less-than-optimal, habitat. The Partridge River is 4.9 miles south of the Plant Site, and the Embarrass River is 2.5 miles north and west. The USFWS National Bald Eagle Management Guidelines (USFWS 2007) suggest that human activity within 0.25 mile to 2 miles can be seen or heard by eagles and, depending on the level of screening and habituation of individual eagles, may cause them to abandon a nest. Generally, the closer the activity is, the greater the effect. If eagles were to nest on the portion of the Partridge River or the Embarrass River near the NorthMet Project area, they could be within the 2-mile disturbance range. The nearest recorded bald eagle nest to the Mine Site is approximately 6.5 miles to the southeast (MDNR 2013a).

Bald eagle nesting territories in Minnesota generally have a 10-mile radius that varies with habitat quality (Guinn 2004). Bald eagle nests near the NorthMet Project area are on average 5.7 miles apart (3.8 to 9.4 mile range), which is less than the average territory radius. This suggests that the area is densely populated with bald eagle nesting territories and that no new eagles are likely to move into the area (MDNR 2014d). As eagles become more numerous, any eagles seeking to establish new territories in the area would need to select lower quality habitat and/or move into closer proximity to human activity.

Surface water contaminants (e.g., mercury) that are absorbed by prey species such as waterfowl via dietary exposure (e.g., through the consumption of fish) could lead to ingestion of contamination by eagles (Marr 2008). However, bald eagles are relatively insensitive to the toxic effect of mercury exposure through their food (Judd 2013). In addition, waterfowl and some birds of prey demethylate mercury, which reduces their potential exposure.

In summary, the NorthMet Project Proposed Action is not likely to affect bald eagles because the known nesting sites are more than 2 miles from the NorthMet Project area; optimal habitat for nesting and foraging bald eagles is not present at the Mine Site, Plant Site, or Transportation and Utility Corridor; and bald eagles are not sensitive to mercury exposure.

Great Gray Owl

During owl surveys (AECOM 2009a), one great gray owl was observed foraging along the Transportation and Utility Corridor near the Mine Site. A great gray owl had used a historic goshawk nest at the Mine Site. Great gray owls nested in the NorthMet Project area in 2006 (AECOM 2009a), 2010, and 2011 (USFS 2013). Owls are sensitive to disturbance, so populations would be unlikely to use the NorthMet Project area during mine operations, though the species may be affected by the NorthMet Project Proposed Action as it has been observed and has nested in the area.

Three-Toed Woodpecker

Systematic survey data for three-toed woodpeckers are lacking; however, one bird was observed during overall field surveys (ENSR 2000) and by USFS personnel in 2007. Generally, the young age of the forest habitat at the Mine Site is not suitable for three-toed woodpeckers, and populations or individuals in the area are not likely to occur. Woodpeckers are sensitive to disturbance and would not be expected to use the Mine Site during mining operations. Though not surveyed, the Transportation and Utility Corridor and Plant Site lack the old-growth forest or recent burn habitat preferred by the three-toed woodpecker. Woodpeckers are sensitive to disturbance and would not be expected to use the Transportation and Utility Corridor or Plant Site. Though existing populations are estimated to be low, and prime habitat is not available, the three-toed woodpecker may be affected by loss of overall forest habitat in the NorthMet Project area.

5.2.5.2.5 Other Wildlife Species

Other wildlife species in the NorthMet Project area, including common and/or game species (such as white-tailed deer, bear, fox, porcupine, etc.) would likely be affected in ways similar to special status species. Mobile individuals would avoid direct effects but may be indirectly affected by a decrease of habitat. Given the adjacent habitat available to these species, local effects are expected due to competition from migrating individuals, but these would not threaten overall populations. Effects on wildlife species important to the Bands are discussed in Section 5.2.9 on a connected ecosystems level.

Due to the relative stability in population and harvest levels for white-tailed deer and bear (MDNR 2013b, MDNR 2013c), along with the limited hunting access at the NorthMet Project area and available adjacent habitat, the NorthMet Project Proposed Action is not likely to threaten deer or bear populations or hunting opportunities. Model estimates show that changes in the average annual flow of the Partridge and Embarrass rivers would be within naturally occurring annual variations. As a result, effects to amphibians or sensitive wildlife species due to hydrologic changes in these systems would be limited.

5.2.5.3 NorthMet Project No Action Alternative

5.2.5.3.1 Mine Site

Under the NorthMet Project No Action Alternative, mining would not occur. As described in Section 5.2.4.3.1, forest harvesting would continue to occur in portions of the federal lands, including the Mine Site. While timber harvests would result in the immediate decrease of some habitat types, permanent changes are not expected and conversion from one habitat type to another would benefit some species. Direct and indirect effects of the NorthMet Project No Action Alternative on wildlife and their habitat types are not expected, as the federal lands would continue to be managed as they currently are. Species individuals may still be affected due to existing land use (timber harvest, exploration, vehicle traffic, etc.) but effects are less than those expected under the NorthMet Project Proposed Action. The use of privately owned land at the Mine Site would also determine effects on wildlife under the NorthMet Project No Action Alternative.

5.2.5.3.2 Plant Site and Transportation and Utility Corridor

Under the NorthMet Project No Action Alternative, the former LTVSMC processing plant would be reclaimed and areas revegetated in accordance with the Reclamation Plan (PolyMet 2015g) much sooner than under the NorthMet Project Proposed Action. Revegetation would restore habitat for some species. Species individuals may still be affected due to disturbances related to reclamation, but effects are less than those expected under the NorthMet Project Proposed Action. The Transportation and Utility Corridor would remain in private ownership and would likely continue to be used in a similar manner as under existing conditions. Wildlife could be affected along the Transportation and Utility Corridor by noise and light associated with vehicle traffic, and by collisions with vehicles. However, impacts would be fewer than under the NorthMet Project Proposed Action due to a lower frequency of vehicle activity along these routes.

5.2.6 Aquatic Species

This section describes the potential effects of the NorthMet Project Proposed Action on fish and aquatic macroinvertebrate communities, especially special status species, associated with waterbodies found in the NorthMet Project area. These potential effects include changes in physical habitat (including flow), riparian and aquatic connectivity, and water quality.

Summary

The NorthMet Project Proposed Action could affect aquatic physical habitat via changes in flow, affect riparian and aquatic connectivity via construction activities within the riparian zone, affect water quality by increasing solute concentrations above Class 2B standards, and, as a result of these changes, potentially affect aquatic species including special status species (i.e., federally or state-listed threatened and endangered species, RFSS, and MDNR SGCN).

The NorthMet Project Proposed Action would reduce flow in the Partridge River by a maximum of about 8 percent (Section 5.2.2.3.2) and reduce flow in the Embarrass River by a maximum of about 3 percent (Section 5.2.2.3.3), and generally change flows in several tributary streams draining to the Partridge and Embarrass rivers by a maximum of about plus or minus 20 percent, which would fall into the range of annual natural variability in terms of precipitation (Section 5.2.2.3). These reduced flows are not anticipated to result in any measurable effect on available aquatic habitat in any streams in the NorthMet Project area, as long as seasonal flow variation is also maintained. Studies conducted by the USGS in streams and rivers indicated that the severity of flow alteration had a direct correlation on the community alteration of fish and macroinvertebrates (Carlisle et al. 2013).

The NorthMet Project Proposed Action activities would not occur within the riparian buffer of any streams; therefore the NorthMet Project Proposed Action would not affect the extent of natural vegetative cover along riparian areas and would not result in a decrease in the RCI. The NorthMet Project Proposed Action would also not result in any new dams, bridges, or culverts within perennial or intermittent streams; therefore, the NorthMet Project Proposed Action would not affect the hydrologic connectivity along streams and would not result in a decrease in the ACI. In the general vicinity of the NorthMet Project area, there are numerous case histories of dewatered mine pits in wetland areas. The historical information clearly indicates that there has not been extensive loss (i.e., drying up) of wetlands next to these pits except perhaps within 100 ft or so of the pit rim. This may be explained by the hydrogeology, which typically consists of a thin and moderately permeable surficial unit overlying low-permeability bedrock. Even when the pit water level is well below the top of bedrock, the low-permeability bedrock limits the amount of surficial groundwater that can drain downward into the pit and there is sufficient recharge to the surficial unit to maintain wetland conditions. It is anticipated that riparian zones (wetlands) adjacent to the Partridge River would not experience any measurable groundwater drawdown, particularly coupled with minimal surface water flow change due to the NorthMet Project Proposed Action.

Water quality modeling (see Section 5.2.2) predicts that the NorthMet Project Proposed Action would meet all Class 2B (aquatic life) water quality standards with the possible exception of aluminum in Embarrass River tributaries draining the Tailings Basin. For aluminum, ambient water quality, at times, already exceeds the Class 2B standard in both the Partridge River and Embarrass River. In the Partridge River, the NorthMet Project Proposed Action would not

measurably increase aluminum concentrations relative to the CEC Scenario results (Section 5.2.2.3.2). In the Embarrass River, the increase in concentration relative to the CEC Scenario would not be the result of increased aluminum loadings from the NorthMet Project Proposed Action, but rather the result of mass loading from surface runoff and the loading from other minor sources (Section 5.2.2.3.3). Although all other solutes are predicted to meet evaluation criteria or not cause or contribute to exceedances of evaluation criteria, the aggregate of these solutes, primarily metals, has the potential to affect aquatic biota.

In terms of special status species, there are no federal or state-listed threatened or endangered fish or macroinvertebrate species known to occur in the NorthMet Project area (USFWS 2011). There are four special status aquatic species (i.e., RFSS and SGCN) that have not been found in the NorthMet Project area, but suitable habitat is likely to occur and the species could be present.

The NorthMet Project area encompasses several waterbodies within both the Partridge and Embarrass River watersheds that provide a variety of habitats for aquatic biota. Predicted effects on aquatic biota from the NorthMet Project Proposed Action are possible due to changes in water chemistry, including increases in heavy metals. Effects on the success of fish spawning in tributary streams would be addressed by maintenance of seasonal, bankfull flows over the life of the NorthMet Project Proposed Action, especially when stream-related flow augmentation occurs within the Embarrass River Watershed.

5.2.6.1 Methodology and Evaluation Criteria

The operation, reclamation, and closure of the NorthMet Project Proposed Action may result in changes in the physical aquatic habitat or water quality that would result in effects on fish and aquatic species. To assess these effects, predicted changes in water quality and flow, as presented in Section 5.2.2, were used in combination with data on existing aquatic biota conditions, as discussed in Section 4.2.6, to determine potential effects on aquatic biota in surface waterbodies located in the NorthMet Project area.

The following criteria were considered in this evaluation:

- Physical alteration of stream conditions and the effect on fish and macroinvertebrate assemblages;
- Numeric water quality standards established for the protection of aquatic life in affected waterbodies;
- The structure or function of the aquatic species assemblages in affected stream segments; and
- Effects on one or more protected aquatic species or their habitat.

With respect to mercury, the criteria is an increase in the body burden of mercury in aquatic biota since this is the primary mechanism through which mercury affects aquatic life.

5.2.6.2 NorthMet Project Proposed Action

5.2.6.2.1 Partridge River

This section describes the potential effects of the NorthMet Project Proposed Action on aquatic resources in the Partridge River Watershed, including effects on physical habitat, riparian and aquatic connectivity, and water quality.

Physical Habitat Effects

Hydrologic changes often have effects on fish and aquatic macroinvertebrates. While many aspects of the hydrologic regime can be important to the maintenance of fish and macroinvertebrate assemblages, reduction in baseflow (the portion of streamflow from groundwater) is particularly relevant because it represents a loss of habitat.

In the Partridge River, results of the water modeling (described in Section 4.2.2)—as predicted at monitoring stations SW-002, SW-004, and SW-004a—were used to describe predicted flow for the upper Partridge River Watershed within the vicinity of the Mine Site. These monitoring stations were selected due to their geographical location (see Figure 5.2.6-1), and likely represent the area that would best describe potential maximum effects along the Partridge River.

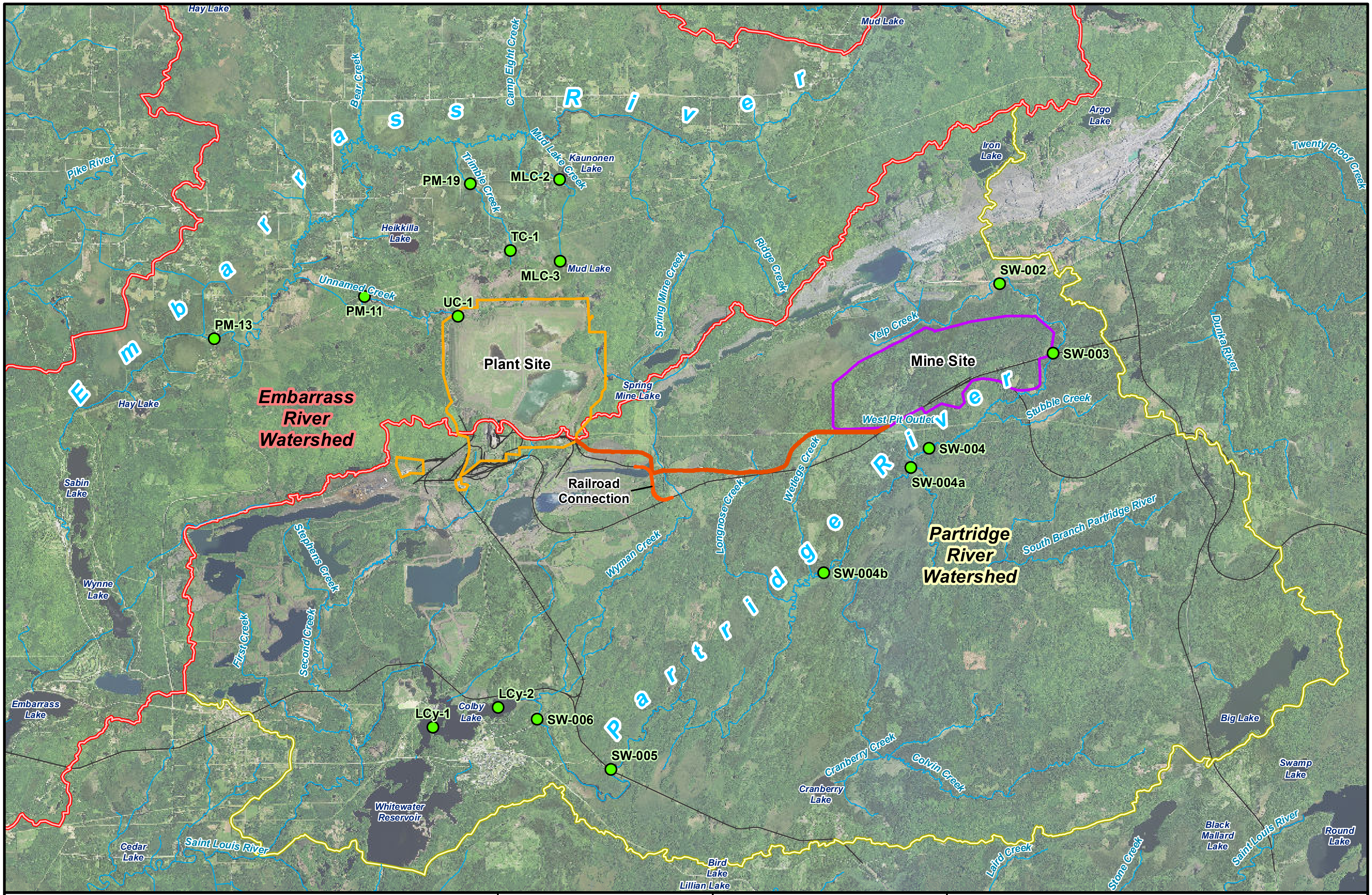
At SW-002, SW-004, and SW-004a, baseflow (i.e., average 30-day annual low flow) gradually decreases during the first 11 years of mining, but in the worst case only represents a 4 to 5 percent reduction and a 0.3 to 1.6 cfs reduction in absolute flow (year 11). In terms of long-term closure, the average annual 30-day minimum flow is estimated to decrease from 0.41 cfs (existing conditions) to 0.40 cfs at SW-002 and from 0.92 cfs (existing conditions) to 0.89 cfs at SW-004. At SW-004a, the average annual 30-day minimum flow is estimated to increase from 2.44 cfs (existing conditions) to 2.98 cfs (see Table 5.2.6-1). The annual daily mean flow would follow similar trends as the 30-day annual low flow, with a maximum decrease of 5 percent at year 11 and remain approximately the same as existing conditions for long-term closure (PolyMet 2015m, Attachment J). Most of these changes in flow are too small to be measurable and, therefore, hydrologic alteration is not expected to degrade physical aquatic habitat by destabilizing the stream channel.

The effects from the NorthMet Project Proposed Action on seasonal flow would be negligible and, therefore, no adverse effects on aquatic habitat or species are anticipated.

Flow monitoring methods have been determined by the MDNR based on professional judgement and accumulated data. Monitoring would be conducted at a minimum of three sites for each of the impacted streams whenever there is a 20 percent fluctuation in watershed area or an addition / reduction of flow that exceeds 20 percent of the mean annual flow located: 1) within 2,000 ft of each outflow; 2) at the endpoint of impact; and 3) midway between the two points (Chisholm 2006).

Flow reductions within the Partridge River would be reduced by a maximum 8 percent. Varying degrees of hydrologic alteration can be tied to ecological condition using the Limits of Hydrologic Alteration (LOHA) Method, which is intended to provide a better articulation of the aspects of flow rate and timing thought to be most important to ecological condition, and provide more elaboration on the ecological changes that are associated with increasing degrees of hydrologic alteration. Research in review lists 10 percent, 20 percent, and greater than 20 percent flow alteration as setting the ecological condition of 'natural,' 'minimally altered,' and 'moderately altered,' respectively (Chisholm 2006). A review of case studies (Richter et al. 2011) found that recommendations for flow protection are quite consistent, typically resulting in a range of allowable cumulative depletion of 6 percent to 20 percent of normal to low flows, but with occasional allowance for greater depletion in seasons or flow levels during which aquatic species are thought to be less sensitive. This review supports the conclusion that flow reductions in the Partridge River Watershed due to the NorthMet Project Proposed Action are anticipated to be within the natural ecological condition and have minimal impacts to ecosystem function and aquatic species.

Proposed flow monitoring details would be finalized during the permitting process to ensure average annual flow standards are being met during mine operations, reclamation, and post-closure maintenance phases (see Table 5.2.2-53).



Water Sampling Location
Embarrass River Watershed
Partridge River Watershed
Stream/River
Mine Site
Plant Site
Transportation and Utility Corridor
Existing Railroad

This document is a working document. This document may change over time as a result of new information, further deliberation, or other factors not yet known to the Co-lead Agencies.

N W E S

0 0.5 1 2 3 Miles

Figure 5.2.6-1
Partridge and Embarrass River Watershed
Surface Water Evaluation Locations
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

132 -Page Intentionally Left Blank-

Table 5.2.6-1 Partridge River Flow Modeling Results for Evaluation Locations SW-002, SW-004, and SW-004a

	SW-002							SW-004							SW-004a						
Statistic (Unit)	**Existing Conditions**	**Year 1**	**Year 2**	**Year 11**	**Year 20**	**West Pit Filling**	**Long-term Closure**	**Existing Conditions**	**Year 1**	**Year 2**	**Year 11**	**Year 20**	**West Pit Filling**	**Long-term Closure**	**Existing Conditions**	**Year 1**	**Year 2**	**Year 11**	**Year 20**	**West Pit Filling**	**Long-term Closure**
Annual Daily Mean (cfs)	6.09	5.84	5.84	5.79	6.12	6.09	6.09	13.97	13.51	13.52	13.37	13.70	14.08	14.07	38.33	37.74	37.62	36.66	37.32	37.10	38.72
October Mean (cfs)	22.76	21.81	21.83	21.63	22.86	22.75	22.75	52.43	50.60	50.64	50.07	51.26	52.74	52.73	144.03	141.74	141.25	137.55	140.03	139.19	143.92
November Mean (cfs)	4.59	4.33	4.32	4.27	4.47	4.46	4.46	11.68	10.77	10.77	10.66	10.91	11.16	11.16	31.61	30.45	30.35	29.68	30.14	30.02	31.64
December Mean (cfs)	1.7	1.64	1.64	1.62	1.71	1.70	1.70	4.43	4.02	4.02	3.97	4.06	4.16	4.16	12.85	12.33	12.29	12.02	12.19	12.13	13.80
January Mean (cfs)	0.57	0.54	0.54	0.54	0.56	0.56	0.56	1.37	1.26	1.26	1.25	1.28	1.31	1.31	3.95	3.83	3.81	3.72	3.78	3.76	4.60
February Mean (cfs)	1.06	1.01	1.01	1.00	1.06	1.05	1.05	2.40	2.32	2.32	2.30	2.35	2.42	2.42	6.59	6.48	6.46	6.29	6.41	6.37	7.02
March Mean (cfs)	1.44	1.38	1.38	1.37	1.45	1.44	1.44	3.10	3.04	3.04	3.01	3.08	3.18	3.18	8.50	8.42	8.39	8.15	8.32	8.26	8.59
April Mean (cfs)	30.58	29.23	29.24	28.96	30.56	30.41	30.42	71.41	68.77	68.80	68.04	69.66	71.58	71.58	200.60	197.10	196.46	191.58	194.90	193.79	198.90
May Mean (cfs)	7.36	7.04	7.06	7.01	7.46	7.43	7.43	17.52	16.90	16.92	16.74	17.17	17.66	17.66	49.01	48.33	48.20	46.98	47.88	47.55	49.58
June Mean (cfs)	11.55	11.15	11.17	11.08	11.70	11.65	11.65	25.56	25.32	25.38	25.11	25.78	26.45	26.45	67.75	67.46	67.23	65.54	66.77	66.44	69.71
July Mean (cfs)	5.97	5.78	5.78	5.74	6.06	6.04	6.04	13.54	13.23	13.22	13.10	13.43	13.75	13.75	35.56	35.14	34.92	34.04	34.67	34.46	36.68
August Mean (cfs)	3008	2.89	2.89	2.87	3.03	3.03	3.03	6.40	6.41	6.39	6.33	6.48	6.67	6.67	16.71	16.64	16.75	16.32	16.62	16.53	17.48
September Mean (cfs)	8.93	8.62	8.61	8.52	9.02	8.97	8.97	20.14	19.47	19.43	19.24	19.70	20.19	20.18	52.93	51.97	51.64	50.26	51.20	50.83	53.44
Average Annual 30-day Max (cfs)	25.59	22.58	22.60	22.39	23.67	23.57	23.58	54.01	52.46	52.49	51.91	53.19	54.70	54.70	150.46	148.47	148.21	144.46	147.03	146.24	149.90
Average Annual 90-day Max (cfs)	13.71	13.14	13.14	13.02	13.77	13.71	13.71	31.66	30.66	30.66	30.33	31.07	31.95	31.94	87.78	86.48	86.26	84.06	85.58	85.07	87.62
Average Annual 30-day Min (cfs)	0.41	0.39	0.39	0.38	0.40	0.40	0.40	0.92	0.86	0.86	0.85	0.87	0.89	0.89	2.44	2.38	2.36	2.30	2.33	2.32	2.98
Average Annual 90-day Min (cfs)	0.63	0.60	0.60	0.60	0.62	0.62	0.62	1.46	1.35	1.35	1.34	1.36	1.39	1.39	3.87	3.76	3.73	3.64	3.70	3.68	4.50
Avg. Hydrograph Increase (cfs/day)	3.94	3.84	3.85	3.86	4.04	4.03	4.01	6.93	6.91	6.96	6.89	7.14	7.40	7.40	20.61	20.82	20.87	20.17	20.47	20.65	20.92
Avg. Hydrograph Decrease (cfs/day)	1.49	1.44	1.45	1.44	1.52	1.51	1.51	2.46	2.49	2.50	2.47	2.56	2.64	2.65	7.06	7.18	7.19	7.04	7.13	7.18	7.25

Source: PolyMet 2015m, Attachment J (Partridge River Hydrologic Impact Assessment Results).

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No effects on aquatic resources are anticipated from hydrologic changes at the Partridge River tributary streams, Colby Lake, or Whitewater Reservoir, from the NorthMet Project Proposed Action. On an annual average basis, inflow to Colby Lake would be reduced about 1.7 percent during operations (in mine year 11) and have virtually no change during closure (see Section 5.2.2.3.2) (PolyMet 2015m). Withdrawals at Colby Lake would create an average annual water level fluctuation of about 3.6 ft, compared to 3.9 ft for zero withdrawal. Withdrawals at the Whitewater Reservoir would create an annual fluctuation of about 4.2 ft compared to 2.9 ft for zero withdrawal. Effects on Colby Lake and Whitewater Reservoir are expected to be negligible as they would be well within the range of effects experienced during the former LTVSMC taconite mining operations.

Approximately 227 gpm of surface water seepage flows from the existing LTVSMC Tailings Basin to the headwaters of Second Creek. Under the current LTVSMC Consent Decree, most of this seepage is captured and pumped back to the Tailings Basin, resulting in a net reduction in base flow to Second Creek. The NorthMet Project Proposed Action would continue pumping this seepage back to the Tailings Basin for water quality protection reasons, but would augment flows in Second Creek at approximately 80 percent of the current seepage volume (i.e., about 184 gpm) with WWTP effluent throughout NorthMet Project Proposed Action operations, reclamation, and long term closure. With these augmentation flows, total flow volume in Second Creek would be equivalent to at least 80 percent of historic flow volume and fluctuations through the year would mimic the natural hydrograph (PolyMet 2015j); therefore, the designed flow augmentation to Second Creek is not expected to affect the available aquatic species habitat by degrading the habitat with decreased flow to the headwater portions of this stream and would in fact help mitigate the hydrologic effect associated with the current pump back requirements.

Riparian and Aquatic Connectivity

The NorthMet Project Proposed Action activities would not occur within the riparian buffer of any streams; therefore, the NorthMet Project Proposed Action would not affect the extent of natural vegetative cover along riparian areas and would not result in a change in the RCI for the Partridge River.

The NorthMet Project Proposed Action would not result in any new dams, bridges, or culverts within perennial or intermittent streams; therefore, the NorthMet Project Proposed Action would not affect the hydrologic connectivity along streams and would not result in a change in the ACI for the Partridge River.

Water Quality Effects

Surface water chronic standards, specifically the Class 2B standards, were developed to be protective of aquatic life and to promote the "propagation and maintenance of a healthy community of cool or warm water sport or commercial fish and associated aquatic life, and their habitats" (*Minnesota Rules*, part 7050.0222). The chronic standards reflect "the highest water concentration of a toxicant to which organisms can be exposed indefinitely without causing chronic toxicity" (*Minnesota Rules*, part 7050.0218, subpart 3, item I).

As described in more detail in Section 5.2.2, the GoldSim water quality model results were screened to compare the single highest monthly P90 water quality prediction from among 2,400 months covered over the 200 year model period by the simulation with CEC Scenario values and the water quality evaluation criteria (see Section 5.2.2.1). The screening analysis indicates that the NorthMet Project Proposed Action would meet all Minnesota Class 2B water quality standards and proposed evaluation criteria with the exception of aluminum (see Table 5.2.6-2).

The results indicate aluminum would exceed the Class 2B chronic standard (125 μg/L) at all evaluation locations. Maximum aluminum P90 values for the NorthMet Project Proposed Action ranged from a low 306μg/L (SW-006) to a high of 313 μg/L (SW-002). However, Partridge River concentrations at the same locations for the CEC Scenario are nearly identical, also exceeding the standard. Therefore, the NorthMet Project Proposed Action would not worsen existing conditions relative to aluminum concentrations in the Partridge River.

Mercury was not included in the GoldSim model for either the Mine Site or the Plant Site, as insufficient data and unique modeling requirements for mercury dynamics prevented modeling mercury like the other solutes. Regardless, the NorthMet Project Proposed Action would still need to demonstrate that the mercury evaluation criteria would be protected (see Section 5.2.2.1). Therefore, a simple mass balance model estimation method was used. This simple estimation method was preferred over a detailed mechanistic model because it incorporated the important input and removal processes for mercury, was very transparent with regard to data inputs, and allowed for easy assessment of the effects of changing parameter values on mercury concentrations. For the Mine Site, this method, in combination with analog data from existing natural and mine pit lakes in the region, was used to assess future mercury concentrations in the West Pit lake and in the overflow water. The NorthMet Project Proposed Action is also estimated to result in a net decrease in mercury loadings to the Partridge River (see Sections 5.2.2.3.4 and 6.2.2.4).

An exceedance of aluminum could potentially affect aquatic species by causing pulmonary problems, developmental issues, and osmoregulatroy disturbances (Soucek 2006). However, given the similarity between the CEC Scenario and the NorthMet Project Proposed Action aluminum values at Partridge River evaluation locations, impacts from aluminum to aquatic species due to the NorthMet Project Proposed Action are not anticipated.

Table 5.2.6-2 Partridge River Maximum P90 Solute Concentration Over Entire 200-Year Simulation at Each Evaluation Location Based on GoldSim Probabilistic Model

Parameter	Evaluation Criteria	Units	SW-002		SW-004		SW-004a	
			NorthMet Project Proposed Action	**CEC Scenario**	**NorthMet Project Proposed Action**	**CEC Scenario**	**NorthMet Project Proposed Action**	**CEC Scenario**
General								
Chloride	230	mg/L	16.9	16.9	16.8	16.7	16.8	16.9
TDS[2]	700[3]	mg/L	207	207	204	204	214	204
Metals Total								
Aluminum	125	µg/L	**313**	**313**	**312**	**311**	**310**	**315**
Antimony	31	µg/L	0.25	0.3	0.26	0.3	4.2	0.3
Arsenic	53	µg/L	2.6	2.6	2.6	2.6	2.7	2.6
Boron	500	µg/L	200	199	198	197	200	202
Cadmium	NA[1]	µg/L	0.17	0.17	0.16	0.16	0.93	0.17
Chromium	11	µg/L	1.4	1.4	1.4	1.4	1.7	1.5
Cobalt	5	µg/L	1.3	1.3	1.3	1.3	3.1	1.3
Copper	NA[1]	µg/L	3.5	3.5	3.4	3.4	5.8	3.5
Lead	NA[1]	µg/L	0.94	0.94	0.92	0.92	1.9	0.97
Nickel	NA[1]	µg/L	4.3	4.3	4.3	4.3	26.7	4.4
Selenium	5	µg/L	1.5	1.5	1.5	1.5	1.5	1.5
Silver	1	µg/L	0.11	0.11	0.11	0.11	0.16	0.11
Thallium	0.56	µg/L	0.12	0.12	0.11	0.11	0.11	0.12
Zinc	[1]NA[2]	µg/L	25.4	25.4	25.5	25.4	48.7	25.4

Sources: PolyMet 2015m; PolyMet 2014v.

Notes:
Bolded numbers show exceedances at the P90 modeled concentrations.

For each constituent at each location, the maximum solute concentration over the entire 500-year simulation period is recorded for each of 500 realizations of the Monte Carlo run. At the end of the Monte Carlo run, there is a list of 500 maximum concentration values for each constituent at each location. Each list is converted to a cumulative frequency distribution. Each value in this table is the 90th percentile concentration from the associated distribution.

[1] Parameter has a hardness-based evaluation criterion and is screened using a different procedure (see Table 5.2.2.-32)[2] TDS is calculated as the sum of 90th-percentile alkalinity, calcium, magnesium, sodium, potassium, chloride, sulfate, and fluoride using the formula provided in PolyMet (2013i, Section 6.2.6.25m)

Colby Lake

As discussed in Section 5.2.2 and exhibited in Table 5.2.6-3, Colby Lake would exceed the evaluation criteria for aluminum, arsenic, iron, and manganese under the NorthMet Project Proposed Action. Potential effects of aluminum on aquatic species are discussed in Section 5.6.2.2.1. Exceedances of arsenic could potentially result in poor growth rates and mortality in aquatic species; however, adverse effects have only been reported in water containing concentrations between 19 and 48 µg/L (Eisler 1988a). However, comparing the evaluation criteria exceedances to the CEC Scenario indicates no effects on aquatic species would result from the NorthMet Project Proposed Action, as modeled values are nearly identical under the No Action Continuation of Existing Conditions Scenario.

Table 5.2.6-3 Maximum P90 Surface Water Concentrations for Colby Lake

Parameter	Colby Lake Evaluation Criteria	Units	CEC Scenario (Max P90 Value)	NorthMet Project Proposed Action (Max P90 Value)
General				
Chloride	230	mg/L	15.3	15.3
Metals Total				
Aluminum	125	µg/L	**266**	**266**
Antimony	5.5	µg/L	0.26	0.48
Arsenic	2	µg/L	**2.44**	**2.46**
Cadmium	NA[1]	µg/L	0.17	0.20
Chromium	100	µg/L	1.28	1.28
Cobalt	2.8	µg/L	1.22	1.26
Copper	NA[1]	µg/L	9.83	9.88
Iron	300	µg/L	**5,043**	**5,034**
Lead	NA[1]	µg/L	1.26	1.31
Manganese	50	µg/L	**207**	**202**
Nickel	NA[1]	µg/L	4.42	5.43
Selenium	5	µg/L	1.29	1.29
Silver	1	µg/L	0.11	0.11
Thallium	0.28	µg/L	0.07	0.08
Zinc	NA[1]	µg/L	26.7	27.6

Source: PolyMet 2014v

Note: Bold font indicates an exceedance of the Class 2B water quality standards evaluation criteria.

Special Status Species

There are no federally listed or state-listed threatened or endangered fish or macroinvertebrate species known to occur in the Partridge River (USFWS 2011). There are four special status aquatic species that have not been found in the NorthMet Project area, but suitable habitat is likely to occur and the species could be present, including:

- Quebec emerald dragonfly – RFSS species,
- Ebony boghaunter – RFSS species,

- Creek heelsplitter mussel – SGCN and RFSS species, and
- Northern brook lamprey – SGCN and RFSS species.

Since the NorthMet Project Proposed Action is not predicted to result in any measurable changes in low flows and negligible changes in average flows, no effects on RCI and ACI, and no change in water quality for any of the Class 2B water quality standards, no effects on aquatic special status species is expected within the Partridge River Watershed.

Furthermore, the USFS determined that the NorthMet Project Proposed Action would not affect three RFSS aquatic species on the Superior National Forest, which include lake sturgeon, nipigon cisco, and shortjaw cisco. In addition, the NorthMet Project Proposed Action may affect individuals, but would not likely cause a trend to federal listing or loss of viability for the remaining six RFSS aquatic species, discussed in Section 4.2.6, on the Superior National Forest. Please see the Biological Evaluation listed on the USFS website (http://www.fs.usda.gov/goto/superior/northmet) for more information about effects on RFSS aquatic species.

5.2.6.2.2 Embarrass River Watershed

This section describes the potential effects of the NorthMet Proposed Action on aquatic resources in the Embarrass River Watershed, including effects on physical habitat, riparian and aquatic connectivity, and water quality.

Physical Habitat Effects

The NorthMet Project Proposed Action could potentially affect flows in the three tributary streams draining the Tailings Basin (i.e., Mud Lake Creek, Trimble Creek, and Unnamed Creek) and flow in the Embarrass River downstream of these tributary effects (i.e., PM-13). As discussed in Section 5.2.2, the NorthMet Project Proposed Action includes engineering controls that would capture nearly all seepage from the Tailings Basin, and to mitigate this effect by augmenting flows to two of the three Embarrass River tributary streams, Unnamed Creek and Trimble Creek, and Second Creek, a Partridge River tributary, with WWTP effluent to maintain average annual flows in these tributaries within 20 percent of existing conditions (see Table 5.2.6-4). Mud Lake Creek would be augmented via a drainage swale on the east side of the Tailings Basin. The tributary streams flow augmentation would result in only about a two percent reduction in average annual flow at PM-13 in the Embarrass River. Changes in average annual flow of this magnitude (less than 20 percent) would fall into the range of annual natural variability in terms of precipitation and would have minimal impacts to ecosystem function and aquatic species within the Embarrass River Watershed; however, seasonal flow data was not available for this watershed—in particular the tributaries. Flow monitoring details under the NorthMet Project Proposed Action would be finalized during the permitting process to ensure average annual flow standards are being met during mine operations, reclamation, and post-closure maintenance phases (see Table 5.2.2-54).

Dampening of the hydrologic curve could have an adverse effect on aquatic biota due to stream destabilization, including aggredation, degradation, and resultant loss of habitat. Maintenance of spring bankfull flow is particularly important for the success of fish spawning in tributaries because high flows trigger spawning runs and maintain spawning habitat. Effects on the success of fish spawning in tributary streams would be addressed by maintenance of seasonal, bankfull flows over the life of the NorthMet Project Proposed Action, especially when stream-related flow augmentation occurs within the Embarrass River Watershed.

Table 5.2.6-4 WWTP Minimum Flow Requirements for Stream Augmentation

Tributary	Historical Average Annual Flow (gpm)	NorthMet Project Designed Average Annual Flow (gpm)[1]
Second Creek	227	184
Trimble Creek	1,888	1,178
Unnamed creek	1,180	336
Total	**3,295**	**1,698**

Source: PolyMet 2015i.

Note:
[1] Includes predicted future flow contribution of headwaters watershed.

Water Quality Effects

As described in more detail in Section 5.2.2, the GoldSim water quality model results were screened to compare the single highest monthly P90 water quality prediction from among 2,400 months (Partridge River) or 6,000 months (Embarrass River) covered over the 200- to 500-year model period with the CEC Scenario modeled values and the water quality evaluation criteria (see Section 5.2.2.1). The screening analysis indicates that the NorthMet Project Proposed Action would meet all Minnesota Class 2B water quality standards and proposed evaluation criteria with the exception of aluminum (see Table 5.2.6-5).In addition, surface water constituents that have hardness-based evaluation criteria were screened. It was not possible to develop a single evaluation criterion to which the GoldSim-predicted solute concentrations could be compared. The approach to screening was therefore based on evaluating the frequency of the occurrence of an exceedance for each monthly timestep. The value for lead at PM-11 is the only value that exceeded the frequency of exceedance threshold of 5 percent (Section 5.2.2).

The results indicate the maximum P90 values of aluminum would exceed the Class 2B standard (125 µg/L) at all evaluation locations except TC-1 for both the CEC Scenario and the NorthMet Project Proposed Action. Maximum aluminum P90 values for the NorthMet Project Proposed Action ranged from a low 112 µg/L (TC-1) to a high of 189 µg/L (MLC-3). As discussed in Section 5.2.2, however, the predicted increases in aluminum are not the result of increased aluminum loadings from the NorthMet Project Proposed Action, but rather the result of mass loading from surface runoff and the loading from other minor sources. Given the similarity between the CEC Scenario and the NorthMet Project Proposed Action aluminum values at Embarrass River evaluation locations, impacts from aluminum to aquatic species due to the NorthMet Project Proposed Action are not anticipated.

As discussed in Section 5.2.2.3.3, NorthMet Project Proposed Action lead concentrations at PM-11 are generally higher than CEC Scenario concentrations. However, it is concluded that due to the expected performance of the WWTP, it is likely that actual lead concentrations at PM-11 would have acceptably low frequencies of exceedance. Therefore, impacts from lead to aquatic species due to the NorthMet Project Proposed Action are not anticipated. Potential impacts to aquatic species caused by exposure to high levels of lead are discussed below.

Although maximum solute P90 concentrations are expected to meet Class 2B water quality standards for solutes other than aluminum, the NorthMet Project Proposed Action is projected to alter the existing water quality of the Embarrass River by increasing some solute concentrations from 2 to almost 30 times the existing level (Tables 4.2.2-32 and 5.2.2-45). Non-contact surface runoff and the addition of WWTP effluent to Unnamed Creek, Trimble Creek, and Second Creek as part of the augmentation program is projected to contribute to these loading increases.

Mercury was not included in the GoldSim model for either the Mine Site or the Plant Site, as insufficient data and unique modeling requirements for mercury dynamics prevented modeling mercury like the other solutes. Regardless, the NorthMet Project Proposed Action would still need to demonstrate that the mercury evaluation criteria would be protected (see Section 5.2.2.1). Therefore, a simple mass balance model estimation method was used. This simple estimation method was preferred over a detailed mechanistic model because it incorporated the important input and removal processes for mercury, was very transparent with regard to data inputs, and allowed for easy assessment of the effects of changing parameter values on mercury concentrations. For the Plant Site, this method, in combination with analog data from existing natural and mine pit lakes in the region, was used to assess future mercury concentrations in seepage, discharge from the WWTP, and volatilization from the Tailings Basin pond (this mechanism is discussed in Section 5.2.7, Air Quality). The NorthMet Project Proposed Action is predicted to result in a net increase in mercury loadings to the Embarrass River (see Sections 5.2.2.3.4 and 6.2.2.4). This is primarily attributable to the redirection of surface runoff diverted via the drainage swale constructed east of the Tailings Basin East Dam directly to Mud Lake Creek as part of the Tailings Basin expansion to the Embarrass River.

Heavy metals have a wide spectrum of adverse effects on aquatic life that could include impacts to reproduction, growth, behavior, and metabolism. These effects are dependent upon such factors as species, age, weight, sex, trophic level, concentration of the metal, and ambient water conditions such as pH, salinity, hardness, temperature, and dissolved oxygen (Girgin et al. 2010). The bioavailability of heavy metals such as cadmium, copper, nickel, lead, and zinc generally decreases with increasing hardness in freshwater systems (Girgin et al. 2010). See Section 5.2.2.1.2 for details regarding the relationship between heavy metals and hardness. Exceedances of mercury could cause adverse impacts such as reproduction, growth, and osmoregulation issues in aquatic organisms. Mercury rapidly accumulates in aquatic biota and can inhibit fish reproduction at water concentrations as low as 0.03 μg/L (Eisler 1987); however, seepage water from the Tailings Basin is expected to be less than 0.001 μg/L. Conversely, lead does not bioaccumulate and tends to decrease with increasing trophic levels in freshwater habitats. Exposure to high levels of lead could result in muscular and neurological degeneration and destruction, growth inhibition, reproductive problems, paralysis, and mortality in fish. It could also negatively affect invertebrate reproduction as well as reduce growth, photosynthesis, mitosis, and water absorption in aquatic plants (Eisler 1988b).The NorthMet Project Proposed Action is designed to capture metals with engineering controls and adaptive management. Water monitoring (see Table 5.2.2-54) would ensure that water quality standards would be met with engineering controls and adaptive management. In addition, spill prevention plans would be implemented. These measures would minimize any potential impacts to aquatic species.

Table 5.2.6-5 Embarrass River Maximum P90 Solute Concentration Over Entire 500-Year Simulation Period Based on GoldSim

			PM-13		PM-11		PM-19		MLC-2	
Parameter	**Evaluation Criteria**	**Units**	**NorthMet Project Proposed Action**	**Continuation of Existing Conditions**	**NorthMet Project Proposed Action**	**Continuation of Existing Conditions**	**NorthMet Project Proposed Action**	**Continuation of Existing Conditions**	**NorthMet Project Proposed Action**	**Continuation of Existing Condition**
Chloride	230	mg/L	9.7	13.1	8.8	22.1	7.5	22.2	10.2	20.7
TDS[2]		mg/L	257	479	131	919	138	667	213	531
Metals Total										
Aluminum	125	µg/L	**180**	**179**	**159**	**151**	**135**	**129**	**187**	**158**
Antimony	31	µg/L	9.2	0.40	19.6	0.68	19.0	0.49	0.40	0.44
Arsenic	53	µg/L	5.8	4.2	10.0	3.6	9.8	4.0	4.4	4.4
Boron	500	µg/L	151	225	356	**517**	349	370	94.5	282
Cadmium	NA[1]	µg/L	1.0	0.15	2.0	0.26	1.9	0.19	0.16	0.17
Chromium	86	µg/L	4.1	1.7	7.5	1.5	7.4	1.3	1.8	1.6
Cobalt	5	µg/L	3.0	2.6	5.0	4.7	4.9	2.7	2.7	2.5
Copper	NA[1]	µg/L	5.7	2.6	9.0	5.2	8.9	3.3	2.2	2.7
Lead	NA[1]	µg/L	1.7	0.59	3.0	0.42	2.9	1.1	1.4	1.3
Nickel	NA[1]	µg/L	28.4	4.5	50.0	9.8	49.1	5.8	4.1	4.5
Selenium	5	µg/L	2.74	0.76	4.99	0.93	4.87	0.77	0.87	0.76
Silver	1	µg/L	0.18	0.14	0.32	0.25	0.32	0.18	0.13	0.15
Thallium	0.56	µg/L	0.17	0.15	0.23	0.16	0.23	0.18	0.17	0.19
Vanadium	NA	µg/L	6.5	3.7	9.5	1.0	9.3	3.7	5.2	4.8
Zinc	NA[1]	µg/L	57.0	18.5	99.9	15.8	98.2	15.3	19.2	18.1

Source: PolyMet 2014w and PolyMet 2015j.

Notes:
For each constituent at each location, the maximum solute concentration over the entire 500-year simulation period is recorded for each of 500 realizations of the Monte Carlo run. At the end of the Monte Carlo run, there is a list of 500 maximum concentration values for each constituent at each location. Each list is converted to a cumulative frequency distribution. Each value in this table is the 90th percentile concentration from the associated distribution.
Bold value indicates exceedance of the evaluation criterion at the P90 modeled concentrations.
[1] Parameter has a hardness-based evaluation criterion and is screened using a different procedure (see Table 5.2.2.-32).
[2] TDS is calculated as the sum of 90th-percentile alkalinity, calcium, magnesium, sodium, potassium, chloride, sulfate, and fluoride using the formula provided in PolyMet (2013i, section 6.2.6.25m).

Special Status Species

There are no federally listed or state-listed threatened or endangered fish or macroinvertebrate species known to occur in the Embarrass River (USFWS 2011). There are four special status aquatic species that have not been found in the NorthMet Project area, but suitable habitat is likely to occur and the species could be present, including:

- Quebec emerald dragonfly – RFSS species;
- Ebony boghaunter – RFSS species;
- Creek heelsplitter mussel – SGCN and RFSS species; and
- Northern brook lamprey – SGCN and RFSS species.

The NorthMet Project Proposed Action is not predicted to result in any measurable changes in low flows, and there would be negligible changes in average annual flows, no effects on RCI and ACI, and no change in water quality for any of the Class 2B water quality standards.

Similarly for the Embarrass River, as stated above for the Partridge River, the USFS determined that the NorthMet Project Proposed Action would not affect three RFSS aquatic species on the Superior National Forest, which include lake sturgeon, nipigon cisco, and shortjaw cisco. In addition, the NorthMet Project Proposed Action may affect individuals, but would not likely cause a trend to federal listing or loss of viability for the remaining six RFSS aquatic species, discussed in Section 4.2.6, on the Superior National Forest.

5.2.6.3 NorthMet Project No Action Alternative

Under the NorthMet Project No Action Alternative, the NorthMet Project Proposed Action would not occur and associated effects on fish and other aquatic life would not occur.

Although under the No Action Alternative, the NorthMet Project Proposed Action, including the proposed Tailings Basin seepage collection and water treatment engineering controls, would not occur, the No Action Alternative would not necessarily be static. In this case, it is anticipated that the water quality of seepage from the existing LTVSMC Tailings Basin would improve over time as a result of natural attenuation and/or possible additional mitigation measures at some point in the future pursuant to new requirements in permits or other state or federal remediation requirements.

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5.2.7 Air Quality

This section assesses the effects of the NorthMet Project Proposed Action on air quality. Procedures for air quality assessments vary depending upon the level of emissions from a proposed project. The USEPA defines sources as "major" or "minor," depending on their emissions levels of regulated pollutants (250 tpy of any criteria pollutant, 100,000 tpy of GHGs, 10 tpy of a single HAP, or 25 tpy of all HAPs). As presented in this section, the NorthMet Project Proposed Action has been defined as a synthetic minor source according to this definition, since the project would limit its emissions through permit restrictions to less than the emission levels stated above. However, at the request of several state and federal agencies, much of the analyses were conducted to address requirements for major sources. Discussions of the air quality assessment methodologies, air quality effects, and potential mitigation measures are addressed for criteria pollutants, air toxics, and amphibole fibers.

Summary

The NorthMet Project Proposed Action has been designed so that it is considered a synthetic minor source for air permitting purposes. However, the evaluation of the NorthMet Project Proposed Action in this FEIS has treated it as a major source due to its sensitive nature. Compliance with state and federal ambient air quality standards and growth increments, designed to protect human health and the environment, were evaluated using generally accepted state and federal threshold criteria. The NorthMet Project Proposed Action has been shown to not cause or contribute to significant air quality effects. Local and regional effects, up to 300-km from the project facilities, were evaluated to incorporate federally sensitive, pristine area resources such as BWCAW and Voyageurs National Park. Effects of dust from mining and ore transport are generally confined to areas disturbed by project activities. The effects of reactive dust emissions on wetlands are discussed in Section 5.2.3. Control technologies similar to federal Best Available Control Technologies (termed BACT-like) were evaluated and applied to the project equipment in order to minimize the potential for air emissions. In particular, BACT-like controls were incorporated to reduce mercury emissions to levels that would not impede current State of Minnesota mercury emissions reduction goals. BACT-like fine-particulate matter emission controls were also incorporated to specifically control the release of more than 99.9 percent of amphibole fibers in the ore.

5.2.7.1 Methodology and Evaluation Criteria

The following subsections describe the air quality standards used in the assessments, local and federal regulations that affect the NorthMet Project Proposed Action, and modeling methodologies and specific modeling assessments conducted, as well as the criteria used to define significant effects from operation of the NorthMet Project Proposed Action.

5.2.7.1.1 Regulatory Setting

<u>Air Quality Standards</u>

The USEPA has established NAAQS for seven criteria air pollutants including NO_2, SO_2, CO, O_3, PM_{10}, $PM_{2.5}$, and lead. Primary standards are established to protect the public health; secondary standards are set to protect public welfare, including protection from damage to animals, crops, vegetation, visibility, and buildings. It should be noted that Title 42, Chapter 85, Subchapter I, Part A, Section 7408 (a)(2) of the CAA directs the USEPA to develop air quality criteria for air pollutants that have identifiable effects on public health or “welfare.” The term "welfare" in the context of the CAA includes the protection of vegetation, and the secondary NAAQS are designed to be protective of plant life including the effects of both concentration and deposition of material.

The MPCA has also promulgated ambient air standards for the State of Minnesota, known as the MAAQS. In addition to the criteria pollutants, the MAAQS contain standards for TSP and hydrogen sulfide (H_2S). As with the NAAQS, the MAAQS primary standards are established to protect the public health; secondary standards are set to protect public welfare, including protection from damage to animals, crops, vegetation, visibility, and buildings.

The NAAQS and MAAQS are summarized in Table 5.2.7-1.

Table 5.2.7-1 Summary of NAAQS and MAAQS

Pollutant	Averaging Period	Standard Value (ppm)	Standard Value (µg/m^3)	Standard Type[1]	Notes
Carbon Monoxide	1-Hour	35	40,000	Primary	Not to be exceeded more than once per year
	1-Hour[2]	30	35,000	Primary	
	8-Hour	9	10,000	Primary and Secondary	
Nitrogen Dioxide	Annual Arithmetic Mean	0.05	100	Primary and Secondary	Not to be exceeded
	1-Hour	0.10	188	Primary	Not to exceed the 98th percentile of the Maximum Daily 1-hour Values averaged over a 3-year period
Ozone	8-Hour	0.075	147	Primary and Secondary	4th highest daily maximum 8-hour average
Lead	Quarterly		0.15	Primary and Secondary	Rolling 3-month average
Total Suspended Particulate (TSP)[2]	Annual Geometric Mean		75 60	Primary Secondary	Not to be exceeded
	24-Hour		260 150	Primary Secondary	Not to be exceeded more than once per year
PM_{10}	Annual Arithmetic Mean[2]		50	Primary and Secondary	Not to be exceeded
	24-Hour		150	Primary and Secondary	Not to be exceeded more than once per year on average over 3 years

Pollutant	Averaging Period	Standard Value (ppm)	Standard Value (µg/m³)	Standard Type[1]	Notes
$PM_{2.5}$	Annual Arithmetic Mean		12	Primary and Secondary	Not to exceed the 3-year average of the weighted annual mean concentrations
	24-Hour		35	Primary and Secondary	Not to exceed the 3-year average of the 98th percentile of 24-hour concentrations
Sulfur Dioxide	Annual Arithmetic Mean	0.03 0.02	80 60	Primary Secondary[2]	Not to be exceeded
	24-Hour	0.14	365	Primary and Secondary	Not to be exceeded more than once per year
	3-Hour	0.5	1,300	Primary and Secondary	
	3-Hour[2]	0.35	915	Secondary	
	1-Hour[2]	0.5	1,300	Primary	
	1-Hour	0.075	196	Primary	Not to exceed the 99th percentile of the Maximum Daily 1-hour Values averaged over a 3-year period
Hydrogen Sulfide[2]	½-Hour	0.05	70	Primary	Not to be exceeded over 2 times per year
	½-Hour	0.03	42	Primary	Not to be exceeded over 2 times in any 5 consecutive days

Source: MPCA 2013b; USEPA 2013.

[1] Primary standards set limits to protect human health; secondary standards set limits to protect public welfare.
[2] MAAQS only.

Federal Regulations

Attainment Status

Under the CAA, the USEPA has defined all areas within the United States as one of two classifications, attainment or non-attainment. “Attainment areas” are those areas that either have collected ambient air quality data to demonstrate that they are in compliance or they do not have demonstrated non-compliance with the NAAQS, and so they are known as “unclassified areas.” An area that does not meet NAAQS is considered to be a “nonattainment area” for that pollutant, and the USEPA requires the state to develop state implementation plans to control existing and future emissions in order to bring the area into compliance with the NAAQS. The NorthMet Project area has been designated by the USEPA as attainment or unclassified for all air quality pollutants.

Prevention of Significant Deterioration Review

Under the CAA, the federal Prevention of Significant Deterioration (PSD) requirements provide for a pre-construction review and permit process for the construction and operation of a new or modified major stationary source in attainment areas. The review includes the following:

- BACT demonstration;
- ambient air quality analysis to assess potential project effects with NAAQS and PSD increments;
- an assessment of Air Quality Related Value (AQRV) of the direct and indirect effects of a project on general growth, soil, vegetation, and visibility for Class I regions within 300 km;
- an ambient monitoring program if no representative data are available; and
- public comment.

The USEPA's PSD program allows all attainment areas various levels of air quality protection and growth depending upon its designated class. Class I areas are special areas of natural wonder and scenic beauty—such as national parks, national monuments, and wilderness areas—where air quality should be given special protection. Class II areas are non-Class I areas that are allowed moderate growth and air quality degradation with Class II incremental limits. Class III areas are all non-Class I areas that are deemed unclassified and allow maximum growth and air quality degradation with no incremental limits. For attainment areas, the USEPA has promulgated PSD increments for four pollutants (NO_2, SO_2, PM_{10}, and $PM_{2.5}$) for both Class I and Class II regions. The increments are designed to allow for ambient concentrations within an area to increase by the maximum allowable amount above baseline concentrations. Class I PSD increments are designed to keep pristine areas clean and have more restrictive allowable increment thresholds. Class II PSD increments are designed to allow further growth within the rest of the country. Table 5.2.7-2 provides a summary of the Class I and Class II PSD increments.

Table 5.2.7-2 Summary of Allowable Prevention of Significant Deterioration Class I and Class II Increments

	Allowable Increment (μg/m^3)	
Pollutant, Averaging Period	**Class I Region**	**Class II Region**
SO_2, 3-hour	25	512
SO_2, 24-hour	5	91
SO_2, Annual	2	20
NO_2, Annual	2.5	25
PM_{10}, 24-hour	8	30
$PM_{2.5}$, 24-hour	2	9
$PM_{2.5}$, Annual	1	4

The NorthMet Project area is located within a Class II attainment area, as designated by the USEPA. In relation to the NorthMet Project Proposed Action, the federal CAA defines a source as a major source in an attainment area if it has any criteria pollutant emissions above 250 tpy or 100,000 tpy of GHG emissions. Because the NorthMet Project Proposed Action is proposing to limit its actual emissions below "major source" thresholds for the federal PSD program, the

NorthMet Project Proposed Action is not subject to PSD requirements and, thus, modeling of PSD increment consumption requirements do not specifically apply for permitting. For the purposes of this FEIS, NorthMet Project Proposed Action effects have been compared to the PSD Class I (generally pristine areas) and Class II (remaining areas) increments, as requested by several agencies, to ensure that the NorthMet Project Proposed Action is not contributing to any significant air quality effects.

Air Quality Related Values

In addition to PSD increments, major PSD sources that are located within 186 miles (300 km) of a Class I area may be required by the FLM to evaluate effects on AQRVs, which may include flora/fauna, visibility, water quality, soils, and odor for a specific Class I area. The NorthMet Project area is within 186 miles (300 km) of four Class I areas: BWCAW and Rainbow Lakes Wilderness (administered by the USFS) and Voyageurs National Park and Isle Royale National Park (under the administration of the National Park Service). Although the NorthMet Project Proposed Action is agreeing to emission limits to avoid being a major PSD source, an evaluation of the applicable AQRV was conducted for comparison in this FEIS. Table 5.2.7-3 provides the distances to each Class I area from the NorthMet Project area.

Table 5.2.7-3 NorthMet Project Setting Relative to Class I Regions

Class I Region	Distance from NorthMet Project Area (km/mi)
BWCAW	34/21
Voyageurs National Park	82/51
Rainbow Lakes Wilderness	142/88
Isle Royale National Park	218/135

New Source Performance Standards

The federal New Source Performance Standards are technology-based standards that are applicable to new or modified stationary sources of regulated emissions. The New Source Performance Standards program has defined emission limitations for approximately 70 source categories that are designated by size, as well as type of process. A comprehensive list of the applicable regulations for this facility would be included as part of the air quality permit. The following is a partial list of standards that apply to the NorthMet Project Proposed Action; these could vary depending on the final assessment of the permit application by the MPCA:

- Subpart A – General Provisions, which provides for general notification, recordkeeping, and monitoring requirements.
- Subpart LL – Standards of Performance for Metallic Minerals Processing Plants, which covers particulate and opacity emission limits for any new, modified, or reconstructed sources.
- Subpart OOO – Standards of Performance for Nonmetallic Mineral Processing Plants, which limits particulate emissions and opacity from new, modified, or reconstructed sources processing nonmetallic mineral (e.g., limestone or construction rock).

- Subpart IIII – Standards of Performance for Stationary Compression Ignition Internal Combustion Engines, which limits NO_x, PM, CO, fuel oil sulfur content, and opacity for new, modified, and reconstructed stationary compression ignition internal combustion engines.
- Subpart Dc – Standards of Performance for Small Industrial-Commercial-Institutional Steam Generating Units which, depending on fuel type, can regulate PM and/or SO_2 emissions from new, modified, or reconstructed boilers.

Air Conformity Determination

A conformity determination must be conducted by the lead federal agency if a federal action would generate emissions exceeding the conformity threshold levels (de minimis) of the pollutant(s) for which a Class I or Class II region is designated as a nonattainment area or as a maintenance area. Since the NorthMet Project area is classified as in attainment for all criteria pollutants, a General Conformity Determination is not required.

<u>State of Minnesota Regulations</u>

Nonferrous Mineland Reclamation rules, *Minnesota Rules* part 6132.800, administered by the MDNR, require the control of dust from areas disturbed specifically by mining operations.

Also, the MPCA has promulgated rules concerning the control and permitting of all sources (not just for mining operations) throughout Minnesota. The following regulations are evaluated for the NorthMet Project Proposed Action.

Prevention of Significant Deterioration Review

Minnesota Rules, part 7007.3000, incorporate by reference the federal PSD requirements that provide for a pre-construction review and permit process for the construction and operation of a new or modified major stationary source in attainment areas.

The NorthMet Project Proposed Action is designed to limit emissions below major source thresholds (i.e., to be permitted as a synthetic minor source). Thus, for permitting purposes, the NorthMet Project Proposed Action would not be considered a major source for PSD (BACT demonstration, PSD increment assessment, and AQRV assessment would not be required via *Minnesota Rules*, part 7007.3000). However, a comprehensive analysis of NAAQS, MAAQS, PSD Class I and II increments, and AQRV is allowed, under Minnesota Rules, part 7007.0100(7)(k) and (v), as part of the evaluation of effect. An evaluation of pollution control technology was conducted for the Mine Site and Plant Site (PolyMet 2014m, PolyMet 2014n, PolyMet 2015e).

Minnesota Standards of Performance

A comprehensive list of Minnesota Standards of Performance would be identified in the air quality permit. The following is a list of Minnesota Standards of Performance applicable to the NorthMet Project Proposed Action. This list may change, depending upon the final assessment of the permit application by the MPCA.

Control of Fugitive PM (*Minnesota Rules*, part 7011.0150), which applies to bulk material handling operation, roads, and other fugitive sources. The rule prohibits the release of "avoidable amounts" of PM, and facilities are required to take reasonable precautions to prevent the discharge of visible fugitive emissions beyond the property line.

Standards of Performance of Stationary Internal Combustion Engines (*Minnesota Rules*, part 7011.2300). This applies to the emergency fire water pumps and the emergency generators, and limits SO_2 emissions to 0.5 pound per million British thermal units (lb/MMBTU) heat input.

Standards of Performance for Post-1969 Industrial Process Equipment (*Minnesota Rules*, part 7011.0715). This would apply to all new ore-handling equipment and other new sources that would generate PM emissions for which a standard of performance has not been promulgated in a specific rule. Due to the remote location of the NorthMet Project area (i.e., any source that is not in the Minneapolis-Saint Paul Air Quality Control Region or the City of Duluth, and which is located not less than 0.25 mile from any residence or public roadway), the required control equipment efficiency standard would be 85 percent.

Standards of Performance for Existing Indirect Heating Equipment (*Minnesota Rules*, part 7011.0510). The rule limits the PM emissions to between 0.4 and 0.6 lb/MMBTU, limits SO_2 emissions to between 1.6 and 4.0 lb/MMBTU, and limits opacity to 20 percent. This may apply to existing indirect heaters if used in the mining and processing operations.

Standards of Performance for New Indirect Heating Equipment (*Minnesota Rules*, part 7011.0515). The rule limits emissions of PM to between 0.1 and 0.4 lb/MMBTU, SO_2 emissions to between 0.8 and 4.0 lb/MMBTU, NO_x emissions to between 0.2 to 0.7 lb/MMBTU, and opacity to 20 percent. This may apply to new indirect heaters that may be used in the mine processing operations.

Standards of Performance for Fossil-Fuel-Burning Direct Heating Equipment (*Minnesota Rules*, part 7011.0610). The rule limits PM emissions based upon process throughput and limits opacity to 20 percent. This may apply to process heaters that may be used in the mine processing operations.

Standards of Performance for Pre-1969 Industrial Process Equipment (*Minnesota Rules*, part 7011.0710). The rule limits mass PM emissions based upon process weight and limits opacity to 20 percent. Alternatively, due to the remote location of the NorthMet Project area, compliance can be demonstrated with a pollution control equipment efficiency of 85 percent. This may apply to existing ore-handling equipment that may be used in the mine processing operations.

Standards of Performance for Stationary Compression Ignition Internal Combustion Engines (*Minnesota Rules*, part 7011.3520). The rule incorporates federal Standards of Performance for Stationary Compression Ignition Internal Combustion Engines under 40 CFR, Part 60, Subpart IIII. This may apply to fire water pumps and emergency generators that may be used in the mine processing operations.

Stationary Reciprocating Internal Combustion Engines (*Minnesota Rules*, part 7011.8150). The rule incorporates federal National Emissions Standards for Hazardous Air Pollutants under 40 CFR, Part 63, Subpart ZZZZ. This may apply to fire water pumps and emergency generators that may be used in the mine processing operations.

5.2.7.1.2 Evaluation Criteria

Various state and federal air quality standards and emissions standards have been established to minimize degradation of air quality. The criteria used for the evaluation of potential effects on air quality from the NorthMet Project Proposed Action or an alternative are whether it would cause an exceedance of NAAQS or MAAQS.

In addition to legally applicable statutory or regulatory requirements, the following criteria also were considered in evaluating effects from the NorthMet Project Proposed Action:

- Consumption of PSD increments as defined by the CAA Title I, PSD rule;
- Adverse effects on visibility in Class I areas;
- Adverse effects on other AQRV in Class I areas; and
- Adverse effects on human health as determined by an Air Emissions Risk Analysis (AERA) (MPCA 2013b).

5.2.7.1.3 NorthMet Project Proposed Action Emissions

From an air quality perspective, emissions from the NorthMet Project Proposed Action would be expected to occur from the mining operations at the Mine Site and ore/concentrate processing at the Plant Site. Although the emission generating activities at these two sites are separated geographically, they are joined by the rail line that would be used to transport ore from the Mine Site to the Plant Site. As such, the three components constitute a single project for permitting purposes, and, thus, the total emissions from both sites are summed for the purposes of this analysis.

The indirect non-GHG emissions from electrical purchases are not estimated for the NorthMet Project Proposed Action. If additional electrical capacity were required, then the electrical generating units would be subject to environmental permitting and regulation and would need to meet stringent emission limits for both criteria and non-criteria pollutants. In addition, no direct emissions of odor-causing compounds from the Mine Site or Plant Site are anticipated.

At the Mine Site, emissions were estimated for material handling sources associated with excavation, portable crushing and screening operations, blast hole drilling, use of unpaved roads, and vehicle exhaust.

Material handling includes the loading of overburden, waste rock, lean ore, and ore into trucks with shovels or loaders. After it is hauled, the ore would be dumped into the Rail Transfer Hopper and the overburden, waste rock, and lean ore would be unloaded at the appropriate stockpile or pit. The crushing and screening operations would be used to break up and separate the larger rocks from soil and gravel in the overburden to produce rock suitable for construction purposes. Haul trucks would travel over unpaved roads from the excavation site to the rail loading and stockpiling areas. Fugitive emissions would be generated as part of these operations. In order to minimize fugitive emissions, the NorthMet Project Proposed Action would utilize several control measures. These include minimization of drop distances for ore-screening, truck loading/unloading, and rail-loading; water and other dust suppressants on haul roads (90 percent control); water sprays for rock crushing and screening; down-hole watering during blasting operations; and environmental observations and recording. In addition, two PM_{10} monitors are proposed to minimize fugitive dust effects at the mine.

At the Plant Site, point source emissions are predicted to occur from the crushing plant, flotation operation autoclaves and other hydrometallurgical processes, process consumables handling, and combustion. In addition, fugitive emissions are expected to occur from raw materials handling, Plant Site roads, the Tailings Basin, and from vehicle use of Dunka Road. Water spraying or other dust suppression would be used on all unpaved roads at the Plant Site, resulting in an 80 percent reduction in associated fugitive emissions.

PolyMet is proposing to accept emission limits below the major source threshold (stationary sources less than 250 tpy for criteria pollutants and 100,000 tpy for GHGs) so as to be classified as a synthetic minor PSD source and therefore not be subject to PSD requirements including modeling attainment with PSD increments for permitting purposes. As demonstrated in Table 5.2.7-4, below, the NorthMet Project Proposed Action does not have projected controlled emissions above major PSD thresholds on an annual basis. PSD required modeling analyses, however, were performed for this FEIS to assess its effect to ensure that the minor-source NorthMet Project Proposed Action does not cause or contribute to significant effects.

Criteria Pollutants

Criteria pollutant emissions are expected from both the Mine Site and Plant Site. Detailed information on the emission calculations for each site source is available as separate documents (MPCA 2012e; PolyMet 2015e). Table 5.2.7-4 summarizes the NorthMet Project Proposed Action maximum emissions for the Mine Site, Plant Site, and total emissions from PSD-regulated stationary sources for comparison with PSD Major Source Thresholds.

Table 5.2.7-4 Annual Criteria Air Pollutant Emissions for Prevention of Significant Deterioration-regulated Stationary Sources

Pollutant	Plant Site Projected Controlled Emissions (tpy) (controlled potential)	Mine Site Projected Controlled Emissions (tpy) (controlled potential)	Total Projected Controlled Emissions (tpy) (controlled potential)	PSD Major Source Thresholds (tpy)
NO_x	117	5	122	250
SO_2	7	0.8	8	250
TSP	201	9	210	250
PM_{10}	192	4	196	250
$PM_{2.5}$	190	2	192	250
VOC	50	0.2	50	250
Lead	0	0	0	250
CO	127	2	129	250

[1] The Plant Site emissions shown in Table 5.2.7-4 are the basis for the air dispersion modeling an impact assessment for the Project; however, planned changes to the Plant Site unit operations and configuration result in lower emissions of all criteria pollutants; therefore, additional air dispersion modeling analysis is not necessary because the worst case emissions were modeled.

In accordance with PSD permitting requirements, for this assessment, mobile emissions and fugitive emissions sources are not included in the determination of a major source. Under PSD requirements, fugitive sources are only included if the stationary source is defined as one of 28 named source categories. The NorthMet Project Proposed Action is not included in any of the USEPA-listed source categories; therefore, fugitive sources are not included in the determination of a major source. However, to assess modeled air effects, mobile and fugitive emissions from the operations were evaluated. The non-PSD-regulated mobile source emissions and fugitive emissions are summed in Table 5.2.7-5. Due to the size of the ore rock being transported, the design of the railcars, and the short distance of transport from the Mine Site to the Plant Site, the ore fines are expected to be coarse in nature. Thus, no significant reactive airborne fugitive dust from the rail transport is expected (MDNR et al. 2011) and is not included in the fugitive emissions. Any spillage of the ore fines is expected to be within 2 meters of the rail line, along the path, and any effects of the reactive ore on the ground has been addressed in Section 5.2.3.

Table 5.2.7-5 Annual Air Pollutant Emissions for non-Prevention of Significant Deterioration-regulated Mobile Sources and Fugitive Sources

Pollutant	Plant Site Projected Controlled Emissions (tpy)	Mine Site Projected Controlled Emissions (tpy)	Total Projected Controlled Emissions (tpy)
NO_x	58	321	379
SO_2	0	2	2
PM_{10}	238	462	700
$PM_{2.5}$	31	77	108

Hazardous Air Pollutants Emissions

Small amounts of potentially toxic compounds, which are referred to as HAPs, are expected to be associated with the NorthMet Project Proposed Action. Table 5.2.7-6 provides the estimate of HAP emissions for the NorthMet Project Proposed Action stationary sources. These emission levels reflect potential emissions taking into account the proposed pollution control equipment for the NorthMet Project Proposed Action (controlled). As seen in the table, total emissions of a single HAP are below 10 tpy and the combined HAP emissions are below 25 tpy, indicating that the HAP emissions would not exceed USEPA major source thresholds for HAPs. Although HAP emissions from mobile sources were not included in the table to address emission thresholds, these emissions were used in assessing the potential effects on human health. The AERA itself is not limited to an assessment of HAPs, but is inclusive of any air toxic pollutant that screened in during the scoping process.

Table 5.2.7-6 Annual Hazardous Air Pollutant Emissions

Pollutant	Plant Site Projected Controlled Emissions (tpy) (controlled potential)	Mine Site Projected Controlled Emissions (tpy) (controlled potential)	Total Projected Controlled Emissions (tpy) (controlled potential)	Major Source Threshold (tpy)
Single HAP[1]	4	1	5	10
Combined HAPs	14	3	17	25

[1] Nickel is the HAP with the highest emissions for the Plant Site; manganese has the highest emissions at the Mine Site (2 tpy). Highest single HAP emissions for the NorthMet Project Proposed Action (Plant Site plus Mine Site) are the nickel emissions. Values in Table 5.2.7-6 reflect nickel emissions.

Greenhouse Gas Emissions

Direct and indirect GHG emissions would be associated with the NorthMet Project Proposed Action. Direct emissions are emitted from project sources; indirect emissions are from sources that are not part of the project, but are generated from activities that support the project (e.g., off-site electrical needs). These gases include primarily carbon dioxide (CO_2), N_2O, and methane

(CH_4). GHG emissions are estimated based upon their global warming potential and are expressed in carbon dioxide equivalents (CO_2e). Global warming potential is the relative effect a specific compound has on the overall global warming effects. The global warming potential factors for the three pollutants are 1, 310, and 21, respectively. For this assessment, the CO_2e is estimated by multiplying the specific emissions by its global warming potential factor and then summing the results. Table 5.2.7-7 summarizes the controlled direct GHG emissions for the NorthMet Project Proposed Action. As seen from the table, total direct GHG emissions are less than 100,000 tpy of CO_2e and would not exceed the USEPA major source thresholds for GHGs.

Table 5.2.7-7 Annual Greenhouse Gas Emissions for Prevention of Significant Deterioration-regulated Stationary Sources[2]

Pollutant	Plant Site Projected Controlled Emissions (tpy)	Mine Site Projected Controlled Emissions (tpy)	Total Projected Controlled Emissions (tpy)	Major Source Threshold (tpy)
CO_2	75,532	1,740	77,232	-
N_2O	0.9	0.08	1.0	-
CH_4	0.5	0.02	0.5	-
Total CO_2e[1]	**75,836**	**1,764**	**77,600**	**100,000**

[1] CO_2e is used to assess PSD applicability and considers only emissions from stationary sources. The PSD applicability is based on short tons of emissions and the Table 5.2.7-7 values are all in short tons per year.
[2] The values in Table 5.2.7-7 are not proposed permit limits.

Estimated annual maximum potential emissions of the NorthMet Project Proposed Action are based as it is currently proposed running at maximum capacity (potential) (see Table 5.2.7-7). Potential annual GHG emissions from the NorthMet Project Proposed Action, as opposed to maximum potential emissions, are shown below in Table 5.2.7-8. Potential emissions are the sum of direct and indirect GHG emissions. Potential GHG emissions from the NorthMet Project Proposed Action are calculated using The Climate Registry General Reporting Protocol (Climate Registry 2008) and the MPCA General Guidance for Carbon Footprint Development in Environmental Review (MPCA 2011e). Emissions are calculated using default emission factors for specific fuels from the two documents. The annualized carbon footprint is summarized in Table 5.2.7-8; the lifetime carbon footprint is provided in Table 5.2.7-9.

For this analysis, emission estimates for the direct and indirect source equipment used generally accepted emission factors and estimation methods from the World Resource Institute Greenhouse Gas Protocol Standard, the Intergovernmental Panel on Climate Change (IPCC), and the MPCA General Guidance on Carbon Footprint in Environmental Review (MPCA 2009d). Emissions estimates from secondary emissions sources generally utilized emissions factors that would represent estimates greater than actual values (high estimation) or best estimates of actual values based upon literature review (central tendency) (PolyMet 2015e).

Table 5.2.7-8 NorthMet Project Proposed Action Annual Greenhouse Gas Emissions

Pollutant	Potential Direct Emissions[1] (CO_2e – mtpy)[2]	Potential Indirect Emissions[3] (CO_2e – mtpy)	Potential Total Emissions (CO_2e – mtpy)
Mine Site Point Source	1,600	--	--
Mine Site Mobile Source	38,086	--	--
Plant Site Point Source	138,641	--	--
Plant Site Mobile Source	8,014	--	--
Terrestrial Carbon Loss	10,000		
Totals	**196,341**	**511,000**	**707,342**

[1] Maximum Potential Direct Emissions are all emissions from sources that are under direct control of the NorthMet Project Proposed Action and full maximum capacity.
[2] CO_2e is in metric tons per year (mtpy). Emission estimates are expressed as metric tons per year in Table 5.2.7-8 because that unit is the international discussion of CO_2e emissions.
[3] Indirect emissions: Emissions that are a consequence of the activities of the reporting entity, but that occur at sources owned or controlled by another entity. For example, emissions that occur at a power plant as a result of electricity being generated and subsequently used by the NorthMet Project Proposed Action.

Table 5.2.7-9 NorthMet Project Proposed Action Lifetime Greenhouse Gas Emissions

Pollutant	Potential Direct Emissions[1] (CO_2e – mt)[2]	Potential Indirect Emissions (CO_2e – mt)[6]	Potential Total Emissions (CO_2e – mt)
Mine Site Emissions[3]	793,734		
Plant Site Emissions[3]	2,933,181		
Construction Emissions[4]	94,186		
Reclamation Emission[5]	1,549,688		
Subtotals	**5,370,789**	**10,220,000**	**15,590,789**
Terrestrial Carbon Loss[7]	199,963	-	199,963
Totals	**5,570,752**	**10,220,000**	**15,790,752**

[1] Maximum Potential Direct Emissions are all emissions from sources that are under direct control of the NorthMet Project Proposed Action and full maximum capacity.
[2] CO_2e is in metric tons (mt).
[3] Based upon maximum annual emissions occurring for 20 years.
[4] Includes Phase I (flotation concentration production only) and Phase II (Hydrometallurgical Plant) construction.
[5] Based on 20-year closure period and 30-year long-term closure period for the WWTF and WWTP.
[6] Indirect emissions: Emissions that are a consequence of the activities of the reporting entity, but that occur at sources owned or controlled by another entity. For example, emissions that occur at a power plant as a result of electricity being generated and subsequently used by the NorthMet Project Proposed Action.
[7] Terrestrial carbon loss includes: wetland carbon loss, 20 years of emissions from stockpiled peat, and emission from peat used in reclamation.

5.2.7.1.4 Predictive Modeling Approach

Detailed air dispersion modeling was conducted to evaluate compliance with NAAQS and MAAQS, to support PSD increment analysis, and to identify other potential effects on Class I and Class II areas. Although the NorthMet Project Proposed Action is not considered a major source for PSD considerations, the modeling analysis was conducted pursuant to the PSD regulations. The methods used for modeling are summarized below.

<u>NAAQS, MAAQS, and Class II Increment Modeling Approach</u>

To assess the effects on air quality, air dispersion modeling techniques were utilized. The MPCA prefers the AERMOD modeling system, and USEPA has included AERMOD as an approved guideline model. Meteorological data (2006 to 2010) from the Hibbing station and concurrent International Falls mixing height data, suitable for input to AERMOD, were used to evaluate the NorthMet Project Proposed Action. The AERMINUTE meteorological processor was used to develop the meteorological dataset for AERMOD.

The air quality modeling addressed individual point sources, as well as all sources of fugitive particulate matter. The modeling was conducted to determine the extent of effects from criteria pollutant emissions on ambient air quality and to identify the significant impact area for each pollutant. Modeling was conducted for PM_{10}, $PM_{2.5}$, NO_2, and SO_2 and their respective applicable averaging times at both the Mine Site and Plant Site (PolyMet 2014m; PolyMet 2014n). Ozone emissions were not modeled or analyzed for NAAQS due to the regional nature of ozone formation involving complex interaction of multi-pollutants. It should be noted that ozone is not emitted directly from any mining or ore-processing source. Emissions of lead and CO were not modeled for the NorthMet Project Proposed Action following the MPCA-approved modeling protocols for the Plant Site and Mine Site. NorthMet Project Proposed Action emissions were initially modeled and compared to their respective Significant Impact Limit (SIL), as provided in Table 5.2.7-10 for each of the pollutants and averaging times. The SIL is the threshold for a given pollutant and averaging time, where no further modeling analysis is required. Modeled concentrations above the SIL do not define a significant effect in the context of the EIS; rather, where the modeled concentrations are above the SIL, more refined modeling is required in order to evaluate compliance with PSD increments and NAAQS. The farthest distance from the source where the concentration is above the SIL defines the circular region that would require further affect modeling.

All point and fugitive sources associated with the Mine Site and Plant Site were included in the source input files for PSD Class II increment modeling, with the exception of the Plant Site unpaved roads, which were in operation at the baseline date. Additionally, data on the following nearby major increment-consuming (or increment-expanding) sources, which were determined and provided by the MPCA, were also included as source input:

- Mesabi Nugget;
- Mesabi Mining Project;
- Cliffs Erie pellet yard; and
- Former LTVSMC processing plant.

It should be noted that the Northshore Mine was determined to be permitted before the PSD baseline date, and is not an increment-consuming source; therefore, it was not included in the increment modeling.

Model inputs for these sources were provided by the MPCA. For comparison to the NAAQS, a background concentration was added to the modeled concentration. PM_{10} background concentrations represent the 2008 to 2010, 3-year average concentrations for the high-second-high 24-hour concentration and maximum annual average concentration from the Virginia, Minnesota air quality monitoring site. $PM_{2.5}$ background concentrations represent the 2008-2010 average concentrations for the highest 2nd high (H2H) 24-hour and annual average concentrations from the same station. Hourly SO_2 and NO_2 background concentrations are from 2008-2010 MPCA update data for use in modeling assessments (MPCA 2012i) for sites outside Minneapolis.

Project design modifications were made to the NorthMet Project Proposed Action since modeling was undertaken. These modifications include the addition of a SAG Mill, relocation of the Coal Ash Landfill, installation of cement deep soil mixing, and construction of a water containment system on the eastern side of the Tailings Basin. The Co-lead Agencies considered information provided by PolyMet pertaining to these project modifications and determined that the existing air dispersion modeling was representative and additional modeling was not required for the EIS but may be required for permitting.

Class I Area-Related Modeling Approach

An air quality modeling analysis was conducted to estimate effects of the NorthMet Project Proposed Action on air quality in Class I areas. The Class I AQRV analyses addressed PSD Class I increments for SO_2, PM_{10}, NO_2, sulfur and nitrogen deposition, and visibility impairment. Regional haze is addressed in Section 6.2.3.8.8. The dispersion modeling analysis used standard USEPA long-range transport modeling methodologies and followed guidance as presented in: 1) USEPA's Guideline on Air Quality Models, the Interagency Workgroup on Air Quality Modeling Phase 2 report; 2) the Federal Land Managers' Air Quality Related Values Work Group (FLAG) Phase I report (revised November 2010); and 3) the "FLM Recommendations on Class I Area Analyses." The analyses also incorporated suggestions and guidance received from the USFS and the National Park Service. The California Puff (CALPUFF) air quality modeling system (version 5.8, June 23, 2007 release) was used for all Class I area analyses.

Input options and data utilized in the models generally corresponded to default or USEPA-recommended values along with representative, NorthMet Project Proposed Action-specific source input parameters. The CALPUFF modeling analysis used refined meteorological fields from the CALMET subprogram of CALPUFF, developed from the 5th Generation NCAR/Penn State Mesoscale Model prognostic meteorological data for the available years 2002, 2003, and 2004. These were refined using concurrent surface, upper air, and precipitation data as outlined in the Final SDD. CALMET settings were based on the USEPA Office of Air Quality Planning and Standards memorandum "Clarification on EPA-FLM Recommended Settings for CALMET" (August 31, 2009) (USEPA 2009a). Hourly surface data from approximately 88 stations and precipitation data from 99 stations were used along with upper air data from four stations. No cloud data were used.

Pollutant emissions modeled in CALPUFF were SO_2, NO_x, PMC (coarse particulate matter), PMF (fine particulate matter), elemental carbon, secondary organic aerosols, and SO_4. Additionally, the pollutants SO_4, NO_3, and HNO_3 were modeled as products of the chemical transformation of SO_2 and NO_x. For the AQRV analysis, the MESOPUFF II scheme was used for the chemical mechanism to compute chemical transformation rates based on user-supplied background values for ozone and ammonia. Per MPCA guidance, the MESOPUFF II algorithm and secondary particulate formation were not used in the PM_{10} increment consumption evaluation. Finally, the CALPOST and POSTUTIL post-processing programs were used to generate values of pollutant concentration, deposition, and visibility.

For the increment consumption analysis, emissions were modeled as the worst case over the expected life of the NorthMet Project Proposed Action. For the AQRV analysis, four emissions scenarios, representing emissions at different stages of the NorthMet Project Proposed Action, were modeled. The scenarios differ only in mobile source emissions (which were not included in the increment analysis). The effects of all four scenarios on visibility within the Class I areas are presented in Section 5.2.7.2.1.

5.2.7.2 NorthMet Project Proposed Action

This section describes effects that may occur on local and regional air quality from implementing the NorthMet Project Proposed Action. Potential effects on visibility that could occur from increases in project emissions are also discussed. The results of the modeling are used to represent an upper bound for assessing potential effects from the NorthMet Project Proposed Action.

5.2.7.2.1 NAAQS and Prevention of Significant Deterioration Increment Impact Analysis

State and federal air quality rules prohibit emissions from a new facility that cause or contribute to an exceedance of MAAQS or NAAQS. To demonstrate NorthMet Project Proposed Action effects relative to NAAQS and PSD increments, an air dispersion modeling analysis for the NorthMet Project Proposed Action was conducted (PolyMet 2014m; PolyMet 2014n; PolyMet 2015e).

Initial Significant Impact Limit Analysis

The Mine Site and Plant Site are located 8 miles apart, but are connected by a private railway that was originally constructed to transport iron ore pellets from Cliffs Erie's process plant to their ore dock. A portion of this railway is proposed to be used for the transportation of ore from the Mine Site to the Plant Site. Although the site may be permitted as a single facility, the Mine Site and Plant Site emission sources are not adjacent to each other but rather separated by a substantial (8 miles) distance. Therefore, it is appropriate and informative to perform individual air dispersion modeling for two distinct sets of receptors, one set surrounding the Mine Site and the second surrounding the Plant Site. For the Mine Site receptor grid, both Mine Site and Plant Site emissions were modeled explicitly. However, for the Plant Site receptor grid, only the emissions from the Plant Site were included, since previous modeling of the Mine Site emissions showed that effects were below the SIL in the region encompassing the Plant Site receptor grid. SILs have been established by the USEPA such that concentrations below these levels are not anticipated to contribute to a change in the overall effect when combined with other nearby source effects. The MPCA approved the exclusion of the Mine Site emissions in assessing the effects at the Plant Site receptor grid locations, as they would not likely contribute to a change in the overall effects. The results are discussed below.

The Plant Site PM_{10} emissions were modeled with all sources operating at full capacity in a single modeling run. This conservatively predicts (overestimates) the effects, as not all sources would be capable of operating simultaneously at full capacity. PM_{10} and $PM_{2.5}$ are the primary pollutants emitted from the Plant Site. Emissions of SO_2 and NO_x would be relatively small because the process is conducted at relatively low temperatures and would not include any continuously operating fuel combustion sources. The Mine Site emission rates are based on a daily average mining rate of 32,000 tons of ore.

Table 5.2.7-10 shows modeled effects at the Mine Site and Plant Site receptors compared to the SIL. The maximum modeled effects are maximums from either the Mine Site or the Plant Site analyses, since each analysis includes all NorthMet Project emissions, as defined above. The USEPA has developed SILs as a way to screen out, from further PSD analysis, pollutants that are not expected to cause any significant contribution to existing air quality levels. The emissions included are at 100 percent capacity for each averaging period.

The overall effects within the Plant Site receptor grid predicted higher maximum concentrations than the effects within the Mine Site receptor grid for all pollutants modeled. As seen in the table, maximum PM_{10} and $PM_{2.5}$ concentrations in both regions (and for all averaging periods) were above their respective SILs, so further analysis in those regions, for those pollutants, was conducted. For NO_2 and SO_2, the effects in the Plant Site receptor grid exceed their SILs for all averaging periods and additional analysis was conducted for this receptor region. The NO_2 and SO_2 effects in the Mine Site receptor grid are all below each respective SIL, and, thus, no additional analysis was conducted.

Table 5.2.7-10 Highest NorthMet Project Proposed Action Effects and Prevention of Significant Deterioration Class II Significant Impact Limits

Pollutant	Averaging Time	PSD Class II Significant Impact Limits (μg/m^3)	Plant Site Area Modeled Effects (μg/m^3)[1]	Mine Site Area Modeled Effects (μg/m^3)[1]
SO_2	1-hour	7.83	***103***	0.7
	3-hour	25	***85***	0.5
	24-hour	5	***35***	0.1
	Annual	2	***6***	0.01
PM_{10}	24-hour	5	***44***	***30***
	Annual	1	***12***	***6.3***
$PM_{2.5}$	24-hour	1.2	***17***	***10***
	Annual	0.3	***6***	***2.2***
NO_2	1-hour	7.52	***88***	5.3
	Annual	1	***3***	0.1

[1] Bold and italicized values exceed SIL.

Prevention of Significant Deterioration Class II Increment Analysis

Based upon the results of the SIL analysis, PSD Class II increment analyses were completed for PM_{10} for both the Mine Site and Plant Site receptor grid locations. In addition, a PSD Class II increment analysis was conducted for NO_2 and SO_2 only at the Plant Site receptors. Even though maximum $PM_{2.5}$ concentrations exceed the SILs, the minor source baseline date for increment analysis in St. Louis County has not been set. Therefore, no increment analysis can be conducted for this pollutant. However, modeling of $PM_{2.5}$ was conducted for comparison with the $PM_{2.5}$ NAAQS; the results are presented later in this section. The modeling included all NorthMet Project Proposed Action increment-consuming sources at maximum emission rates plus all nearby increment-consuming (and expanding) emissions sources, including the Cliffs Erie pellet yard, the former LTVSMC processing plant, and Mesabi Nugget. The results of the increment analyses are shown in Table 5.2.7-11, along with a comparison to the allowable Class II PSD increments.

Table 5.2.7-11 Results of Class II Prevention of Significant Deterioration Increment Analysis

Pollutant	Averaging Time	Plant Site Receptor Grid Modeled Effects (µg/m^3)$^{(1)(3)}$	Mine Site Receptor Grid Modeled Effects (µg/m^3)$^{(1)(3)}$	PSD Increment Limits (µg/m^3)
SO_2	3-hour	85	NA	512
	24-hour	35	NA	91
	Annual	6	NA	20
$PM_{10}$$^{(2)}$	24-hour	27	27	30
	Annual	-0.1	6	17
NO_2	Annual	3.2	NA	25

1 SO_2 concentrations were not modeled due to negligible incremental effect.
2 Modeled PM_{10} concentrations are based on operating scenarios at year 8 and year 13.
3 Plant Site modeled emissions include expansion credit and are evaluated at Plant Site boundary. Mine Site modeled emissions include Plant Site, Mesabi Nugget, Cliffs Erie pellet yard, and former LTVSMC processing plant and existing LTVSMC Tailings Basin.

The table displays the maximum predicted concentrations for each pollutant of concern and each averaging period for both the Mine Site and Plant Site receptor grid locations. Since the receptor grid locations for the Mine Site and Plant Site represent separate distinct regions, the maximum modeled effect for each modeling region is compared separately with the PSD Class II increment limit to assess potential significant effects. Overall, all modeled effects are below their respective PSD Class II limits; however, the maximum 24-hour PM_{10} effects in the Mine Site and Plant Site modeling regions approach the Class II increment (27 µg/m^3 versus 30 µg/m^3).

Mine Site Receptors Analysis

The PM_{10} modeling was conducted for two operating scenarios corresponding to the temporary stockpile phase and the in-pit disposal/stockpile reclamation phase that would occur over the 20-year life of the mine. The worst case years for temporary stockpile phase waste rock (year 8) and in-pit disposal (year 13) were chosen to represent the worst case for the entire mine life. Due to the low modeled concentrations and constant emission rates for NO_x and SO_2, only one scenario (year 8) was modeled for these two criteria pollutants. The modeling results for the Mine Site receptors, including sources from the haul road, material handling, mine pits, and diesel locomotives indicate that the highest modeled 24-hour H2H PM_{10} concentration was 27 µg/m^3 for the year 8 operating scenario and 29 µg/m^3 for the year 13 operating scenario (shown on Table 5.2.7.11). The H2H corresponds to not exceeding a standard more than once per year, as defined by the applicable standard. NO_2 and SO_2 effects from the NorthMet Project Proposed Action at the Mine Site were below the SILs, so no additional modeling including nearby sources was performed.

Plant Site Receptors Analysis

The Plant Site PM_{10} emissions were modeled with all sources operating at full capacity in a single modeling run (independent of operating year). This conservatively predicts (overestimates) the effects, as not all sources would be capable of operating simultaneously at full capacity. The operation at the Plant Site, including fugitive sources, building vents, limestone material handling, and vehicular traffic on unpaved roads results in a maximum increment concentration for PM_{10} of 27 µg/m^3 on the Plant Site boundary receptor grid, based on the 24-hour H2H modeling. Modeled effects for SO_2 and NO_x at the Plant Site receptors are also below the PSD Class II increments thresholds.

The data in Table 5.2.7-11 summarize the PSD increment modeling results and demonstrate that the NorthMet Project Proposed Action, in conjunction with all other neighboring PSD sources, would satisfy all state and federal increment requirements. The maximum concentrations for the Mine Site receptor grid and the Plant Site receptor grid are presented separately. Since the two receptor grids represent two separate AOCs, the maximum concentrations are not additive.

NAAQS and MAAQS Impact Analysis

The NAAQS modeling predicted the maximum effect of development at the Mine Site and Plant Site combined with activities at other regional sources. The highest total effects modeled, plus background concentrations, are compared to applicable MAAQS and NAAQS. Maximum emission rates were modeled for all NorthMet Project Proposed Action sources and key criteria pollutants (i.e., NO_x, SO_2, PM_{10}, and $PM_{2.5}$).

Table 5.2.7-12 summarizes the results of the NAAQS model analysis for the Mine Site and Plant Site separately and with both sites modeled together. The modeled concentration from either the Mine Site receptors or the Plant Site receptors was added to the ambient background to assess total effect, since, in each area, modeling analysis included the entire NorthMet Project area and nearby sources. The highest 6th high (H6H) PM_{10} concentration for the 5-year modeling period was used for comparison to the NAAQS PM_{10} 24-hour standard. The highest 8th high (H8H) 1-hour NO_2 and 24-hour $PM_{2.5}$ concentration for the 5-year modeling period was used for comparison to the NAAQS NO_2 1-hour standard and the $PM_{2.5}$ 24-hour standard, respectively. The H8H concentration represents the 98th-percentile daily maximum concentrations modeled over a 5-year period, as defined by each standard. The highest 4th high (H4H) 1-hour SO_2 concentration for the 5-year modeling period was used for comparison to the 1-hour SO_2 NAAQS. The H4H concentration represents the 99th-percentile daily maximum 1-hour concentrations modeled over a 5-year period, as defined by the standard. The H2H 3-hour and 24-hour SO_2 concentrations were used for comparison with the 3-hour and 24-hour SO_2 NAAQS. Maximum annual average concentrations for NO_2, SO_2, PM_{10}, and $PM_{2.5}$ were compared against their respective annual average NAAQS.

Mine Site

The analysis for the Mine Site included potential emissions from the nearby sources included in the NAAQS analysis, specifically Mesabi Nugget, Cliffs Erie Pellet Yard, Northshore Mine, and the Plant Site. The sources to the west of the Mine Site (Mesabi Nugget, Cliffs Erie Pellet Yard, and the Plant Site) were modeled collectively in a separate modeling run to determine their maximum modeled effect on the Mine Site receptor grid (PolyMet 2015b).

The PM_{10} NAAQS modeling results conservatively added the maximum modeled emissions from the Mine Site and Plant Site and the maximum modeled effect from the other nearby sources to background concentrations for comparison to the NAAQS. Cumulative modeling and further analyses for NO_2 and SO_2 were not performed because the NO_2 and SO_2 concentrations at the Mine Site were shown to be well below the SILs.

The maximum effects from the Mine Site analysis are slightly higher for PM_{10} and slightly lower for $PM_{2.5}$ than the effects from the Plant Site summarized below in Table 5.2.7-12. The maximum predicted annual $PM_{2.5}$ concentration (Mine Site contribution plus background) was 10 µg/m^3 or approximately 83 percent of the corresponding NAAQS. The maximum predicted 24-hour $PM_{2.5}$ concentration was 32 µg/m^3 or approximately 91 percent of the short-term $PM_{2.5}$ standard. All other predicted concentrations are at or below 60 percent of the allowable levels, which demonstrates compliance with MAAQS and NAAQS.

Table 5.2.7-12 Results of Class II NAAQS Modeling

Pollutant	Averaging Time	Maximum Modeled – Plant Site (µg/m^3)[1,2]	Maximum Modeled – Mine Site (µg/m^3)[1]	Total (µg/m^3)[2,3]	NAAQS and MAAQS (µg/m^3)
SO_2	1-hour	*109*	NA	109	1,300[(4)]
	1-hour	*109*	NA	*109*	196[(5)]
	3-hour	*97*	NA	97	915
	24-hour	*40*	NA	40	365
	Annual	*7*	NA	7	60
PM_{10}	24-hour	80	*88*	88	150
	Annual	*26*	29	29	50[(6)]
$PM_{2.5}$	24-hour	*34*	32	34	35
	Annual	*11*[(7)]	10	11	12
NO_2	1-hour	*177*	NA	*177*	188[(8)]
NO_2	Annual	*21*	NA	21	100

[1] Maximum concentrations include background.
[2] Concentrations exceeding the standard are bolded and italicized.
[3] Total concentration displayed is the maximum modeled concentration, from either the Plant Site receptors or Mine Site receptors, added to the background concentration.
[4] MAAQS for 1-hour SO_2.
[5] NAAQS for 1-hour SO_2.
[6] The annual NAAQS for PM_{10} was rescinded on October 17, 2006.
[7] The maximum modeled Plant Site concentration was calculated as the maximum design value as defined by the USEPA guidance (USEPA 2013).
[8] NAAQS for 1-hour NO_2.

Plant Site

The NAAQS modeling on the Plant Site ambient boundary included all Plant Site sources plus emissions from the Tailings Basin and unpaved roads. Maximum predicted concentrations were added to background values to calculate maximum ambient air concentrations. All predicted concentrations are below allowable levels, and the results demonstrate compliance with all MAAQS and NAAQS.

5.2.7.2.2 Prevention of Significant Deterioration Class I Modeling Analysis

Modeling analysis was conducted to assess the effects from the emissions of the NorthMet Project Proposed Action in four USEPA-designated Class I areas within the NorthMet Project area. Modeled effects were assessed against the PSD Class I Increment and AQRVs.

<u>Prevention of Significant Deterioration Class I Increment Modeling Results</u>

Maximum pollutant concentrations within the BWCAW, Voyageurs National Park, Isle Royale National Park, and Rainbow Lakes Wilderness Class I areas were estimated for each of three years and are provided in Table 5.2.7-13. As shown in the table, all of the concentrations, except for the maximum 24-hour PM_{10} concentration at BWCAW, are below their respective Class I SIL threshold. This indicates that the NorthMet Project Proposed Action contribution to increment consumption would be considered de minimis relative to other sources. The exceedance of the PM_{10} 24-hour Class I SIL at BWCAW triggers an additional cumulative modeling analysis, including all nearby increment consuming and expanding PM_{10} sources. The cumulative analysis for this pollutant and averaging period are discussed in Section 6.2.7.

Table 5.2.7-13 Summary of Prevention of Significant Deterioration Class I Increment Analysis

Pollutant	Averaging Period	Year Evaluated 2002	2003	2004	Max (µg/m^3)	Class I Inc (µg/m^3)	Class I SIL (µg/m^3)
Boundary Waters Canoe Area Wilderness							
SO_2	3-Hour	0.106	0.082	0.088	0.106	25	1
	24-Hour	0.020	0.025	0.021	0.025	5	0.2
	Annual	0.001	0.001	0.001	0.001	2	0.1
NO_2	Annual	0.037	0.036	0.029	0.037	2.5	0.1
PM_{10}	24-Hour	0.331	0.263	0.278	**0.331**	8	0.3
	Annual	0.016	0.020	0.015	0.020	4	0.2
Voyageurs National Park							
SO_2	3-Hour	0.014	0.010	0.020	0.020	25	1
	24-Hour	0.004	0.005	0.004	0.005	5	0.2
	Annual	0.000	0.000	0.000	0.000	2	0.1
NO_2	Annual	0.004	0.005	0.005	0.005	2.5	0.1
PM_{10}	24-Hour	0.072	0.131	0.081	0.131	8	0.3
	Annual	0.004	0.004	0.004	0.004	4	0.2
Isle Royale National Park							
SO_2	3-Hour	0.001	0.001	0.001	0.001	25	1
	24-Hour	0.001	0.000	0.000	0.000	5	0.2
	Annual	0.000	0.000	0.000	0.000	2	0.1
NO_2	Annual	0.002	0.001	0.001	0.002	2.5	0.1
PM_{10}	24-Hour	0.031	0.018	0.019	0.031	8	0.3
	Annual	0.002	0.001	0.001	0.002	4	0.2
Rainbow Lakes Wilderness							
SO_2	3-Hour	0.003	0.003	0.003	0.003	25	1
	24-Hour	0.001	0.001	0.001	0.001	5	0.2
	Annual	0.000	0.000	0.000	0.000	2	0.1
NO_2	Annual	0.002	0.002	0.002	0.002	2.5	0.1
PM_{10}	24-Hour	0.030	0.033	0.021	0.033	8	0.3
	Annual	0.002	0.001	0.002	0.002	4	0.2

In 2010, the USEPA promulgated a Class I increment for $PM_{2.5}$. However, the minor source baseline date for $PM_{2.5}$ has not been triggered for the NorthMet Project area. Therefore, a comparison of $PM_{2.5}$ concentration with the $PM_{2.5}$ Class I increment and SILs is not required and was not performed.

<u>Class I Areas – Air Quality Related Values Impact Analysis</u>

An air quality modeling analysis was conducted to estimate the effect of the NorthMet Project Proposed Action on air quality in Class I areas. The analysis addressed visibility impacts on the BWCAW, Rainbow Lakes Wilderness, Voyageurs National Park, and Isle Royale National Park.

The Class I AQRV analyses also included sulfur and nitrogen deposition and SO_2 effects on soils, water, and vegetation. The results are discussed below.

Class I Visibility Analysis

A visibility impact analysis was carried out for BWCAW, Voyageurs National Park, and Isle Royale National Park. The Rainbow Lakes Wilderness does not have an AQRV for visibility. The recommended methodology for assessing visibility impacts, according to FLAG guidance, involves the use of CALPOST to process the data on concentrations of pollutants from the CALPUFF modeling of 24-hour emissions. In CALPOST, a daily value of light extinction is defined by the concentrations of each pollutant that can affect visibility, taking into account the efficiency of each particle type in scattering light and the relative humidity, which influences the size of sulfates and nitrates. The FLM has established threshold changes in light extinction (Δb_{ext}) as a percentage of natural background that represent potential adverse effects on visibility. These thresholds are 5 percent (a potentially detectable change) and 10 percent (a level that may represent an unacceptable degradation). In the revised FLAG guidance of 2010, the FLM also lists a threshold of less than 5 percent as “presumptive no adverse impact” when compared to the highest 98^{th} percentile daily predicted impact.

The FLAG 2010 guidance indicates that CALPOST Method 8 is now the preferred visibility impact calculation method for Class I AQRV analysis. Method 8 uses Class I area-specific monthly average relative humidity to calculate light extinction. Method 8 also compares visibility impacts with the 20 percent best pristine days. The previous preferred methodology, Method 2, used the CALPUFF-generated hourly relative humidity data to calculate light extinction. Method 2 compares visibility impacts on annual average pristine conditions. Since previous NorthMet Project Proposed Action modeling used the FLAG 2000 guidance, NorthMet Project Proposed Action visibility impact results calculated using both Method 8 and Method 2 are presented below for comparison.

Table 5.2.7-14 presents results of the initial CALPUFF visibility analysis following the previous FLAG methodology, Method 2, for each NorthMet Project Proposed Action scenario. The maximum change in light extinction for Voyageurs National Park and Isle Royale National Park is below the 5 percent threshold with changes predicted at 4.50 percent and 1.23 percent, respectively. The maximum change in light extinction at the BWCAW for the three years modeled was predicted to be 11.08 percent. The data in Table 5.2.7-14 indicate that calculated visibility impacts greater than 5 or 10 percent could occur at some point within the BWCAW on a small number of days each year.

Table 5.2.7-14 Class I Area Visibility Results for NorthMet Project Proposed Action (Method 2 Analysis)

Class I Area and Meteorological Data Year	Days with ≥5% Visibility Impact	Days with ≥10% Visibility Impact	Maximum Δb_{ext} (%)
	Scenario 1		
BWCAW 2002/2003/2004	8/1/0	1/0/0	11.08/7.88/4.66
Voyageurs National Park 2002/2003/2004	0/0/0	0/0/0	2.28/4.50/2.76
Isle Royale National Park 2002/2003/2004	0/0/0	0/0/0	1.12/1.13/1.23
	Scenario 2		
BWCAW 2002/2003/2004	7/1/0	1/0/0	10.88/7.75/4.56
Voyageurs National Park 2002/2003/2004	0/0/0	0/0/0	2.23/4.41/2.72
Isle Royale National Park 2002/2003/2004	0/0/0	0/0/0	1.10/1.11/1.20
	Scenario 3		
BWCAW 2002/2003/2004	7/1/0	1/0/0	10.99/7.82/4.61
Voyageurs National Park 2002/2003/2004	0/0/0	0/0/0	2.26/4.46/2.74
Isle Royale National Park 2002/2003/2004	0/0/0	0/0/0	1.11/1.12/1.22
	Scenario 4		
BWCAW 2002/2003/2004	3/1/0	0/0/0	9.44/6.80/3.97
Voyageurs National Park 2002/2003/2004	0/0/0	0/0/0	1.84/3.80/2.39
Isle Royale National Park 2002/2003/2004	0/0/0	0/0/0	0.93/0.93/0.99

Table 5.2.7-15 presents results of the initial CALPUFF visibility analysis following the current FLAG methodology, Method 8, for each NorthMet Project Proposed Action scenario. Method 8 requires the eighth-highest visibility impact to be compared with the 5 percent and 10 percent thresholds. The eighth-highest changes in light extinction for the BWCAW, Voyageurs National Park, and Isle Royale National Park are below the 5 percent threshold with changes predicted at 4.86 percent, 1.11 percent, and 0.44 percent, respectively, and demonstrate no expected adverse visibility impacts compared to pristine conditions. These results of the NorthMet Project Proposed Action reflect emission reduction measures to reduce the potential for visibility impacts in the BWCAW, which include: upgrades to the insulation in the existing Crusher and Concentrator buildings, utilization of low-NO_x space heating equipment, a plan to phase in vehicles that meet Tier 4 emission standards, use of efficient gen-set locomotives, the reduction of dust collector exhaust for heating demand reductions, use of appropriate pollution control equipment, and use of lower emitting fuels where feasible.

Table 5.2.7-15 Class I Area Visibility Results for NorthMet Project Proposed Action (Method 8 Analysis)

Class I Area and Meteorological Data Year	98% Days with ≥5% Visibility Impact	98% Days with ≥10% Visibility Impact	8th Highest Δb_{ext} (%)
Scenario 1			
BWCAW 2002/2003/2004	0/0/0	0/0/0	4.86/3.92/3.85
Voyageurs National Park 2002/2003/2004	0/0/0	0/0/0	0.89/1.11/0.97
Isle Royale National Park 2002/2003/2004	0/0/0	0/0/0	0.44/0.21/0.23
Scenario 2			
BWCAW 2002/2003/2004	0/0/0	0/0/0	4.74/3.83/3.80
Voyageurs National Park 2002/2003/2004	0/0/0	0/0/0	0.85/1.09/0.96
Isle Royale National Park 2002/2003/2004	0/0/0	0/0/0	0.43/0.19/0.22
Scenario 3			
BWCAW 2002/2003/2004	0/0/0	0/0/0	4.80/3.87/3.83
Voyageurs National Park 2002/2003/2004	0/0/0	0/0/0	0.86/1.09/0.97
Isle Royale National Park 2002/2003/2004	0/0/0	0/0/0	0.43/0.20/0.22
Scenario 4			
BWCAW 2002/2003/2004	0/0/0	0/0/0	4.21/3.45/3.42
Voyageurs National Park 2002/2003/2004	0/0/0	0/0/0	0.74/0.97/0.82
Isle Royale National Park 2002/2003/2004	0/0/0	0/0/0	0.36/0.17/0.19

Effects on Soils, Waters, and Vegetation

<u>*Deposition of Nitrogen and Sulfur*</u>

Potential effects on soils, waters, and vegetation in Class I areas due to deposition of sulfur and nitrogen were evaluated based upon model-predicted annual deposition for the NorthMet Project Proposed Action emissions from the Mine Site and Plant Site. Impacts were evaluated according to the USFS publication “Screening Procedures to Evaluate Effects of Air Pollution on Eastern Wildernesses Cited as Class I Air Quality Areas.” Criteria for assessment of deposition impacts are different for USFS areas (BWCAW and Rainbow Lakes Wilderness) and National Park System areas (Voyageurs National Park and Isle Royale National Park). The National Park Service has established a Deposition Analysis Threshold (DAT) of 0.01 kilograms per hectare per year (kg/ha/yr) for both sulfur and nitrogen deposition for Class I areas in the eastern United States. The DAT is a level below which adverse effects from a new or modified source are not anticipated and are considered insignificant. The USFS has established Green Line Values for assessing impacts of deposition at BWCAW and Rainbow Lakes Wilderness, which account for soil conditions and water chemistry in development of safe levels. The Green Line values represent the total pollutant loading below which there are no adverse effects (PolyMet 2015e). As such, for BWCAW and Rainbow Lakes Wilderness, background deposition levels are added to the maximum NorthMet Project Proposed Action impacts from all scenarios to assess against Green Line Values. The current background nitrogen deposition for Rainbow Lakes Wilderness

(5.88 kg/ha/yr) is at the Green Line Value range for nitrogen (5 to 8 kg/ha/yr). All other background deposition values for BWCAW and Rainbow Lakes Wilderness are below their respective Green Line Values (see Table 5.2.7-16).

The CALPUFF results for each of the Class I areas were processed with CALPOST to calculate total annual deposition of sulfur and nitrogen at each receptor as a result of the NorthMet Project Proposed Action maximum annual average emissions. Total sulfur deposition is calculated from the wet (rain, snow, fog) and dry (particle, gas) deposition of SO_2 and sulfate; total nitrogen is represented by the sum of nitrogen from wet and dry fluxes of nitric acid, nitrate, ammonium sulfate, and ammonium nitrate, and the dry flux of NO_x.

Terrestrial effects of nitrogen and sulfur deposition for the Class I areas are shown in Table 5.2.7-16. As stated earlier, Green Line Values (Wilderness Areas) are compared to the maximum modeled NorthMet Project Proposed Action deposition plus background; the DAT values (National Parks) are compared to the modeled NorthMet Project Proposed Action effects only. As seen from the table, the maximum predicted total sulfur and nitrogen deposition are all below Green Line Value ranges for BWCAW. The maximum predicted total sulfur deposition is also below the Green Line Value for Rainbow Lakes Wilderness. However, the maximum predicted total nitrogen deposition at Rainbow Lakes Wilderness (5.9 kg/ha/yr) is within the Green Line Value range of 5 to 8 kg/ha/yr. The nitrogen deposition contribution from the NorthMet Project Proposed Action emissions is 0.02 percent of the total nitrogen deposition impact (0.001 kg/ha/yr). Table 5.2.7-16 also compares the ambient annual and 3-hour SO_2 concentrations due to the NorthMet Project Proposed Action to the Green Line Values. Modeled concentrations of SO_2 in both wilderness areas are below the Green Line Values for SO_2 concentration.

Finally, Table 5.2.7-16 compares terrestrial impacts of sulfur and nitrogen deposition in the Class I areas to the DAT values. The maximum predicted total sulfur and nitrogen values are below the DAT value of 0.01 kg/ha/year.

Table 5.2.7-16 Terrestrial Effects of Annual Deposition of Sulfur and Nitrogen from the NorthMet Project Proposed Action in Class I Areas

Class I Area	**Proposed Action Effects**	**Background Level**	**Total (Proposed Action + Background)**	**Terrestrial Green Line Value**	**Deposition Analysis Threshold**
BWCAW					
Annual avg. SO_2 ($\mu g/m^3$)	0.001	1.2	1.2	5 $\mu g/m^3$	NA
3-hour max. SO_2 ($\mu g/m^3$)	0.105	10.8	10.9	100 $\mu g/m^3$	NA
Sulfur (kg/ha/yr)	0.000	2.85	2.9	5-7 kg/ha/yr	NA
Nitrogen (kg/ha/yr)	0.009	4.75	4.8	5-8 kg/ha/yr	NA
Rainbow Lakes Wilderness					
Ann. avg. SO_2 ($\mu g/m^3$)	0.000	1.6	1.6	5 $\mu g/m^3$	NA
3-hour max. SO_2 ($\mu g/m^3$)	0.003	14.4	14.4	100 $\mu g/m^3$	NA
Sulfur (kg/ha/yr)	0.000	2.98	3.0	5-7 kg/ha/yr	NA
Nitrogen (kg/ha/yr)	0.000	5.88	5.9	5-8 kg/ha/yr	NA
Isle Royale National Park					
Sulfur	0.000	NA	NA	NA	0.01 kg/ha/yr
Nitrogen	0.000	NA	NA	NA	0.01 kg/ha/yr
Voyageurs National Park					
Sulfur	0.000	NA	NA	NA	0.01 kg/ha/yr
Nitrogen	0.001	NA	NA	NA	0.01 kg/ha/yr

Table 5.2.7-17 summarizes the aquatic effects from sulfur and nitrogen deposition for the Class I areas. Green Line Values for aquatic effects at the wilderness areas are based upon total sulfur deposition, as well as total sulfur deposition plus 20 percent of the total nitrogen deposition (sulfur + 20 percent nitrogen). Maximum predicted values for these two measures for all scenarios were below the Green Line Value ranges for BWCAW. The maximum predicted total sulfur deposition and total sulfur plus 20 percent nitrogen deposition for Rainbow Lakes Wilderness are just below the Green Line Value, and nearly all of the effects are associated with the current background level. Aquatic effects at the National Parks are also compared to the DAT values. The modeled maximum annual nitrogen and sulfur deposition effects due to the NorthMet Project Proposed Action have levels below the respective National Park Service DAT levels for both Voyageurs National Park and Isle Royale National Park. The highest effects are predicted in Voyageurs National Park, with values approximately one-tenth of the incremental DAT level for sulfur and one-fifth of the incremental nitrogen DAT level.

Table 5.2.7-17 Aquatic Effects of Deposition of Sulfur and Nitrogen from the NorthMet Project Proposed Action in Class I National Park Areas

Class I Area	Proposed Action Effects (kg/ha/yr)	Background Level (kg/ha/yr)	Total (Proposed Action + Background) (kg/ha/yr)	Aquatic Green Line Value (kg/ha/yr)	Deposition Analysis Threshold (kg/ha/yr)
BWCAW					
Total Sulfur	0.000	2.85	2.85	7.5-8.0	NA
Total S + 20% of Total N	0.002	3.80	3.80	9-10	NA
Rainbow Lakes Wilderness					
Total Sulfur	0.000	2.98	2.98	3.5-4.5	NA
Total S + 20% of Total N	0.000	4.16	4.16	4.5-5.5	NA
Isle Royale National Park					
Total Sulfur	0.000	NA	NA	NA	0.01
Total N	0.000	NA	NA	NA	0.01
Voyageurs National Park,					
Total Sulfur	0.000	NA	NA	NA	0.01
Total N	0.001	NA	NA	NA	0.01

<u>SO_2 Effects on Flora and Fauna</u>

Potential SO_2 effects on flora and fauna in Class I areas were evaluated using the model-predicted concentrations from NorthMet Project Proposed Action emissions. The USFS has set screening criteria for potential air pollution effects on vegetation for SO_2 as a total annual average ambient concentration of 5 $\mu g/m^3$. As stated earlier, Green Line screening values "were set at levels at which it was reasonably certain that no significant change would be observed in ecosystems that contain large numbers of sensitive components."

Though the USFS screening levels were established specifically for Class I areas administered by the USFS (i.e., BWCAW and Rainbow Lakes Wilderness) the same criteria were applied to Voyageurs National Park and Isle Royale National Park, which are administered by the National Park Service but do not have published standards similar to the USFS. Table 5.2.7-18 compares maximum CALPUFF NorthMet Project Proposed Action impacts from all scenarios and existing background concentrations to the Green Line screening levels for each Class I area. The summation of the NorthMet Project Proposed Action and background contributions is well below the Green Line levels so no threat to sensitive vegetation in Class I areas is expected from direct SO_2 emissions produced by the NorthMet Project Proposed Action.

There are no established screening criteria for NO_2 and PM_{10} for effects on flora and fauna. As shown in Class I increment modeling results (PolyMet 2015e), modeled maximum annual concentrations of NO_2 and PM_{10} from the NorthMet Project Proposed Action are below the secondary NAAQS standards (protecting vegetation), so it is not expected that there would be impacts on the Class I areas from these pollutants.

Table 5.2.7-18 Comparison of Projected Class I SO_2 Concentrations to Green Line Screening Criteria for Vegetation Effects

Class I Area	Background Air Concentration (μg/m^3)	Max. Modeled Proposed Action Contribution (μg/m^3)	Total Proposed Action Air Concentration (μg/m^3)	Green Line Concentration (μg/m^3)
	Annual	Annual	Annual	Annual
BWCAW	1.2	0.001	1.2	5
Isle Royale National Park	2.0	0.000	2.0	5
Rainbow Lakes Wilderness	1.6	0.000	1.6	5
Voyageurs National Park	0.7	0.000	0.7	5

5.2.7.2.3 Potential Estimated Human Health Risk from the Plant and Mine Sites Air Emissions

This section includes the assessment of potential human health effects from the NorthMet Project Proposed Action. Separate AERAs were conducted for the Mine Site and Plant Site due to the large distances (approximately 6 miles) between the Mine Site and Plant Site sources. It should be noted that AERAs from the Mine Site and Plant Site are also considered cumulatively in Section 6.7.5.

Estimations of additional lifetime cancer risk, potential for non-cancer effects from chronic exposures, and potential non-cancer health effects from short-term exposures were conducted for hypothetical residents, farmers, off-site workers, and/or for short-term visitors. The hypothetical individuals were assumed to breathe outdoor air for the entire exposure duration. Inhalation exposures were assessed for an approximate lifetime (approximately 70 years) for the resident and farmer; a maximum hour for the short-term visitor; and 8-hour days, 250 days per year for 25 years for the off-site worker (USEPA 1993). Hypothetical short-term and off-site worker ingestion exposures were not assessed. The farmer ingestion exposure was assessed for a 40-year duration and the resident ingestion exposure was assessed for a 30-year duration. When both ingestion and inhalation risks were assessed, these were summed for a total multi-pathway risk. This screening procedure is conservative and is intended as a regulatory tool to define whether more detailed analysis is warranted rather than estimating risk levels for actual individuals.

<u>Mine Site Air Emissions Risk Analysis</u>

An AERA was conducted for the Mine Site in January 2008 for the DEIS. A Supplemental AERA was conducted as part of the project changes defined with the current NorthMet Project Proposed Action (Barr 2013i). The screening human health risk analysis followed the MPCA-accepted November 2011 Work Plan (PolyMet 2015e). Sulfuric acid aerosol emissions were screened out of the quantitative assessment for potential acute inhalation effects by scaling the Plant Site 2005 modeled acute inhalation hazard quotients to the current potential sulfuric acid emissions. As identified in the Mine Site AERA, the quantitative evaluation identified 11 chemicals for evaluation (CFEs), which are summarized in Table 5.2.7-19. The identified CFEs include six risk-driver chemicals from the 2008 AERA (dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene, manganese compounds, nickel compounds, NO_2, and dioxins/furans). The remaining five compounds are from the 2008 AERA that now have toxicity values (acetaldehyde, arsenic compounds, cobalt compounds, crystalline silica, and diesel particulate).

Table 5.2.7-19 Chemicals for Evaluation of the Incremental Human Health Risk Assessment for the Mine Site

Chemical	Total Mine Site Maximum Hourly Emission Rate (Year 8) (g/sec)	Total Mine Site Annual Emission Rate (Year 8) (g/sec)	Total Mine Site Maximum Hourly Emission Rate (Year 13) (g/sec)	Total Mine Site Annual Emission Rate (Year 13) (g/sec)
Acetaldehyde	2.44E-05	1.40E-06	2.44E-05	1.40E-06
Arsenic	0.0013	0.0004	0.0014	0.0005
Cobalt	0.0036	0.0025	0.0040	0.0027
Crystalline Silica	0.5820	0.3952	0.6467	0.4339
Dibenzo(a,h)anthracene	2.92E-06	2.57E-06	2.92E-06	2.57E-06
Diesel Particulate Matter	0.2276	0.2237	0.2276	0.2237
Indeno(1,2,3-cd)pyrene	3.41E-06	2.99E-06	3.41E-06	2.99E-06
Manganese	0.0638	0.0450	0.0702	0.0488
Nickel	0.0245	0.0152	0.0266	0.0166
Oxides of Nitrogen	12,5173	9.2554	12,5173	9.2254
Dioxins/Furans (as 2,3,7,8-TCDD TEQ)	4.12E-10	3.73E-10	4.12E-10	3.73E-10
Number of CFEs	11			

g/sec = gram(s) per second

Estimations of additional lifetime risk and potential non-cancer effects from chronic (long-term) exposures were conducted for both inhalation and ingestion exposures for the hypothetical resident and farmer. The resident is assumed to inhale outdoor air and ingest soil and produce grown at a site of maximum air concentration. The farmer scenario assumed inhalation of outdoor air and ingestion of soil and produce, and also includes ingestion of meat and dairy products grown at the location of maximum air concentration.

Air dispersion modeling was conducted for the Mine Site to estimate maximal annual and hourly air concentrations for the CFE using the AERMOD model with 5 years of hourly meteorological data from the Hibbing weather station. The assessment was conducted for the years 8 and 13, which were determined to be the years of highest air emissions. Direct (inhalation) and indirect (ingestion) risk estimates were made for inhalation and bioaccumulative toxic pollutant ingestion, respectively, using the MPCA Risk Analysis Screening Spreadsheet, which estimates potential incremental cancer and noncarcinogenic human health effects for long-term exposures.

Acute inhalation risks were estimated for the ambient air at and beyond the Mine Site property boundary (see Large Figure 4 in PolyMet 2015e). Because of the historical and present mining and industrial land use around the Mine Site, the reasonable future land use for residential and farming was considered in assessing chronic risks for areas (i.e., receptors) outside of the Mineral Mining/Industrial District air boundary (see Large Figure 5 in PolyMet 2015e). The Mineral Mining/Industrial District air boundary encompasses an area approximately 1 km beyond the Mine Site air boundary and no farmers or residents are expected to be present within this area either presently or for the foreseeable future.

The results of the Mine Site assessment demonstrate that the chronic additional lifetime cancer and non-cancer effects, as well as the potential acute non-cancer health effects from direct exposure (inhalation) at the Mine Site property boundary for off-site workers were below guidance levels (PolyMet 2015e). The MEI inhalation pathway additional lifetime cancer risk at the Mine Site ambient air boundary was estimated from the assessment of year 13 emissions with a maximum value of 5E-06, which is below the MDH guideline value of 1E-05. The maximum potential sub-chronic and acute non-cancer risk estimates were calculated to be 0.2 and 0.8 respectively, which are both below the guidance level of 1.0.

The multi-pathway cancer risk for the hypothetical farmer was estimated to be 1E-05. This is at the MDH additional lifetime cancer risk guidance level of 1E-05. The major risk drivers were dioxins and dibenzo(a,h)anthracene associated with potential emissions from mine vehicles. It should be noted that maximum multi-pathway additional lifetime cancer risk is located at the Mining/Industrial District boundary. The nearest small farms are located 6.5 miles from the Mine Site.

The multi-pathway additional lifetime cancer risk for a hypothetical nearby resident at the Mining/Industrial District boundary was 8E-07, which is below the MDH guidance value of 1E-05. The major risk drivers for cancer endpoints for this receptor were nickel compounds, arsenic compounds, and dioxins.

The non-cancer chronic multi-pathway hazard indices (HIs) for the farmers and residents were each calculated to be 0.04, which is below the MDH guidance value of 1.0. Due to the variation (i.e., each compound has a unique concentration where health effects are expected for a target organ) in estimating the health effects for noncarcinogenic effects, the HI is the sum of the individual ratios of the maximum concentration divided by the chemicals' health benchmark. This ratio is then compared to a general guidance value of 1.0. Thus, the chronic non-cancer results for both the hypothetical farmer and resident were approximately 4 percent of the guidance value where health effects become more likely to occur.

The acute non-cancer HI was predicted at the Mine Site operating boundary with a value of 0.8, as compared to the MDH's acute HI guidance level of 1.0. This screening value sums all of the acute HIs for all pollutants regardless of their toxic endpoint (specific target organ) and the specific locations of maximum modeled air concentrations of the compounds. The risk driver for acute inhalation was NO_2 from the diesel fuel combustion. When adjusting HIs for the various locations of the maximum modeled annual average air concentration for risk-driver pollutants (i.e., risk-driver pollutant concentrations differ in space), the maximum acute HI for the off-site worker was reduced to 0.8, below the acute guidance level. Table 5.2.7-20 provides a summary of the Mine Site risk assessment.

Table 5.2.7-20 Summary of the Incremental Human Health Risk Assessment for the Mine Site

Exposure Route	Exposure Scenario	Location and Type of Receptor	Potential Non-cancer Health Effects (HI)[1]	Potential Cancer Effects (Risk Estimate)[2]
Inhalation Exposure Only	Acute (1-hour)	Mine Site Property Boundary	0.80	NA
	Chronic (~lifetime)	Mine Site Property Boundary	0.20	5E-06
Multi-pathway Exposure	Chronic (~lifetime)	Farmer	0.04	1E-05
		Resident	0.04	8E-07

[1] HI is the sum of individual non-cancer chemical quotients for acute or chronic exposure. Incremental non-cancer (chronic and acute) guideline value is 1.0.
[2] Potential human health risks from carcinogenic chemicals (summed for all chemicals) were estimated using the MPCA's Risk Assessment Screening Spreadsheet. Incremental cancer risk guideline value is 1E-05.

<u>Plant Site Air Emission Risk Analysis</u>

As with the Mine Site, an AERA was conducted for the Plant Site and results were reported in the scoping EAW (May 2005). The 2005 AERA included specific chemicals for potential evaluation as defined in MPCA's AERA Guidance (MPCA 2004). NorthMet Project Proposed Action changes since May 2005 resulted in the AERA being revised for the DEIS. A Supplemental AERA was conducted, as part of the changes defined with the FEIS NorthMet Project Proposed Action (PolyMet 2015e) and although some project modifications have been made to the Plant Site since the SDEIS (Section 3.2), the Supplemental AERA is adequate for the FEIS (PolyMet 2015e). The screening human health risk analysis followed the MPCA-accepted August 2011 Work Plan (PolyMet 2015e). Sulfuric acid aerosol emissions were screened out of the quantitative assessment for potential acute inhalation effects by scaling the 2005 modeled acute inhalation hazard quotients to the current potential sulfuric acid emissions. As identified in the Plant Site AERA, the quantitative evaluation identified 10 CFEs, which are summarized in Table 5.2.7-21. The identified CFEs include three risk-driver chemicals from the 2007 AERA (arsenic compounds, nickel compounds, and NO_2) and four compounds from the 2007 AERA that now have toxicity values (acetaldehyde, cobalt compounds, crystalline silica, and diesel particulate). The remaining three were added either because of increased emissions (hydrochloric acid and manganese) or new emissions from mobile diesel sources included in the analysis (dioxins/furans).

Table 5.2.7-21 Chemicals for Evaluation of the Incremental Human Health Risk Assessment for the Plant Site

Chemical	**Maximum Hourly Emission Rate 2012 (g/sec)**	**Annual Emission Rate 2012 (g/sec)**
Acetaldehyde	1.66E-05	9.49E-07
Arsenic	3.03E-03	7.75E-04
Cobalt		5.44E-03
Crystalline Silica		1.30E+00
Diesel Particulate Matter		4.47E-02
Hydrochloric Acid	2.45E+00	2.90E-02
Manganese		5.91E-02
Nickel	1.33E-01	1.36E-01
Oxides of Nitrogen	1.10E+01	
Dioxins/Furans (as 2,3,7,8-TCDD TEQ)		1.12E-10
Number of CFEs		10

g/sec = gram(s) per second

Similar to the Mine Site AERA, air dispersion modeling was conducted to estimate air concentrations for the CFE, using the AERMOD model with 5 years of hourly meteorological data from the Hibbing weather station. Direct and indirect risk estimates were made for inhalation and bioaccumulative toxic pollutant ingestion, respectively, using the MPCA Risk Analysis Screening Spreadsheet, which estimates potential incremental cancer and noncarcinogenic human health risks for both acute and long-term effects.

Acute risks were estimated for the ambient air at and beyond the NorthMet Project area ownership boundary for off-site workers. Because of the historical and present mining and industrial land use around the Plant Site, the reasonable future land use for residential and farming was considered in assessing chronic risks for areas (i.e., receptors) outside of the former LTVSMC processing plant air boundary. The former LTVSMC processing plant ambient air boundary encompasses most of the industrial land use in the Hoyt Lakes area and no farmers or residents are expected to be present within this area for the foreseeable future.

Initially, a screening level human health risk is conducted where all CFEs maximum concentrations are assumed to occur at the same location. A refinement to the risk assessment is the calculation of maximal potential health effects paired in both space and time. That is, when the health effect impacts are calculated for all pollutants at each receptor and meteorological condition modeled. The results of the Plant Site assessment demonstrate that the chronic additional lifetime cancer and noncarcinogenic effects are at or below guidance levels and the acute noncarcinogenic health effects are also below the guidance level, when adjusted for locational differences (PolyMet 2015e).

The multi-pathway (ingestion and inhalation) additional lifetime cancer risk at the former LTVSMC processing plant ambient air boundary was estimated to be 1E-05 for farmers and 5E-06 for a hypothetical nearby residents, which is below the MDH guidance level value of 1E-05. Similarly, the off-site worker inhalation additional lifetime cancer risk at the NorthMet Project area boundary was predicted at 1E-05, also at the MDH additional lifetime cancer risk guidance level. The major risk drivers for these estimated cancer endpoints were cobalt, nickel, and dioxins/furans (farmers only).

The non-cancer chronic multi-pathway HI for the farmers and residents were each calculated to be 0.2, primarily from the potential nickel emissions. Due to the variation (i.e., each compound has a unique concentration where health effects are expected for a target organ) in estimating the health effects for noncarcinogenic effects, the HI is the sum of the individual ratios of the maximum concentration divided by the chemicals' reference exposure level and compared to a general guidance value for chronic HI as 1.0. Thus, the chronic non-cancer results for both the hypothetical farmer and resident were approximately 20 percent of the chronic guidance level, below which health effects would not occur. The chronic HI for the hypothetical off-site worker was estimated to be 1, which is at the chronic guidance level.

The acute inhalation HI at the former LTVSMC processing plant ambient air boundary was 0.5, as compared to the MDH's acute HI guidance level of 1.0. This boundary was the location assessed in consideration of a potential resident. This HI is a summation of all of the acute hazard quotients for all pollutants regardless of their toxic endpoint (specific target organ) and the specific locations of maximum modeled air concentrations of the compounds. The risk drivers for the acute inhalation pathway at the location of a potential resident were NO_2 emissions from the natural gas combustion and nickel from the Hydrometallurgical Plant. When adjusting HIs for the various locations of the maximum modeled annual average air concentration for risk-driver pollutants (i.e., risk-driver pollutant concentrations differ in space), the acute inhalation HI for the off-site worker was 1.0, at the acute guidance level. Table 5.2.7-22 provides a summary of the Plant Site risk estimates.

Table 5.2.7-22 Summary of the Incremental Human Health Risk Impacts for the Plant Site

Exposure Route	**Exposure Scenario**	**Location and Type of Receptor**	**Potential Non-cancer Health Effects (HI)[1]**	**Potential Cancer Effects (Risk Estimate)[2]**
Inhalation Exposure Only	Acute (1-hour)	Off-Site Worker Plant Site Property Boundary	1.0	NA
	Acute (1-hour)	Resident at former LTVSMC ambient air boundary	0.5	NA
	Chronic (~ lifetime)	Plant Site Property Boundary	1.0	1E-05
Multi-pathway Exposure	Chronic (~ lifetime)	Farmer	0.2	1E-05
		Resident	0.2	5E-06

[1] HI is the sum of individual non-cancer chemical risks for acute or chronic exposure. Incremental non-cancer (chronic and acute) guideline value is 1.0.
[2] Potential human health risks from carcinogenic chemicals (summed for all chemicals) were estimated using the MPCA's Risk Assessment Screening Spreadsheet. Incremental cancer risk guideline value is 1E-05.

5.2.7.2.4 Greenhouse Gases Impact Analysis

The science, policy, and regulatory frameworks regarding GHGs are continually evolving and are often subject to differing interpretation. For the purposes of the FEIS, the information presented below is intended to provide the current understanding through June 15, 2012 with subsequent information regarding climate change updated in the FEIS.

Global Effects

According to the IPCC, since preindustrial times, human activities, particularly the burning of fossil fuels, have resulted in increases in the concentrations of GHGs in the earth's atmosphere (Solomon et al. 2007). It is estimated that 40 percent of a pulse emission of CO_2 remains in the atmosphere for approximately 100 years. Approximately 15 to 30 percent of the emissions are expected to remain after 1,000 years and 10 to 15 percent are expected to remain after 10,000 years. The estimated mean lifetime of emitted fossil CO_2 is between 30,000 and 50,000 years (Archer 2005). As such, the atmospheric GHG levels are likely to continue to rise over the next few decades. GHGs absorb in the infrared part of the electromagnetic spectrum. At elevated atmospheric concentrations, they act to warm the lower atmosphere and surface of the earth. The IPCC's most recent report (Solomon et al. 2007) found that, under a business-as-usual scenario, globally averaged surface temperature would increase 2.5 to 10.4°F between 1990 and 2100.

Globally, an "unequivocal" warming of 1.3°F (plus or minus 0.3°F) occurred between 1905 and 2005 (Solomon et al. 2007). Other data have shown that the global average temperature has increased by about 1.2 to 1.4°F since 1890, with the 14 warmest years of the past century occurring between 1997 and 2012 (Hansen et al. 2013). The observed increases in global average surface temperature may also be seen in the records of average annual temperatures at the regional and state level. Over the past century, temperatures in the United States have risen at an average rate of 0.11°F per decade, with the past 25 years showing temperature increases of approximately 0.56°F per decade (NOAA 2007). The annual average temperature of Minnesota has increased approximately 1°F in the last century, from 43.9°F (1888 to 1917 average) to 44.9°F (1963 to 1992 average) (MPCA 2009a). The winter season has brought even more dramatic increases of up to five degrees in parts of northern Minnesota (MPCA 2009a). Much of the warming observed in Minnesota has occurred over the last few decades. The observed rate and total increase in temperatures appear more extreme when the more recent years on record are averaged.

Climate changes can involve changes in temperature as well as changes in other meteorological conditions, such as precipitation patterns and shifts in seasons. These changes could affect forest ecosystems, water resources, other unique ecosystems, agriculture, and human health over the next century. Future emissions scenarios, using an ensemble of results from multiple global climate models, suggest an increase in annual precipitation of 10 to 15 percent over the next 70 to 90 years in the Great Lakes Region (USGCRP 2009), although regional results from these models are more uncertain than global results. The current modeling also suggests that winter and spring precipitation would increase 20 to 25 percent; summer rainfall declines 5 to 10 percent in the model results.

Although the degree of effect is uncertain, particularly when analyzed at the regional and local levels, water resources could be affected by changes in climate patterns. Due to increased temperature, evaporation would likely increase which could reduce levels in lakes, rivers, and streams up to 12 inches (MDNR 2009). Increased precipitation could also affect flooding conditions. In addition, severe weather patterns could be affected, resulting in more frequent maximum 25- and 100-year precipitation events and flood patterns. Warmer temperatures may shorten winter seasons, resulting in decreased ice cover on the lakes and streams, as well as early ice breakup in the spring.

If Minnesota's climate becomes drier, forest areas near the prairie-forest border could be replaced with grassland ecosystems (Frelich and Reich 2009). Minnesota's forested areas could decrease by 50 to 70 percent (MPCA 2003). On the other hand, if increased precipitation occurs, resulting in a wetter climate, over long periods of time the current conifers would be replaced with hardwood trees. Pine, birch, and maple forests would be replaced with oak, elm, and ash.

Minnesota's wetland and bog ecosystems may also face changes due to increased precipitation. Variation in wet periods, dry periods, and severe storm frequency could lead to changes in wetland type and distribution that includes wetland losses in some areas and wetland gains in other areas.

Due to the negative effects of peak daytime temperatures during anthesis and grain filling on crop growth, climate change could have a dramatic effect on agriculture. However, climate change would also lengthen the growing season of certain crops within the region, leading in some instances to increased, rather than decreased, agricultural productivity. Droughts, floods, and damage from insects and invasive weeds, could increase the challenges by farmers in the day-to-day management of farms and livestock.

Increased temperatures could increase the potential for heat-related illnesses and insect-borne diseases. Changes in air quality health effects could occur due to the increased temperatures. Higher VOC and ozone levels may occur, as increased temperatures may increase duration and frequency of stagnation conditions that would allow air pollution to build up.

Regulatory Actions

The USEPA has issued regulations under the CAA, and in some cases other statutory authorities, to address issues related to climate change. In addition, MPCA has recently modified its air permit rules to incorporate new federal permit requirements for GHG emissions and currently requires an evaluation of GHG emissions in the environmental review process for projects that must obtain stationary source air permits.

On October 30, 2009, the Final Mandatory Greenhouse Gas Reporting Rule was published requiring suppliers of fossil fuels or industrial GHGs, manufacturers of vehicles and engines, and facilities that emit 25,000 or more mtpy of GHGs to submit annual emission reports to USEPA. The gases covered by the emissions reporting rule are CO_2, CH_4, N_2O, HFCs, PFCs, SF_6, and other fluorinated gases including nitrogen trifluoride and hydrofluorinated ether. The rule required that the first annual GHG emission report be submitted on March 31, 2011, for 2010 emissions. The first reporting deadline was extended to September 20, 2011.

In response to the 2007 United Stated Supreme Court ruling in Massachusetts v EPA, 549 US 497 (2007), on April 17, 2009 the USEPA Administrator signed a Proposed Endangerment and Cause or Contribute Findings for Greenhouse Gases under the Section 202a of the CAA. The Administrator found that current and projected concentrations of the mix of six key GHGs in the atmosphere threaten the public health and welfare of current and future generations. The Administrator further found that the combined emissions of CO_2, CH_4, N_2O, and HFCs from motor vehicles and motor vehicle engines contribute to rising atmospheric concentrations of these key GHGs and hence are a threat to public health and welfare. These findings were a prerequisite to finalizing the GHG standards for light-duty vehicles. On April 1, 2010, USEPA and the DOT's National Highway Safety Administration issued the first national rule limiting GHG emissions from cars and light trucks. This rule confirmed that January 2, 2011 was the first date that a 2012 model year vehicle meeting these rule requirements may be sold in the U.S.

Based upon the above and USEPA's "PSD Interpretive Memo" (identifying that a pollutant is subject to regulation either by a specific provision in the CAA or a regulation adopted by USEPA), USEPA issued a final rule on May 13, 2010 that set GHG thresholds for permits for new and existing sources under New Source Review PSD permit and Title V operating permit requirements, known as the Greenhouse Gas Tailoring Rule. Under the rule and beginning on July 1, 2011, new sources, such as the NorthMet Project Proposed Action, with greater than 100,000 tpy of GHG or existing facilities that increase their GHG emissions by more than 75,000 tpy are subject to PSD and would require BACT for GHG emissions.

Concurrent with USEPA actions, a series of Congressional proposals were developed that, had they been passed, would have changed the U.S. climate policy. GHG emissions legislation considered during the 109th and 110th sessions (January 2005 to January 2007, and January 2007 to January 2009, respectively) of the U.S. Congress ranged from carbon taxes to cap-and-trade and from energy efficiency requirements to moratoriums on coal-fired power plant approvals. Of the legislation proposed during the 109th and 110th Congresses, notable legislative actions include the following:

- Lieberman-Warner Climate Security Act of 2007 (S. 2191);
- Boxer-Lieberman-Warner Climate Security Act Substitution Amendment of 2008 (S. 3036);
- American Clean Energy and Security Act of 2009 (Waxman-Markey – H.R. 2454);
- Clean Energy Jobs and American Power Act of 2009 (Kerry-Boxer (S. 1733)); and
- Kerry-Lieberman American Power Act of 2010.

None of these bills have passed both houses of Congress.

At the state level, efforts to curb statewide and regional GHG emissions are underway. More than half of U.S. states have joined in regional efforts to reduce GHG emissions. In 2007, as part of the Midwestern Greenhouse Gas Reduction Accord, Minnesota committed (along with Illinois, Iowa, Kansas, Michigan, Wisconsin, and the Province of Manitoba, Canada) to long-term GHG reduction targets of 60 to 80 percent below 2005 emission levels. Participants have agreed to pursue the implementation of a regional cap-and-trade system as well as a consistent regional GHG emissions tracking system.

In May 2008, the Governor of Minnesota signed legislation requiring the Minnesota Department of Commerce (MDC) and the MPCA to track and report GHG emissions. In 2007 legislation was passed and signed into law that established GHG emissions reduction targets for 2015 and 2025 of 15 percent and 30 percent, respectively, and directed the Department of Commerce to develop interim reduction recommendations through a length stakeholder process. The 2015 and 2025 goals were designed as milestones toward meeting the State's goal of reducing GHG emissions to a level at least 80 percent below 2005 levels by 2050. Developments in Minnesota's climate change and GHG policy would likely continue as Minnesota strives to meet the goals established in the Next Generation Energy Act of 2007.

On January 13, 2013, the MPCA adopted permanent rules to implement the new GHG permit requirements set by the USEPA. These rules set Part 70 permit thresholds for GHGs at 100,000 tpy. The rule changes also modify requirements for capped and registration permits and insignificant activities. The MPCA has implemented USEPA's final decision to defer including biogenic CO_2 emissions in permitting through permanent rulemaking for biogenic sources for PSD and Title V purposes.

In addition to policies directed at reducing statewide GHG emissions, Minnesota has instituted policies requiring the evaluation of GHG emissions as a part of the environmental review process for certain proposed actions that require stationary source air emissions permits. In July 2008, MPCA issued a General Guidance for Carbon Footprint Development in Environmental Review. The MPCA guidance requests that proposers, in the course of environmental review under MEPA, prepare a GHG inventory for proposed actions that would require stationary source air emissions permits.

NorthMet Project Proposed Action and Climate Change

The NorthMet Project Proposed Action results in direct on-site emissions of GHGs and off-site indirect emissions associated with power generation. There are no analytical or modeling tools to reliably evaluate the incremental effect of a proposed action's discrete GHG emissions on the global and regional climate. In addition, there are no analytical or modeling tools to reliably evaluate any cascading effects, or cumulative effects, from a particular proposed action's GHG emissions on natural ecosystems and human economic systems in a given state or region.

The total potential direct annual emissions from the NorthMet Project Proposed Action are projected to be 196,342 mtpy of CO_2e. This is 0.12 percent of the statewide emissions for Minnesota, 0.003 percent of the United States emissions, and 0.00038 percent of the annual global emission estimations. Combining the direct and indirect emissions from the NorthMet Project Proposed Action (697,342 mtpy CO_2e), the total represents 0.44 percent, 0.01 percent, and 0.0014 percent of the annual statewide, U.S., and global emissions, respectively (PolyMet 2015e). It is possible that, due to global demand for copper, nickel, and precious metals, some of these emissions would occur regardless of the development of the NorthMet Project Proposed Action.

With climate change, average annual temperatures in Minnesota may increase 3 to 5°F over the lifetime of the facility. There may also be a 5 to 15 percent increase in precipitation over the life of the operation (20 years) and reclamation (60 years) (NOAA 2013). Increased temperatures and precipitation may have effects on wetlands, forests, and other cover types that are likely to affect carbon storage and sequestration in these ecosystems. There could be localized impacts due to meteorological changes. Even though a quantitative assessment of the effects could not be conducted, proposed reclamation and mitigation activities described in Section 5.2.7.4.3 can offset some of the carbon emissions caused by NorthMet Project Proposed Action. Overall, climate change could also affect visibility.

5.2.7.2.5 Mercury Deposition Impact Analysis

Total potential mercury emissions to air are estimated to be 4.6 lbs/year from the Plant Site. The primary sources of air emissions are expected to be two emission units that are part of the hydrometallurgical process: the autoclave vent and the autoclave flash vent. The combined air emissions from these two units are estimated to be 4.1 lbs/year. Most of the remaining estimated mercury emissions (0.4 lb/year) are from natural gas used to fuel a package boiler and for space heating. Less than 0.1 lb/year are estimated to be released by the mining, crushing, and milling processes and through wind erosion from the Tailings Basin. Additional information regarding each of these emission sources is summarized in *Mercury Emission Control Technology Review Version 2* (Barr 2012k). Overall, about 95 percent of the mercury originating in the ore is expected to remain within—or be adsorbed to—the tailings and the hydrometallurgical residue, where it would remain isolated from further transport to the environment. Mine Site mercury air emissions would contribute a maximum of 0.17 lbs/year from Tailings Basin construction vehicles (diesel fuel combustion emissions) and approximately 0.6 lbs/year from diesel fuel combustion (PolyMet 2015e). For comparison, Minnesota's statewide mercury air emissions were estimated to be 3,011 pounds in 2005 and about 2,835 pounds in 2011 (PolyMet 2015e).

The low percentage of estimated mercury released to the air is primarily because the oxidizing conditions in the autoclave would cause most of the mercury that is released from the concentrate into the exhaust gas to be in either the oxidized (Hg^{+2}) or particle-bound (Hg(p)) form. Oxidized mercury is water soluble and would be captured in the facility's wet scrubber system. Particle bound mercury would be collected in any device designed to control particulate emissions, such as the autoclave scrubber system. Speciation of mercury air emissions from the autoclave is uncertain, but expected to be primarily in the elemental (Hg^0) form (PolyMet 2015e). Detailed calculations for all Plant Site emission units are provided in UpdatedCalcsPlant Ver7.0_2_26_13 (PolyMet 2015e). The estimated 4.1 lb/yr of Hg^0 emitted from the Plant Site would add to the estimated 19,580,000 pound atmospheric mercury loading and would ultimately return to the terrestrial environment through long-range transport and atmospheric processes (Gaffney and Marley 2014).

The MMREM was used to conduct an evaluation for the potential deposition of mercury related to the Plant Site air emissions to assess the NorthMet Project Proposed Action's potential effects on mercury concentrations in fish and the potential health risks to a hypothetical recreational fisher, as well as a subsistence fisher consuming locally caught fish. The analysis was conducted for five nearby lakes: Heikkila Lake, Colby Lake, and Whitewater Lake (located within 10 km of the Plant Site) and Wynne Lake and Sabin Lake (located within 12 km of the Plant Site). The analysis used the MMREM to assess the potential incremental change in fish mercury concentrations and the potential incremental risks to human health.

Only the Plant Site's potential mercury air emissions were evaluated, as they represent essentially all of the NorthMet Project Proposed Action-related mercury air emissions (PolyMet 2015e). The Mine Site AERA did not assess potential local mercury deposition because potential emissions are less than 1.0 lb/yr (PolyMet 2015e).

Because of uncertainty in speciation of emissions associated with autoclave operations, two speciation scenarios were used for assessing potential effects for the local impacts assessment (PolyMet 2015e). The results of the analysis from the two mercury speciation scenarios on the five nearby lakes estimated that the potential incremental increase in mercury concentrations in the top predator fish would range from 0.002 ppm (Scenario 2, Whitewater Lake) to 0.016 ppm (Scenario 1, Wynne Lake), depending upon the lake and scenario evaluated (see PolyMet 2015e, Attachment T). Scenario 1 assumed that the oxidized and particle-bound mercury released would be 50 percent and 25 percent of the total mercury, respectively. Scenario 2 assumed maximum control efficiency for these fractions, reducing the total percentage released to 10 percent for each. It should be noted that due to the conservatively higher oxidized and particle-bound mercury speciation assumption in Scenario 1, the effects for Scenario 1 are greater than the mercury effects for Scenario 2 for each lake evaluated. These are small compared to the existing Hg concentrations in the top predator fish (95th percentile), which range from 0.35 ppm at Whitewater Lake to 1.34 ppm at Wynne Lake. The NorthMet Project Proposed Action incremental risk quotients for a recreational fisher ranged from 0.013 (Scenario 1) at Whitewater Lake to 0.081 at Wynne Lake; both are below the incremental risk guideline level of 1.0. The incremental risk quotients for subsistence and tribal anglers ranged from 0.098 (Whitewater Lake) to 0.606 (Wynne Lake) for Scenario 1, also below the incremental risk guidance level. Finally, the incremental risk quotients for the subsistence fisher (Treaty Protected catch rate) ranged from 0.132 (Scenario 1, Whitewater Lake) to 0.538 (Scenario 1, Wynne Lake), again below the incremental risk guidance level. Additional information pertaining to fish mercury concentration and the specific Hazard Quotients summarized in the report *Cumulative Impacts Analysis: Local Deposition and Bioaccumulation in Fish* (Barr 2012b) have been included in Section 6.2.6.3.3 summarizing the cumulative effects assessment for mercury deposition. It should be noted that all of the lakes' mercury background concentrations result in a background risk quotient above 1.0 without any incremental increase from the NorthMet Project Proposed Action, which is a common occurrence in Minnesota lakes. Widespread contamination of fish from atmospheric pollution is why Minnesota established a statewide mercury TMDL. The TMDL seeks to reduce atmospheric deposition everywhere in the state in order to make the state's lakes and streams fishable, as required by federal regulations.

In September 2009, the MPCA published Guidelines for New and Modified Mercury Air Emission Sources. The guidelines were developed to limit the mercury emissions from new and expanding sources in order to meet the TMDL goal of total statewide mercury emissions of 789 lbs/year by 2025. In 2012, MPCA revised the guidelines (MPCA 2012h), which includes the following requirements that apply to the NorthMet Project Proposed Action:

- Define and employ BACT on mercury emitting sources. If best controls reduce emissions by less than 90 percent, the new source would be subject to periodic review for opportunities for improved control efficiency and must comply with TMDL requirements.
- Complete environmental review as required by Minnesota law, including for a proposed action and associated cumulative effects.
- For facilities where the MPCA determines a project's mercury emissions would not impede the statewide mercury emissions reduction goals within the mercury TMDL, an emissions limit would be placed into the facility's permit and the project is not be required to submit a mitigation plan.

The NorthMet Project Proposed Action mercury air emissions are about 0.16 percent of 2011 estimated statewide emissions and about 0.6 percent of the TMDL statewide target emissions. The NorthMet Project Proposed Action selected a two-stage mercury control system that is expected to achieve 25 percent control for elemental mercury and 90 percent control for particle bound and oxidized mercury (PolyMet 2015e). Because the total mercury control is less than 90 percent, PolyMet moved forward with the remaining TMDL requirement. In addition, PolyMet has conducted a cumulative effects analysis on the local mercury deposition and bioaccumulation in fish (PolyMet 2015e) and the assessment of the cumulative effects is provided in Section 6.2.3.7.2.

The MPCA has conducted a review of the NorthMet Project Proposed Action mercury emissions and has determined that it would not impede the reduction goals (MPCA 2013b). Thus, no minimization and mitigation plan would be required for the NorthMet Project Proposed Action.

5.2.7.2.6 Sulfur Deposition and Potential Indirect Effects on Mercury Methylation

The Ecosystem Acidification report, in support of the Minnesota Steel EIS, indicates that up to 90 percent of the sulfate deposition in Minnesota is due to out-of-state emissions of SO_2 and that sulfate deposition has been on a downward trend since the mid-1980s. Given the current downward trend of sulfate deposition in Minnesota and the relatively small contribution from Minnesota sources to sulfate deposition in Minnesota, the NorthMet Project Proposed Action is not expected to have a measurable effect on sulfate deposition in the state. The trend of decreasing sulfate deposition in Minnesota is expected to continue into the future due to foreseeable regulatory actions that are expected to further reduce sulfur dioxide emissions on a national basis as well as from specific Minnesota sources. A supplemental assessment of the potential additional sulfur from stack and fugitive dust air emissions was conducted to evaluate the NorthMet Project Proposed Action's effects from sulfate as related to mercury methylation and fish concentrations. Sulfur related emissions include SO_2, sulfuric acid mist (SAM), reduced sulfur compounds and sulfur in particulate (e.g., sulfur in the mineral matrix of the ore). Because the estimated Plant Site and Mine Site emissions for each of these are below the PSD permitting thresholds and Significant Emission Rate (SER), no further consideration of these sources were required for environmental impact purposes (Barr 2015f). However, a summary of each is included in Section 4.0 of the document *Mercury Overview a Summary of Potential Mercury Releases from the NorthMet Project and Potential Effects on the Environment* (Barr 2015f). The evaluation estimates the potential sulfur deposition to the Partridge River (Colby Lake) and Embarrass River (Sabin Lake) watersheds and is summarized below.

Sulfur Dioxide

Plant Site stack SO_2 emissions are estimated at about 7 tpy, while stack emissions of SO_2 at the Mine Site are estimated at about 1.9 tpy. The values are too small for PSD air permitting and therefore are not required to be modeled and are not considered to have significant impacts according to the PSD program. Nevertheless, air concentrations of SO_2 were modeled for the Plant Site Class II Air Quality Air Dispersion Modeling Report (Barr 2012j) and can be used to estimate a potential deposition of sulfur related to SO_2 air emissions. Average watershed air concentrations for SO_2 are based on Class II modeling and reflect the Class II modeling receptor grid (Barr 2012j).

Because SO_2 emissions are in the gas phase and are emitted from a taller stack, they tend to disperse further, and therefore represent a more reasonable approximation of a potential air concentration. Additional inputs such as deposition velocity, lake surface area, and water mixing zone were included for evaluation. Based on the results of the modeling, the potential deposition over the Partridge River (Colby Lake) would be 0.003 $g/m^2/yr$ or about 2 percent of background, with a potential surface water concentration from deposition to the lake surface of 0.03 mg/L. The potential deposition over the Embarrass River (Sabin Lake) would be 0.002 g/m^2/yr or about 2 percent of background), with potential surface water concentration from deposition to the lake surface of 0.02 mg/L. With conservative estimates of potential air concentrations and general overestimates of potential deposition associated with screening equations, potential sulfur deposition from SO_2 emissions is a small percent of background sulfur deposition for both the Embarrass River and Partridge River watersheds.

Sulfuric Acid Mist

The revised air concentration estimate for SAM is 0.12 μg/m^3, as adjusted for the current estimate of SAM emissions of 5.02 tpy (PolyMet 2015e). Additional inputs such as deposition velocity, lake surface area, and water mixing zone were included for evaluation. Based on the results of the modeling, the potential deposition over the Partridge River (Colby Lake) would be 0.0005 g/m^2/yr or about 0.4 percent of background, with a potential surface water concentration from deposition to the lake surface as 0.005 mg/L. The potential deposition and estimated potential incremental sulfate concentration for Embarrass River (Sabin Lake) would also be 0.0005 g/m^2/yr and 0.005 mg/L, respectively. Overall, the deposition from SAM emissions is a small percentage of background sulfur deposition to both the Embarrass River and Partridge River watersheds.

Reduced Sulfur Compounds

Potential NorthMet Project Proposed Action emissions of total reduced sulfur (TRS) compounds, includes hydrogen sulfide (1.88 tpy) and carbon disulfide (5.1 tpy) as estimated to be 6.98 tpy. All of the TRS emissions are from the Plant Site (PolyMet 2015e). No modeling of TRS emissions was required for ambient air quality purposes or the Supplemental Plant Site AERA. However, the potential deposition of sulfur is estimated to be small due to factors such as the ability to remain as a gas under normal environmental conditions, further transport from an emissions source due to oxidation by molecular oxygen and hydroxyl radicals, residence times ranging from 1 day to 40 days, volatilization from the atmosphere, and gas phase at ambient temperatures reacting with photochemically produced hydroxyl radicals (Barr 2015f). Overall, the potential local deposition of sulfur from TRS compounds is uncertain, but it is not expected to exceed evaluation criteria.

Sulfur in Particulate

The estimate of potential sulfur deposition from sulfur in particulate was calculated using the air concentration for the annual averaging time period of 5.8 μg/m^3 at the Plant Site property boundary (PolyMet 2015e). It is assumed that ore processing would be responsible for all modeled air concentrations. Additional inputs such as deposition velocity, lake surface area, and water mixing zone were included for evaluation. Based on the results of the modeling, the potential deposition over the Partridge River (Colby Lake) would be 0.0045 g/m^2/yr or about 4 percent of background, with a potential surface water concentration from deposition to the lake surface as 0.04 mg/L. The potential deposition and estimated potential incremental sulfate concentration for Embarrass River (Sabin Lake) would also be 0.0045 g/m^2/yr and 0.04 mg/L, respectively. Overall, the sulfur in the particulate and the potential sulfur surface water concentrations would be a small percentage of background deposition for the Embarrass River and Partridge River watersheds.

Based on the results of the additional assessment of sulfur deposition, the potential addition of sulfur from these emissions sources would be small to negligible, and therefore would not be expected to have effects on mercury methylation or fish mercury concentrations. Additional information regarding to mercury methylation is provided in Section 5.2.2.3.4. Mercury deposition and bioaccumulation in fish (PolyMet 2015e) and the assessment of the cumulative effects is provided in Section 6.2.3.7.2.

5.2.7.3 NorthMet Project No Action Alternative

Since this alternative would not involve introducing new emission sources, the NorthMet Project No Action Alternative would have no additional effects on air quality either regionally or locally. Therefore, air quality would be substantially similar to existing conditions.

5.2.7.4 Mitigation Measures

If, during permitting, it is determined that mitigation measures are necessary, the measures described in this section could be considered; however, most of the mitigation measures described are incorporated into the design. PolyMet has proposed the following mitigation measures to reduce effects on air quality associated with GHGs.

5.2.7.4.1 Greenhouse Gas Reduction Measures

Review of Current Mitigation Included In the NorthMet Project Proposed Action

The NorthMet Project Proposed Action incorporates both energy and production efficiency to reduce associated GHGs (Barr 2011e). The potential to minimize and reduce GHG emissions from changes in existing land cover (i.e., release of carbon tied up in terrestrial biomass, soils, or peat and the loss of carbon sequestration capacity from the environment) are also discussed (PolyMet 2015e). The following provides a summary of the reduction measures.

PolyMet proposes a hydrometallurgical process, rather than a pyrometallurgical process, which would result in reduced energy usage. The hydrometallurgical process is expected to reduce the NorthMet Project Proposed Action’s energy demand by 50 percent over comparable pyrometallurgical processes. However, while energy use is reduced by one-half, GHG emissions do not decline per unit of production from what would be expected from a pyrometallurgical process, principally because of the large load of non-energy process emissions associated with hydro processing.

PolyMet also proposes to use premium efficiency motors in selected locations rather than standard motors. Motor efficiencies typically vary between 85 and 96 percent, depending upon the size and load of the motor. Gravity transport of process slurries would also be used where possible, instead of pumps. PolyMet proposes to configure the processing plant such that the overall power factor for the facility is as close to one (energy input to energy output) as practical, which would help minimize electricity use.

The primary production excavators and two of the three blast-hole drills would be electric rather than diesel powered, eliminating a direct source of GHG emissions. PolyMet would purchase new gen-set locomotives, which are more efficient and use less fuel than conventional locomotives. Space heating in the former LTVSMC processing plant is a major contributor to total direct GHG emissions and PolyMet would employ natural gas heaters. Per unit of useful energy, the combustion of natural gas results in lower CO_2e emissions than does the combustion of other fuels. Of the three feasible space heating options, electric heating, propane-fired heating, and natural gas-fired heating, natural gas-fired heating would result in aggregate in CO_2 emissions that would be about 80 percent lower than those for electric heating and 66 percent lower than those for propane-fired heaters.

PolyMet evaluated additional methods to reduce the NorthMet Project Proposed Action's GHG emissions but found the additional methods infeasible (PolyMet 2015e). The methods evaluated included electric drive mine haul trucks, electric locomotives, newer mill technology, flotation alternatives, and the use of waste heat from autoclaves for space heating.

Additional Mitigation

To mitigate GHG effects associated with a change in existing land cover (i.e., secondary effects), PolyMet would provide compensatory wetland mitigation (see Section 5.2.3 of this FEIS) for direct effects on wetlands as well as for indirect effects on fragmented wetlands. One of the goals of the compensatory mitigation is to restore high-quality wetland communities of the same type, quality, function, and value as those affected by the NorthMet Project Proposed Action. Given site limitations and technical feasibility, it is impracticable to replace all affected wetland types with an equivalent area of in-kind wetlands. Off-site wetland compensation of 1,631.4 acres wetland restoration and/or preservation, and 225.0 acres of upland buffer have been planned. This off-site mitigation would take place at three sites in northern Minnesota. Based upon the proposed wetland mitigation plan, the number of acres replaced would equal and/or exceed the total number of acres of all types of wetlands lost to NorthMet Project Proposed Action-related activities, other than deep marsh and the final ratios would be determined during wetland permitting. However, the excess replacement would contribute to some degree to compensation of the NorthMet Project Proposed Action's effects on deep marsh wetlands.

5.2.7.4.2 Rail Car Ore Transport Fugitive Dust Mitigation Measures

Rail cars have been designed to centralize the ore fines to the central portion of the rail car to minimize the potential for spillage during transport. Due to the natural moisture content and large size of the ore being mined, fugitive dust from rail car transport is expected to be minimal. Three additional fugitive dust control measures have been identified as part of the Mine Site Fugitive Emission Control Plan. These include the minimizing the drop distance of the ore into the railcars, reporting dusty conditions during loading and transport, and conducting one observation per train to evaluate rail car loading conditions. In addition, annual training would be conducted for all locomotive workers on methods to minimize fugitive dust during ore transport and loading.

5.2.7.4.3 Voluntary Mitigation Measures

Based upon the emissions defined in Section 5.2.7.1.3, the majority of the NO_x and SO_2 emissions are associated with mobile sources (e.g., diesel trucks, locomotives, mining equipment). Although the analysis of these pollutants showed that the NorthMet Project Proposed Action would not cause or significantly contribute to air quality exceedances, a voluntary anti-idle program could further reduce these emissions, as well as PM and GHG. Although there is no regulatory requirement for a program, PolyMet is considering the implementation of an idling reduction policy that would consider the size, fuel type, and function of each type of vehicle, as well as weather conditions and anticipated duration of vehicle stoppage. The policy would need to account for extreme weather conditions in order to avoid potential construction or production delays from the inability of vehicles to restart once turned off. In addition, vehicle owner's policies and maintenance requirements would have to be incorporated for heavy construction equipment and light vehicles that are not owned and operated by PolyMet. The results of such a policy would benefit by reducing environmental impacts, improving worker health and safety, and reducing fuel usage and engine wear.

5.2.7.5 Amphibole Mineral Fibers

5.2.7.5.1 Environmental Consequences

Background

The NorthMet Project Proposed Action would mine ore from the Duluth Complex, which may contain amphibole mineral fibers. Taconite ore mined from the Biwabik Iron Formation at the Northshore Mine and processed at the Silver Bay plant, has received public attention with regard to potential releases of amphibole mineral fibers such as those found with taconite ore on the east end of the Mesabi Iron Range in northeast Minnesota.

Asbestiform amphibole fibers consist of aggregates of long, thick, flexible fibrils that separate along grain boundaries between fibrils. There is little scientific debate that the asbestiform varieties of amphibole fibers are carcinogenic. But the term "mineral fibers" has also encompassed other prismatic crystals and cleavage fragments that meet specified dimensional criteria. Cleavage fragments are generated by crushing and fracturing minerals, including the nonasbestiform analogs of the asbestos minerals. Although the substantial hazards of inhalational exposure to airborne asbestos fibers have been well documented, there is ongoing debate about whether exposure to thoracic-size elongated mineral particles from nonasbestiform analogs of the asbestos mineral is also hazardous.

Regulatory Definitions and Mineralogy

Amphibole minerals are a group of silicate minerals that can occur as either fibrous (asbestiform) or non-fibrous (non-asbestiform). Asbestiform is a mineralogical term describing mineral crystals that form as long, thin, and flexible mineral fibers. Most amphiboles occur in a non-asbestiform habit and asbestiform amphiboles are relatively rare. So while a mineral fiber can be elementally and chemically identical to an asbestos fiber, they can be morphologically different. Mineral fragments, called cleavage fragments, are created and could be emitted into the atmosphere when the ore is ground and crushed. These cleavage fragments tend to be shorter and wider than the fibrous amphiboles but are often indistinguishable from fibrous amphiboles, even at a microscopic scale. This means that a short, blocky mineral fiber might be chemically indistinguishable from a long, thin, flexible asbestos fiber, but due to these morphological differences these fibers may have different properties and different health risks.

Asbestos is a commercial/industrial term with a long history, and is not a mineralogical definition. Asbestos is the name of a group of highly fibrous minerals with separable, long, and thin fibers. Individual asbestos fibers are strong and flexible, heat resistant, and chemically inert. There are six regulated types of asbestos. The six regulated minerals and their associated mineral group are:

- Chrysotile (Serpentine),
- Crocidolite (Reibeckitte) (Amphibole),
- Amosite (Cummingtonite-grunerite) (Amphibole),
- Anthophyllite Asbestos (Amphibole),
- Tremolite Asbestos (Amphibole), and
- Actinolite Asbestos (Amphibole).

From a mineral perspective, amphibole minerals are distinguished from each other by the amount of sodium, calcium, magnesium, and iron that they contain.

A mineral fiber can be analyzed and classified using a microscope. Chrysotile is easily identified by microscopic analysis because of its distinct particle shape. For amphiboles, the distinction between asbestiform and non-asbestiform is less clear. Amphibole particles have a spectrum of shapes from blocky to prismatic to acicular. Amphiboles also break (or cleave) into smaller fragments when finely ground. Long, thin cleavage fragments resemble asbestos fibers, but may not be asbestiform. Cleavage fragments tend to be roughly twice as thick as asbestos fibers (Addison and McConnell 2008). The aspect ratio distributions (i.e., length-to-width ratio) of a population of cleavage fragments and a population of asbestos fibers can overlap. This overlap means that some fibers may be classified as either cleavage fragments or asbestos fibers (Millette 2006). An analyst can compare particle shapes to asbestos reference materials but it can be difficult to classify individual fibers as asbestiform or cleavage fragments because individual fibers do not exhibit all the characteristics of a population.

Regulatory definitions for classifying asbestos and other mineral fibers vary and often do not differentiate between asbestiform and non-asbestiform minerals. The USEPA defines the dimensions of an “asbestos fiber” as a particle 5 micrometers (μm) in length or longer with an aspect ratio of at least 20:1 (USEPA 1993). The National Institute for Occupational Safety and Health (NIOSH) defines an “occupational fiber” as a particle 5 μm in length or longer with an aspect ratio of at least 3:1 (NIOSH 1994). Minnesota agencies define a Minnesota regulated fiber (MN-fiber) as an amphibole or chrysotile mineral particle with an aspect ratio of 3:1 or greater with no limit on length (MDH Methods 851 and 852). The State of Minnesota’s definition of fibers does not distinguish between asbestiform and non-asbestiform amphibole fibers, including cleavage fragments.

Health Impact

There are known health impacts from asbestos and similar asbestiform amphibole minerals. Less certain are the health risks from non-asbestiform minerals—chemically and elementally identical analogs of those minerals. While chemically and elementally identical to asbestos, these fibers have different physical properties. It is not certain exactly what properties of a mineral fiber affect its potency and, in turn, impact the health of an exposed population.

The toxicological literature review prepared for the MDNR (MDNR 2009b) discussed non-asbestiform fibers. A brief summary follows.

Palekar et al. (1979) found non-asbestiform particles to be cytotoxic (meaning toxic to cells); however, epidemiological studies have found limited potential for carcinogenesis from cleavage fragments. Gamble and Gibbs (2008) provided a review of several epidemiological studies regarding exposure to cleavage fragments including several involving taconite miners. They found that there was no statistically significant increase in either lung cancer or mesothelioma from exposure to taconite mining. Ilgren (2004) reviewed animal and human studies and came to the same conclusion. Additionally, Gylseth et al. (1981) performed a study in which non-asbestiform amphibole dust in the lungs of taconite miners was examined. Whereas Gylseth et al. (1981) concluded that exposure to the miners constituted a minor carcinogenic risk, they could not exclude exposure to taconite as a contributing factor to the lung cancer found in the miners examined. Asbestosis and mesothelioma latency periods of 15 to 50 years are not uncommon, creating uncertainties in the interpretation of studies performed to date. It should be noted that taconite is mined in the Biwabik Formation, whereas the ore proposed to be mined for the NorthMet Project Proposed Action is from the Duluth Complex, which is not in contact with the Biwabik Formation at the NorthMet Deposit.

The University of Minnesota conducted a research effort, known as the Minnesota Taconite Workers Health Study (University of Minnesota 2013), funded by the State of Minnesota, to better understand of taconite worker health issues, including an epidemiological investigation into causes of excess rates of disease, including mesothelioma, among taconite workers. The Study did not rule out amphibole mineral fibers as a potential source of health risk or from playing some role in the incidence of disease among taconite workers.

The MDH considers the role of non-asbestiform amphibole fibers in the induction of health effects to be uncertain at this time. MDH concludes that amphibole mineral fibers have the potential for an undetermined toxicity and potency.

Occurrence in the Duluth Complex

The October 2005 SDD for the NorthMet Proposed Action EIS identified that the "… EIS will provide information about the presence of fibers in the NorthMet deposit." Since February 2006 fibers-related information has been submitted to the Minnesota State Agencies (MDNR; MPCA; MDH) for their review and consideration. The report entitled *Fiber Information, NorthMet Mine and Ore Processing Facilities Project, Fibers Data Related to the Processing of NorthMet Deposit Ore* (2007l), hereafter referred to as the "2007 Mineral Fibers Report," provided the bulk of the fibers-related data and information.

The Minnesota Environmental Quality Board (MEQB) has reported that the Duluth Complex contains minor amounts of amphibole minerals, but did not identify chrysotile as a mineral of concern (MEQB 1979). The MEQB (1979) identified that the concentration of asbestiform amphibole minerals in the Duluth Complex ore is expected to be low, "…less than 0.1 ppm by weight in the mineralized areas of the Duluth Complex…." Composite samples using ore from the NorthMet Deposit collected during flotation pilot plant studies in 2000 conducted for PolyMet (SGS 2004) provided results for amphibole and serpentine minerals representative of the MEQB (1979) conclusions. Recognizing the differences between the NorthMet Deposit versus the Biwabik Iron Formation, the MPCA, MDNR, and MDH requested that PolyMet provide additional information on fiber-related data for its mining and processing operations in the NorthMet Deposit.

PolyMet conducted additional flotation pilot testing in July and August 2005. Collected samples considered to be representative of the head feed, tailings, and flotation process water associated with processing ore from the NorthMet Deposit were prepared for analysis by Transmission

Electron Microscopy by additional grinding of the ore and tailings samples with mortar and pestle to produce a very fine powder. Stevenson (1978) states that the finer a material is ground, the higher the number of fibers identified by MDH counting rules (MDH Methods 851 and 852). According to the laboratory conducting this analysis, this only affects fiber counts, not the identification of asbestiform fibers since asbestiform fibers have high tensile strength and flexibility (PolyMet 2015e).

Overall, amphibole mineral fibers were found to represent a relatively small percent of the mineral fibers associated with the processing of NorthMet Deposit ore (Flotation Pilot Testing in July and August 2005); approximately 9 percent of the fibers identified from all collected samples of ore, tailings, and process water. Chrysotile mineral fibers were not identified in samples of ore, tailings, or process water collected from the flotation pilot testing. However, PolyMet's petrographic observations indicate that chrysotile minerals are about 2 percent of the minerals associated with the waste rock from the NorthMet Project Proposed Action.

It is not possible to accurately quantify the amount of fibers that might be emitted from the facility. Instead, this data was used to confirm the presence of amphibole minerals in the ore body and, thus, that the potential exists for MN-fibers to be emitted from the facility.

Data provided in the 2007 Mineral Fibers Report indicates that about 95 percent of the mineral fibers identified in samples collected from the flotation pilot testing were 3 microns or smaller in size, with most being less than 2 microns in size. Therefore, $PM_{2.5}$ (fine particulate) could be used as a surrogate for all mineral fibers, including amphibole mineral fibers.

5.2.7.5.2 Evaluation Criteria

Because the exact human health risk of exposure to non-asbestiform amphibole mineral particles is unknown as well and because there is no method to quantify the potential fiber emissions, there is no accepted methodology for performing a formal health risk assessment for the quantitative assessment of human health effects from the proposed operations. Thus, there is an uncertain level of potential health risk from airborne amphibole mineral fibers for the NorthMet Project Proposed Action. As such, the focus is on minimizing and mitigating any potential release of airborne amphibole mineral fibers.

5.2.7.5.3 NorthMet Project Proposed Action

The presence of amphibole minerals in the Duluth Complex indicates that the potential exists for the emissions of amphibole mineral fibers from the proposed operations. MN-fibers identified in samples collected from the 2005 flotation pilot testing of material representative of processing NorthMet Deposit ore (Barr 2007d) were predominately less than 2.5 μm in aerodynamic diameter (99.6 percent less than 2.5 μm), placing them in the fine fraction of particulate matter ($PM_{2.5}$). A small fraction of these fibers were identified as amphibole (approximately 9 percent). Therefore, the MPCA and the MDH have emphasized additional control of airborne fine particles to minimize potential exposure to asbestiform and non-asbestiform amphibole mineral fibers.

There is the potential that amphibole mineral fibers may be found in water that has come in contact with ore at the Mine Site.

Fugitive Dust Control

Several measures of regulatory requirements would assist in minimizing emissions of fibers. Compliance with the requirements for blasting, found in *Minnesota Rules*, Chapter 6132, would minimize fugitive dust from blasting operations. A fugitive dust suppression plan for the Tailings Basin would be evaluated and approved by the MPCA as part of the air permit. In addition, the NorthMet Project Proposed Action would be required to comply with Federal Mine Safety and Health Administration's regulations for mining operations that include implementation of standards for asbestos exposure to minimize worker exposure. Such measures would also minimize release of amphibole mineral fibers.

The potential for the release of amphibole mineral fibers to the air at the Mine Site would be low because the ore would not be crushed at the Mine Site and the unpaved road surfaces would be constructed of material that is not likely to contain amphibole minerals. PolyMet's decision to use larger haul trucks at the Mine Site, as well as the incorporation of an updated mine plan into the emission calculations, has reduced the estimated fugitive particulate emissions, further reducing the potential for emissions of airborne amphibole mineral particles.

The Tailings Basin would be operated to minimize all fugitive particulate emissions by management to minimize exposed beach areas and wind erosion fugitive dust by treatment of the Tailings Basin roads and inactive beach areas. The deposition of wet tailings would keep the active work area wet and prevent wind erosion. Capillary action near the pond edge is expected to keep the fines wet and minimize the potential for entrainment of the fines into the air.

Particulate Emissions Control Technology

In order to minimize amphibole mineral fiber emissions, and since MN-fibers are predominately in the $PM_{2.5}$ size range, a $PM_{2.5}$ BACT-like analysis for the proposed PolyMet operations was performed in accordance with the USEPA's guidance. The NorthMet Project Proposed Action is not subject to PSD, so this analysis is not otherwise required. The purpose of this analysis was solely to determine the best control for $PM_{2.5}$ and thus for fibers. For this analysis, control technologies are ranked in order of effectiveness, and starting with the most stringent technology, each are evaluated until a technology cannot be ruled out on technological or economic grounds.

The vast majority of potential emissions of MN-fibers for the NorthMet Project Proposed Action would occur from the ore crushing operations at the Plant Site, with minor potential emissions from the Tailings Basin and the Mine Site (PolyMet 2015e).

As a result of the BACT-like analysis, the NorthMet Project Proposed Action would install emission controls in the crushing plant, such that the emissions of fine particulate matter from the ore crushing and associated material handling sources are controlled consistent with recent BACT determinations. The controls would include the use of fabric filters (baghouse or cartridge) designed to reduce emissions to 0.0025 gram per dry standard cubic foot at each unit (PolyMet 2015e). These controls would be applied to all emission sources within the coarse crushing operations (10 units), the drive house (2 units), the fine crushers (8 units), and the concentrator (15 units).

In addition to these controls, the NorthMet Project Proposed Action would also use high-efficiency particulate air (HEPA) filters following the fabric filters on selected units. The HEPA filters would be used when exhaust air from the fabric filters is routed back into the building to provide an added level of assurance that worker exposure to inhalable dust is minimized. In this case, the venting of exhaust air back into a building provides a benefit of reducing the heating fuel demand that offsets the additional cost and energy usage associated with re-routing of air back into a building (PolyMet 2015e). The combination of the cartridge and HEPA filters for fine particulates has a removal efficiency of 99.97 percent. Six units within the coarse crushing operations and nine units within the concentrator would utilize the HEPA filters year-round. Eight of the 10 units within the drive house and fine crusher operations would utilize the HEPA filters during heating season only (PolyMet 2015e).

The use of HEPA filters, during non-essential operations, would provide little air quality benefits for reducing exposure to fine particulates outside the facility boundary. In addition, the modeled $PM_{2.5}$ effects demonstrate that the $PM_{2.5}$ concentrations, which are in the same size range as the amphibole mineral fibers, rapidly decrease in magnitude in all directions. As such, the operational and air pollution equipment controls for the NorthMet Project Proposed Action represent the highest feasible level of fine particulate matter control and, coupled with Hoyt Lakes being 5 miles from the Plant Site, further reduce the potential for public exposure to airborne amphibole mineral fibers.

Amphibole Mineral Fibers in Water Discharges

There is the potential that amphibole mineral fibers may be found in water that has come in contact with ore at the Mine Site. There is no applicable water quality standard specific to non-asbestiform amphibole mineral fibers. The USEPA has developed drinking water standards for asbestos that drinking water utilities must comply with based upon information on the USEPA website(http://water.epa.gov/drink/contaminants/basicinformation/asbestos.cfm). This standard, an MCL, is 7 million fibers per liter. The USEPA has provided proven methods of water treatment to meet the MCL, including coagulation/filtration, direct and diatomite filtration, and corrosion control.

Water in contact with waste rock, ore, and pit walls would be treated during operations utilizing a greensand filter. No discharge would occur off site. During post-closure, a greensand filter, pre-filters, and a RO system would be used to treat water to meet water quality standards prior to discharge. This treated water would be discharged into the Partridge River, which flows into Colby Lake, the only lake in the area used for drinking water. It is the source of drinking water for the City of Hoyt Lakes. Currently, the City utilizes sand filters, coagulation, and settling and has been in compliance with the USEPA asbestos standard. When the RO treatment system is constructed at the Mine Site, it would operate in the same fashion as the City's treatment system. As such, the discharge from the Mine Site is expected to be in compliance with the federal standard prior to it being treated again by the City of Hoyt Lakes.

Nearby Ambient Fiber Monitoring

Baseline ambient air monitoring for mineral fiber concentration is currently being done at Hoyt Lakes. The monitoring location was approved by the MPCA and the monitoring is being conducted according to MPCA methodology. Ambient air monitoring for mineral fibers would also be conducted following facility startup. The mineral fibers data collected after the facility start-up would enable MPCA ample data to compare ambient concentrations, including NorthMet Project Proposed Action emissions, with the baseline conditions.

5.2.8 Noise and Vibration

This section describes effects on humans, including effects on recreational and cultural/spiritual activity, of noise, vibration, and airblast related to the NorthMet Project Proposed Action. The effects on wildlife are described in Section 5.2.5.

Summary

Both noise and vibration dissipate with distance. The residences closest to the mine are at a distance where blasting and other NorthMet Project Proposed Action-related noise would not be heard. The NorthMet Project Proposed Action would comply with all daytime and nighttime regulatory noise limits at sensitive receptors, and the changes in total noise level from current conditions during nighttime operations would not be perceptible. Immediate access to areas around the mine would be restricted. Members of the general public who may be recreating near the NorthMet Project area and tribal members who may have a cultural and spiritual connection to archeological sites in the Superior National Forest, in areas immediately near the mine, may occasionally experience noise and/or vibration associated with the NorthMet Project Proposed Action.

5.2.8.1 Methodology and Evaluation Criteria

This section describes the methodologies and criteria used to evaluate potential noise, ground vibration, and airblast at areas of the Mine Site and Plant Site. NorthMet Project Proposed Action-related sound levels were estimated using the International Standards Organization (ISO) 9613-2 sound-propagation model. The Site Law Formula was the basis for estimating vibration effects. Airblast was estimated using the Terrock model. Each is a desktop model that estimates project effects using site-specific conditions. Estimated effects were compared to federal, state, or local regulations or to project design standards, as appropriate. For noise and vibration, the area of potential effect was defined as a 20-mile radius from the Mine Site and a 20-mile radius from the Plant Site. The area of potential effect for airblast was the distance from the source where measured effects were below the known level for human effects.

5.2.8.1.1 Noise

<u>Noise Impact Assessment Methodology</u>

The noise impact assessment areas for the NorthMet Project Proposed Action include the noise-sensitive receptors within a 20-mile radius of the Mine Site and a 20-mile radius of the Plant Site. The 20-mile radius was selected in order to include the southern edge of the BWCAW, which is located approximately 20 miles north of the Mine Site and Plant Site. The ISO 9613-2 sound-propagation model (*Acoustics-Attenuation of Sound during Propagation Outdoors)* is accepted worldwide and was used to determine the extent of noise effects from the NorthMet Project Proposed Action. This model is the only one that encompasses a standardized method for calculating sound propagation and is the basis for most sophisticated computer modeling programs (Ray 2010). This sound-propagation model consists of octave-band algorithms with nominal mid-band frequencies from 63 to 8,000 Hz for computing the attenuation of sound originating from a point sound source or an assembly of point sources. The source(s) may be mobile or stationary. The model predicts equivalent continuous A-weighted sound pressure levels (L_{eq}) from sources of known sound emission and accounts for the following site conditions and physical effects:

- Meteorological conditions favorable to sound propagation (i.e., downwind propagation with wind speeds between 1 and 5 meters per second when measured 3 to 11 meters above the ground). This is a conservative approach because not all receptors may be located downwind of the sources (i.e., receptors located upwind would experience less noise since noise propagates farther downwind than upwind).
- Topography and the extent of ground absorption from different surfaces.
- Noise emission of each source, as well as its location and elevation.
- Location and elevation above local ground level of all sensitive receptors.
- Screening from any enclosures, barriers, earth berms, buildings, or vegetation.
- Attenuation due to distance (geometrical divergence) and atmospheric absorption.
- Increase in noise level due to reflections from nearby facades and reflective objects.

For the noise assessment of the NorthMet Project Proposed Action, ground topography or surface effects were modeled assuming that the area around the source and the receptors would be a mixed 50 percent hard non-absorptive ground (e.g., paved surfaces, water, ice, concrete, and all other ground surfaces having a low porosity) and 50 percent soft absorptive surface (e.g., ground covered by grass, trees, and farm land, and all other ground surfaces having a high porosity). This is a conservative assumption, as almost 100 percent of the ground adjacent to the mine sound sources and closest receptors is porous with more absorptive capacity that can attenuate noise levels. Temperature and relative humidity of 20 ºC and 70 percent, respectively, were used in estimating the attenuation due to atmospheric absorption. Attenuation due to geometric divergence or spreading is mainly a function of the distance between the sound source and the receiver. A further conservative assumption is that the modeling analysis did not include any potential shielding effects from pit walls, waste rock stockpiles, berms, or vegetation.

Sound power levels for all equipment and trucks at the Mine Site and Plant Site were based on measured octave-band sound power data obtained from similar mine projects in Australia (Bassett Acoustics 2004; URS 2005). For modeling purposes, it was conservatively assumed that all equipment at the Mine Site and Plant Site would be steady noise sources (except for high-energy impulsive noise from blasting [explosives]) and would operate simultaneously and continuously for 24 hours per day. Impact assessment methodology for blasting noise (i.e., airblast overpressures) discussed in Section 5.2.8.1.2, Vibration and Airblast.

Noise Impact Assessment Criteria

Noise effects are commonly judged according to two general criteria: the extent to which a project would exceed federal, state, or (where applicable) local noise regulations, and the estimated degree of disturbance to people who live in or use an area.

According to the noise standards for Minnesota (*Minnesota Rules*, part 7030.0040, subpart 2), permissible noise levels are broadly classified according to land uses such as residential, commercial, or industrial. The standards distinguish between daytime and nighttime noise, with less noise permitted at night. The standards list the sound levels not to be exceeded for more than

10 and 50 percent of the time (L_{10} and L_{50}) during any 1 hour period. The applicable Minnesota Noise Standards are shown in Table 5.2.8-1. Section 4.2.8 provides additional discussion of common noise levels.

Table 5.2.8-1 Applicable Noise Standards for Different Land Uses in Minnesota

Noise Area Classification[1]	Noise Standard (dBA)			
	Daytime (7 a.m. to 10 p.m.)		Nighttime (10 p.m. to 7 a.m.)	
	L_{50}	L_{10}	L_{50}	L_{10}
1	60.0	65.0	50.0	55.0
2	65.0	70.0	65.0	70.0
3	75.0	80.0	75.0	80.0

Source: *Minnesota Rules*, part 7030.0040, subpart 2; MPCA 2008a.

[1] The land use activities associated with each Noise Area Classification (NAC) are described in Minnesota Rules, part 7030.0040, subpart 2 and MPCA 2008a.

- Land use activities under NAC 1 include household units, group quarters, residential hotels, transient lodging camp grounds, correctional institutions, mobile home parks or courts, health and educational services, religious activities, resorts, camping and picnicking areas, motion picture production, and other cultural, entertainment, and recreational activities.
- Land use activities under NAC 2 include rail, road, water, and air transportation activities (passenger), wholesale and retail trade, parks, recreational activities (except entertainment assembly and race tracts), automobile parking, personal services, business services, and other professional services (repair, legal, and contract construction services).
- Land use activities under NAC 3 include manufacturing, petroleum refining and related industries, primary metal industries, race tracks, fair grounds and amusement parks, agricultural and fishing-related activities, retail trade (eating and drinking) and transportation, communication, and utilities (except transportation services and arrangements).

As shown in Table 5.2.8-1, the most stringent standard is the nighttime (10 p.m. to 7 a.m.) standard in a NAC 1, which is 50 dBA for no more than 50 percent of the time (L_{50}). In other words, a nighttime L_{50} of 50 dBA means that from 10 p.m. to 7 a.m., noise levels may not exceed 50 dBA more than 30 minutes in an hour. Similarly, a nighttime L_{10} of 55 dBA means that during these same hours, noise levels may not exceed 55 dBA more than 6 minutes in an hour. Land use activities under NAC 1 include household units or private residences, mobile home parks, transient lodging campgrounds and picnic areas, churches, schools, hospitals, and other cultural, entertainment, and recreational activities.

There are no federal or local noise regulations that would apply to the NorthMet Project Proposed Action.

In addition to state and federal standards, the degree of disturbance becomes a key factor in the evaluation of noise effects, which, in this case, includes a focus on residents in the vicinity of the NorthMet Project Proposed Action, as well as people who frequent the area for recreation, fishing, and hunting, and tribal members who may be involved in traditional natural resource harvests on national forest lands. The concept of human disturbance is known to vary with a number of interrelated factors including: changes in noise levels; the presence of other, non-project-related noise sources in the vicinity; people's attitudes toward the project; the number of people exposed; and the type of human activity affected (e.g., sleep or quiet conversation as compared to physical work or active recreation).

NorthMet Project Proposed Action-related noise effects have been evaluated at sensitive receptors using the state daytime and nighttime noise standards (L_{50} and L_{10}) for NAC 1. These noise standards would apply to the NorthMet Project area throughout the years that the mine is operating (years 1 to 20), when elevated sound level activities from mining, hauling, and crushing operations would occur. The same noise standards would also apply to any potential noise source during closure and post-closure (i.e., after year 20).

Area of Audibility for Boundary Waters Canoe Area Wilderness

Sound from project activities may be audible even if the sound level is lower than the background ambient level. This is because stationary (e.g., drill rigs, crushers) and mobile sources (e.g., dump trucks, graders) associated with mining and crushing activities at the Mine Site and Plant Site may be of a different quality (e.g., electric motor or diesel engine versus a bird call) than natural ambient sound.

It is assumed that noise associated with drilling, excavating, hauling, and crushing activities may be audible up to the location that sound level emitted from these project-related sources attenuates to a level that is 8 dBA below ambient A-weighted sound level. This is identified by the National Park Service at 64 FR 3969-3972 for noise emitted by aircraft that may affect Park visitors. There may be some variability when comparing sound propagation from aircraft engines as done by the National Park Service versus project-related sources (electric motors, diesel engines, etc.). However, for the purpose of this analysis, the 8 dBA method is considered adequate to estimate audible distance from noise sources at the Mine Site and Plant Site. It should be noted that the area of audibility usually applies to certain areas considered by the National Park Service to require substantial restoration of natural quiet (64 FR 3969-3972). For the NorthMet Project Proposed Action, the area of audibility or audibility impacts applies to the BWCAW only. An area of audibility could also be calculated for other non-wilderness receptor locations such as recreational sites within the vicinity of the NorthMet Project area. However, since the area of audibility is based on measured baseline levels for each receptor of concern, separate areas of audibility would be needed for each receptor type. Applying the area of audibility for the BWCAW for other receptor locations is conservative due to the expected higher baseline levels in these areas.

5.2.8.1.2 Vibration and Airblast

Ground Vibration Impact Assessment Methodology

The ground vibration impact assessment area for the NorthMet Project Proposed Action encompasses a 20-mile radius from the Mine Site. When an explosive is detonated in a blasthole, a pressure wave is generated in the surrounding rock. As this pressure wave moves from the borehole, it forms seismic waves by displacing particles in the earth (e.g., glacial till, bedrock). Ground vibration varies with distance from the blast, charge mass per hole, type of explosive, geological conditions, and blasting specifications. For similar geological conditions and blasting specifications, ground vibration varies with distance from the blast and charge mass per hole, according to the Site Law formula. This formula has been used for assessing ground vibration effects from blasting activities at multiple mine and quarry sites in Australia and has also been used in this assessment. The formula accounts for different rock types with a site constant K_g (see note in Table 5.2.8-4 for definition of K_g). Typical K_g factors for free-face hard or highly structured rock, free-face average rock, and heavily confined rock are 500, 1,140, and 5,000, respectively (Dyno Nobel 2010). This vibration assessment has been conducted using a range of these three K_g factors to allow for varying degrees of vibration transmission through different rock types.

Airblast Overpressures Impact Assessment Methodology

The impact assessment area for airblast overpressure (or blasting noise) for the NorthMet Project Proposed Action is the same area that was used to evaluate ground vibration. An airblast is an airborne shock wave that results from the detonation of explosives. The magnitude of airblast overpressure levels at a point remote from the blast is a function of many parameters including charge mass (mass of explosive per drilled hole), confinement, burden (distance between two drilled holes and perpendicular to the free face), attenuation rate, shielding direction relative to the blast, and meteorological conditions at the time of the blast. The attenuation rate for low-frequency blast vibration has been found from experience to be a 9 dBL reduction per doubling of distance (Terrock Consulting Engineers 2009).

Analysis of blasting data from mines and quarries has permitted a relationship to be established between the maximum 120 dBL distance (the distance in front of the blast that the 120 dBL contour occurs), charge mass per hole, and burden using the Terrock model. This model has been used for assessing airblast effects from blasting activities at multiple mine and quarry sites in Australia and has also been used in this assessment. The model accounts for a dimensionless empirical constant, k_a (usually 250 for quarry and mine blasting), and determines the maximum distance to the 120 dBL contour from the blast site.

Ground Vibration and Airblast Overpressure Evaluation Criteria

Humans can feel ground vibration and airblast overpressures at levels well below those that can cause damage to property. Ground vibration and airblast overpressure limits, therefore, have two aspects: an environmental or acceptable human response (annoyance) limit, and a limit to prevent structural damage (which should be considered separately).

To minimize human annoyance and prevent structural damage to properties outside mining areas, the effects of ground vibration and air overpressure from blasting operations must meet the requirements of *Minnesota Rules*, part 6132.2900, subpart 2. According to the *Minnesota Rules*, the maximum PPV from blasting should not exceed 1 in/s (25.4 mm/s) at the location of a structure located on lands not owned or controlled by the permittee. Air overpressure on lands not owned or controlled by the permittee should not exceed 130 dB, as measured on a linear peak scale (dBL) sensitive to a frequency band ranging from 6 cycles per second to 200 cycles per second.

Ground vibration and air blast (overpressure) from rock blasting are primarily related to the weight of explosive detonated at any single instant and the distance to a structure or sensitive receptor.

Aside from the *Minnesota Rules*, there are no specific federal or local vibration regulations associated with mine blasting that would apply to the NorthMet Project Proposed Action.

5.2.8.2 NorthMet Project Proposed Action

5.2.8.2.1 Noise

The primary sources of noise from the Mine Site (3,014.5 acres) during operations would be drilling; blasting; excavation work (hydraulic excavators, front-end loaders); dump trucks hauling material along mine haul roads; material-handling activities at the Rail Transfer Hopper, Overburden Storage and Laydown Area, and waste rock stockpiles; and train horns. Noise would also be generated from auxiliary and support equipment such as tracked dozers, wheel dozers, graders, water trucks, backhoes, and fuel trucks. The sound power levels for each of these sources, based on data from operating mines, are summarized in Table 5.2.8-2.

Table 5.2.8-2 Maximum Sound Power Levels of Major Equipment and Trucks during Operations at the Mine Site and Plant Site

Noise Source Description	Octave Band Center Frequency (Hz) 63.0	125.0	250.0	500.0	1000.0	2000.0	4000.0	8000.0	Overall Linear-Weighted Sound Power Level (dBL)	Overall A-Weighted Sound Power Level (dBA)
Mine Site										
Rotary Drill Rig	110.0	123.0	114.0	119.0	111.0	109.0	103.0	98.0	125.0	119.0
Hydraulic Excavator (31-cy)	111.0	122.0	118.0	117.0	115.0	110.0	104.0	99.0	125.0	119.0
Hydraulic Excavator (31-cy)	111.0	122.0	118.0	117.0	115.0	110.0	104.0	99.0	125.0	119.0
Hydraulic Excavator (31-cy)	111.0	122.0	118.0	117.0	115.0	110.0	104.0	99.0	125.0	119.0
Front-end Loader (21.5-cy)	112.0	111.0	112.0	114.0	112.0	112.0	106.0	101.0	120.0	117.0
Tracked Dozer (582-hp)	118.0	118.0	104.0	100.0	104.0	102.0	97.0	92.0	121.0	109.0
Tracked Dozer (582-hp)	118.0	118.0	104.0	100.0	104.0	102.0	97.0	92.0	121.0	109.0
Wheel Dozer (450-hp)	117.0	123.0	119.0	111.0	107.0	101.0	91.0	83.0	125.0	115.0
Grader (275-hp)	111.0	117.0	113.0	105.0	101.0	95.0	85.0	77.0	119.0	109.0
Grader (275-hp)	111.0	117.0	113.0	105.0	101.0	95.0	85.0	77.0	119.0	109.0
Water Truck (937-hp)	107.0	110.0	116.0	114.0	109.0	107.0	101.0	102.0	120.0	116.0
Water Truck (937-hp)	107.0	110.0	116.0	114.0	109.0	107.0	101.0	102.0	120.0	116.0
Wheel Loader (800-hp)	112.0	111.0	112.0	114.0	112.0	112.0	106	101.0	120.0	117.0
Backhoe (110-hp)	111.0	117.0	113.0	105.0	101.0	95.0	85.0	77.0	119.0	109.0
Fuel Truck (150-hp)	111.0	117.0	113.0	105.0	101.0	95.0	85.0	77.0	119.0	109.0
Fuel Truck (150-hp)	111.0	117.0	113.0	105.0	101.0	95.0	85.0	77.0	119.0	109.0
Dump Truck (240-ton)	95.0	100.0	109.0	114.0	117.0	116.0	111.0	100.0	121.0	121.0
Dump Truck (240-ton)	95.0	100.0	109.0	114.0	117.0	116.0	111.0	100.0	121.0	121.0
Dump Truck (240-ton)	95.0	100.0	109.0	114.0	117.0	116.0	111.0	100.0	121.0	121.0

Noise Source Description	Octave Band Center Frequency (Hz) 63.0	125.0	250.0	500.0	1000.0	2000.0	4000.0	8000.0	Overall Linear-Weighted Sound Power Level (dBL)	Overall A-Weighted Sound Power Level (dBA)
Mine Site										
Dump Truck (240-ton)	95.0	100.0	109.0	114.0	117.0	116.0	111.0	100.0	121.0	121.0
Dump Truck (240-ton)	95.0	100.0	109.0	114.0	117.0	116.0	111.0	100.0	121.0	121.0
Dump Truck (240-ton)	95.0	100.0	109.0	114.0	117.0	116.0	111.0	100.0	121.0	121.0
Dump Truck (240-ton)	95.0	100.0	109.0	114.0	117.0	116.0	111.0	100.0	121.0	121.0
Dump Truck (240-ton)	95.0	100.0	109.0	114.0	117.0	116.0	111.0	100.0	121.0	121.0
Dump Truck (240-ton)	95.0	100.0	109.0	114.0	117.0	116.0	111.0	100.0	121.0	121.0
Total Sound Power Level from all equipment at the Mine Site	125.0	131.0	128.0	128.0	128.0	127.0	121.0	113.0	136.0	133.0
Plant Site										
Primary Crusher	123.0	123.0	121.0	111.0	106.0	105.0	100.0	94.0	127.0	116.0

[1] Assumes all mine equipment and trucks would be in continuous operation at any given time at the Mine Site.
[2] Sound power levels for all equipment and trucks at the Mine Site were taken from the Noise and Vibration Assessment for the Clermont Coal Mine Project, Queensland Australia, August 2004 (Bassett Acoustics 2004). Sound power levels for backhoe and fuel trucks were not available and were assumed to be the same as for the graders due to their similar hp ratings.
[3] Sound power levels for the primary crusher at the Plant Site (116 dBA) were taken from the McArthur River Mine Open Cut Project, Australia (URS 2005).
[4] All mine and plant equipment were assumed to be approximately 5 meters from ground level.
[5] Total sound power level from all equipment at the Mine Site was calculated by logarithmically adding all the octave-band sound power levels for each piece of equipment at the site.

To estimate potential noise effects on closest receptors, noise from proposed mine operations was modeled using the ISO 9613-2 sound-propagation model, as described in Section 5.2.8.1. The Mine Site assessment predicted effects at nine different receptor locations scattered throughout the vicinity of the site. The closest noise-sensitive areas to the Mine Site are shown on Figure 4.2.8-1; the closest of these is the City of Babbitt, located 6.5 miles north of the Mine Site. In addition to the nine identified receptors, other sensitive receptors such as trails and recreational sites (family campgrounds, camp sites, boating, fishing, swimming, and family picnic areas) within the NorthMet Project are vicinity are also shown on Figure 4.2.8-1.

All major mine equipment and trucks shown in Table 5.2.8-2 were assumed to be steady noise sources (see Section 4.2.8.1, Types of Noise) operating simultaneously and continuously for 24 hours per day. This is a conservative assumption, as most noise sources identified in Table 5.2.8-2 are mobile sources such as dump trucks, fuel trucks, dozer, graders, etc., which are non-steady sources (i.e., fluctuating or intermittent sources) that would not operate simultaneously or continuously for 24 hours per day. Tonal noise may occur as a result of the moving parts of internal combustion engines of mobile sources; however, the overestimated sound power levels resulting from the conservative assumption described above (i.e., that all mobile sources are steady sources operating simultaneously) would likely offset any noise increases associated with tonal sounds. The NorthMet Project Proposed Action would not generate highly impulsive sounds such as drop hammering, pile driving, or pavement breaking. High-energy impulsive sounds associated with the use of explosives during blasting (i.e., blasting noise or airblast overpressures) are discussed in Section 5.2.8.2.2. As indicated in Section 4.2.8.1, Types of Noise, annoyance to sounds with strong low-frequency content is virtually only an indoor problem. Because the closest residences (i.e., indoor receptors) are over 8 and 4 miles from the Mine Site and Plant Site, respectively (see Tables 5.2.8-3 and 5.2.8-4), the likelihood of low-frequency-induced annoyance at such distances is very low.

Modeled sound levels from all mine equipment and trucks experienced at the nearest receptors during daytime and nighttime mine operations (excluding baseline levels and plant sources), are shown in Table 5.2.8-3.

Table 5.2.8-3 Predicted Noise Levels at Nearest Receptors to Mining and Hauling Operations at Mine Site (excludes Baseline Levels)

	Distance to Mine Site (miles)[2]		Daytime Noise Levels at Closest Receptors to Mine Site (excludes Baseline Levels) (dBA)			Nighttime Noise Levels at Closest Receptors to Mine Site (excludes Baseline Levels) (dBA)		
Receptor	**Distance**	**Direction**	**L_{eq}**	**L_{50}**	**L_{10}**	**L_{eq}**	**L_{50}**	**L_{10}**
Private Residences (R-1)	8.4	NW	11.9	10.9	14.7	11.9	10.9	14.7
Hoyt Lakes (R-2)	10.3	SW	9.1	8.1	11.9	9.1	8.1	11.9
Boy Scout Camp (R-3)	12.3	SW	6.7	5.7	9.5	6.7	5.7	9.5
Babbitt (R-4)	6.5	N	15.2	14.2	18.0	15.2	14.2	18.0
Skibo (R-5)	9.1	S	10.8	9.8	13.6	10.8	9.8	13.6
Aurora (R-6)	13.8	SW	5.1	4.1	7.9	5.1	4.1	7.9
Ely (R-7)	20.4	N-NE	0.0	0.0	3.8	0.0	0.0	3.8
BWCA Wilderness (R-8)	21.9	N	0.0	0.0	3.8	0.0	0.0	3.8
Tower (R-9)	19.3	NW	0.3	0.0	3.8	0.3	0.0	3.8

[1] N=North, S=South, E=East, W=West, NW=Northwest, NE=Northeast, SW=Southwest

Table 5.2.8-3 indicates that the highest noise levels that would be experienced during operations at the Mine Site would occur at the closest receptors in Babbitt. Excluding baseline levels, L_{50} and L_{10} noise levels from the Mine Site are 14.2 and 18.0 dBA, respectively. Due to the low noise contribution from the Mine Site sources, total L_{50} and L_{10} noise levels at Babbitt and other receptors during daytime and nighttime, inclusive of baseline noise levels, would remain the same (i.e., no change in baseline levels when combined with Mine Site noise levels). The predicted L_{eq} at noise-sensitive receptors around the Mine Site were converted to L_{50} and L_{10} using a USEPA calculation methodology (USEPA 1974). The calculation was based on an assumed standard deviation of 3 dBA for sound level distribution.

The primary sources of noise along the Transportation and Utility Corridor would be trains and train horns used during ore transport from the Mine Site to the Plant Site. The noise from the trains and their horns is expected to have minimal effects because the railroad route between the two locations is approximately 4 to 5 miles from the nearest receptors. Up to 22 trains per day are expected to deliver ore to the Plant Site. This frequency of traffic is less than that experienced on the rail line during past mining operations.

The primary sources of noise from the Plant Site would be crushers. Noise from other sources such as pumps at the existing LTVSMC Tailings Basin is expected to be minor in comparison to noise from the crushers, and, as such, was not quantified. The sound power level for the crushers was estimated to be 116 dBA (Table 5.2.8-2). Sound-propagation modeling was performed for the crushers using the ISO 9613-2 sound-propagation model and assumptions described in Section 5.2.8.1. Modeled sound levels experienced at the nearest receptors during ore-crushing operations, plus baseline levels (excluding baseline levels and mine sources), are shown in Table 5.2.8-4.

Table 5.2.8-4 Predicted Noise Levels at Nearest Receptors to Ore-crushing Operations at Plant Site (excludes Baseline Levels)

	Distance to Mine Site (miles)[2]		Daytime Noise Levels at Closest Receptors to Plant Site (excludes Baseline Levels) (dBA)			Nighttime Noise Levels at Closest Receptors to Plant Site (excludes Baseline Levels) (dBA)		
Receptor	**Distance**	**Direction**	L_{eq}	L_{50}	L_{10}	L_{eq}	L_{50}	L_{10}
Private Residences (R-1)	4.2	N	14.5	13.5	17.3	14.5	13.5	17.3
Hoyt Lakes (R-2)	5.6	S	11.0	9.9	13.8	11.0	9.9	13.8
Boy Scout Camp (R-3)	6.5	S	9.2	8.2	12.0	9.2	8.2	12.0
Babbitt (R-4)	11.8	NE	2.1	1.1	4.9	2.1	1.1	4.9
Skibo (R-5)	10.5	SE	3.5	2.5	6.3	3.5	2.5	6.3
Aurora (R-6)	6.7	SW	9.0	7.9	11.8	9.0	7.9	11.8
Ely (R-7)	24.4	NE	0.0	0.0	3.8	0.0	0.0	3.8
BWCA Wilderness (R-8)	23.0	N	0.0	0.0	3.8	0.0	0.0	3.8
Tower (R-9)	15.4	NW	0.0	0.0	3.8	0.0	0.0	3.8

[1] N=North, S=South, NW=Northwest, NE=Northeast, SW=Southwest, SE=Southeast

Table 5.2.8-4 indicates the highest nighttime L_{50} and L_{10} levels that would be experienced at the closest receptor (private residences, 4.2 miles north of the Plant Site) due to operations at the Plant Site are 13.5 and 17.3 dBA, respectively, exclusive of baseline levels. Due to the low noise contribution from the Plant Site crushers, total L_{50} and L_{10} at the private residences and other receptors during daytime and nighttime, inclusive of baseline noise levels, would remain the same (i.e., no change in baseline levels at closest receptors when combined with Plant Site noise levels).

PolyMet plans to relocate the coal ash landfill from its current location to disposal in the hydrometallurgical residue facility. This relocation of the coal ash landfill would result in temporary noise associated with the use of tracked excavators or front-end loaders for removing fill materials, truck movements along a 2.5-mile haul road to the future Hydrometallurgical Residue Facility, and other construction equipment such as a grader, dozer, and water truck. These activities would be short-term (approximately 50 shifts with 8 hours per shift) and would occur mostly during daytime when noise increases are more tolerable. In addition, there are no noise sensitive receptors in close proximity or within a 1-mile radius of these activities. Based on the information above, noise impacts associated with the relocation of the coal ash landfill would not exceed applicable evaluation criteria.

Aside from the relocation of the landfill, PolyMet also plans to replace the existing conventional ball mills at the Plant Site with semi-autogenous mills. The sound power levels for the replacement semi-autogenous mills are expected to generate a less or equal amount of noise level when compared to the existing ball mills and, as such, are not likely to result in any noise increases. Therefore, noise impact from this change would not exceed applicable evaluation criteria.

The total combined noise effect from operations at the Mine Site, Transportation and Utility Corridor, and Plant Site plus baseline levels is discussed in Section 5.2.8.2.3, Total Noise Effects from NorthMet Project Proposed Action Operations. The area of audibility and noise effects on off-site transportation are also discussed in Section 5.2.8.2.3.

5.2.8.2.2 Ground Vibration and Airblast Overpressure

The potential for ground vibration from hauling material via dump trucks along the mine haul road is expected to be low since rubber-tired vehicles do not generate any significant amount of ground vibration. However, blasting at the Mine Site could affect surrounding residential receptors and structures or buildings with regard to ground vibration and airblast overpressure. The potential effects of ground vibration and airblast overpressure are discussed below. PolyMet has committed to develop an ore and rock blasting program with industry standard methods and experiences from other area mines, including blast vibration damage prevention and monitoring.

Ground Vibration from Blasting at the Mine Site

Except at very close distances to a blast, when permanent ground displacement could occur, ground vibration is an elastic wave motion and the ground returns to its original position after the wave passes. The attenuation rate varies based on the characteristics of the rock through which the vibration travels. Characteristics such as faults and jointing planes, degree and depth of weathering, and the top soil profile contribute to a wide variation of vibration levels.

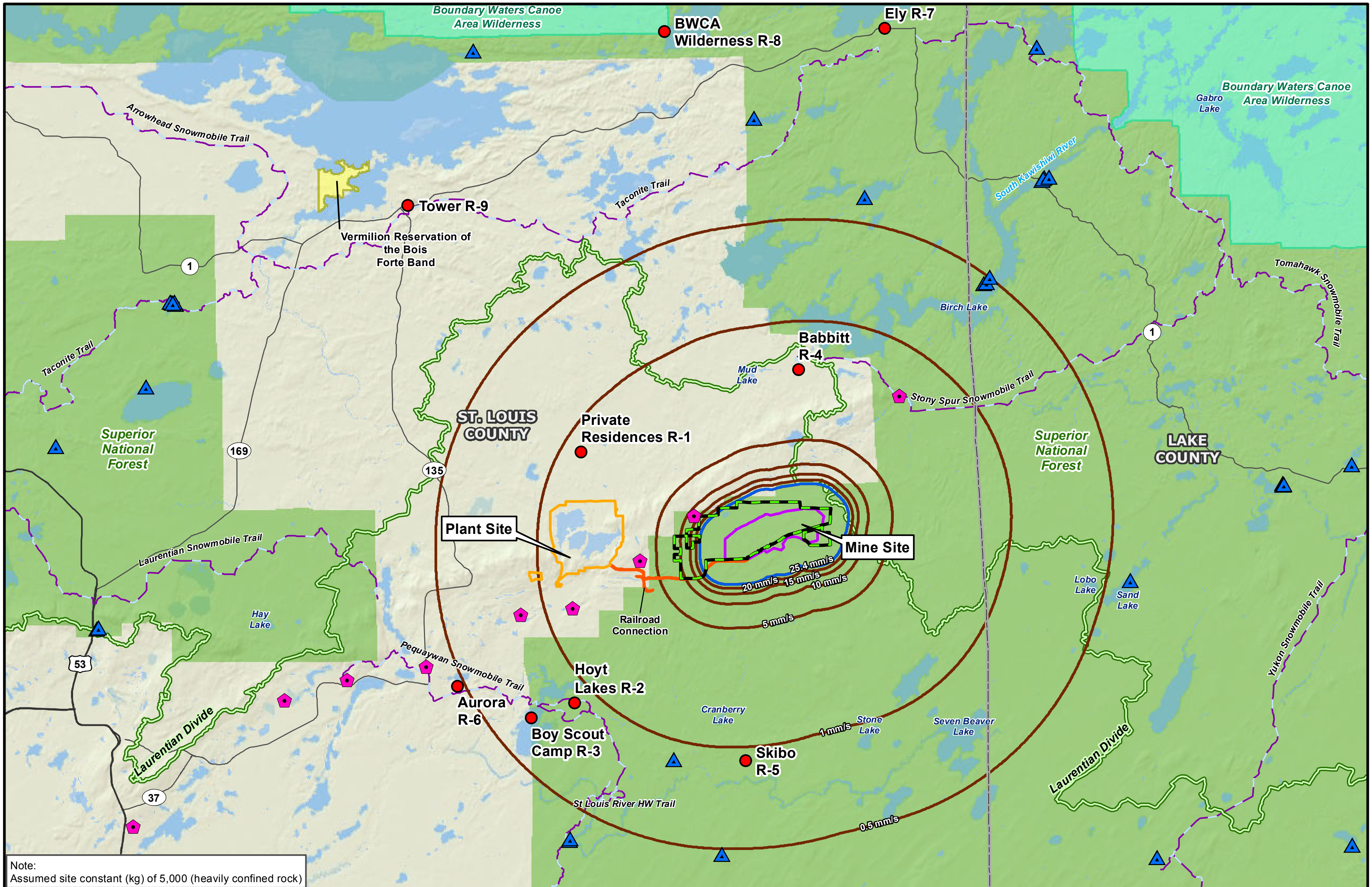
The potential effect of ground vibration from blasting at the Mine Site was assessed using the Site Law formula, as described in Section 5.2.8.1. The vibration assessment was conducted over a range of K_g factors that represent the vibration transmission through different types of ore or waste rock. Using the Site Law formula and appropriate blast parameters, the limiting distances (i.e., distances beyond which an effect would not occur using different K_g factors) for ore and waste rock blasts at ground vibration levels ranging from 0.5 to 25.4 mm/s were calculated and are shown in Table 5.2.8-5. Ground vibration contours from blasting at the Mine Site are shown on Figure 5.2.8-1 (based on a maximum K_g factor of 5,000 for heavily confined rocks).

Table 5.2.8-5 Limiting Distances for Ore and Waste Rock Blasts at Incremental Ground Vibration Levels

Ground Vibration, PPV	Limiting Distance from Blast, D (m)[1]		
(mm/sec)	k_g = 500	k_g = 1,140	k_g = 5,000
25.4	375	627	1,581
20	435	728	1,835
15	521	872	2,197
10	671	1,123	2,830
5	1,035	1,733	4,365
3	1,424	2,384	6,007
1	2,830	4,738	11,936
0.5	4,365	7,306	18,407

Notes:
kg = Site specific empirical constant for predicting ground vibration levels (dimensionless). Usually determined by site calibration. Typical Kg factors for free face hard /highly structured rock, free face average rock, and heavily confined rock are 500, 1140, and 5000, respectively.
[1] Limiting distances for predicting ground vibration levels from blasting were estimated based on the charge mass per hole (3,388 kg/hole). The charge mass per hole was estimated using the blast parameters and specification for this project such as blasthole diameter (311 mm), hole length (22.6 m), burden (8.84 m), spacing (10.1 m), and explosive density (1.69 kg/m^3).

335 -Page Intentionally Left Blank-



Note:
Assumed site constant (kg) of 5,000 (heavily confined rock)

Noise Sensitive Receptor
Federal Lands
Plant Site
Mine Site
Transportation and Utility Corridor
Recreational Site
Native American Reservation
Boundary Waters Canoe Area Wilderness
National Forest
Wildlife Travel Corridor
Ground Vibration Contours
Minnesota Ground Vibration Limit (25.4 mm/s)

US Army Corps of Engineers St. Paul District

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0 1 2 4 6 Miles

Figure 5.2.8-1
Predicted Ground Vibration Contours from Blasting at the Mine Site
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

337 -Page Intentionally Left Blank-

The environmental effects of blasting at non-ferrous mining operations are regulated by the MDNR to ensure that the effects of ground vibrations from production blasts would not be detrimental to human health or welfare or property outside the mining area. According to *Minnesota Rules,* part 6132.2900, subpart 2*,* the maximum PPV from blasting shall not exceed 1 in/s (25.4 mm/s) at the location of a structure located on lands not owned or controlled by the permittee. Assuming a worst-case K_g of 5,000 (heavily confined rocks) and 3,388 kg (7,471 lbs) of explosives per blast hole, the limiting distance for blasts at ground vibration levels of 25.4 mm/s (1 in/s) is 1,581 meters (0.98 mile) and the impact area for this Minnesota ground vibration limit is approximately 11,334 acres (see Table 5.2.8-5; Figure 5.2.8-1). None of the human or structural receptors are located within this ground vibration impact area. The maximum ground vibration level for the closest human or structural receptor in the City of Babbitt, 6.5 miles north of the Mine Site, from the blast site is predicted to be on the order of 1.24 mm/s (0.05 in/s). The predicted ground vibration at all nearby human and structural receptors resulting from blasting at the Mine Site would be well below the applicable limits in Minnesota. Blasting would not occur at night.

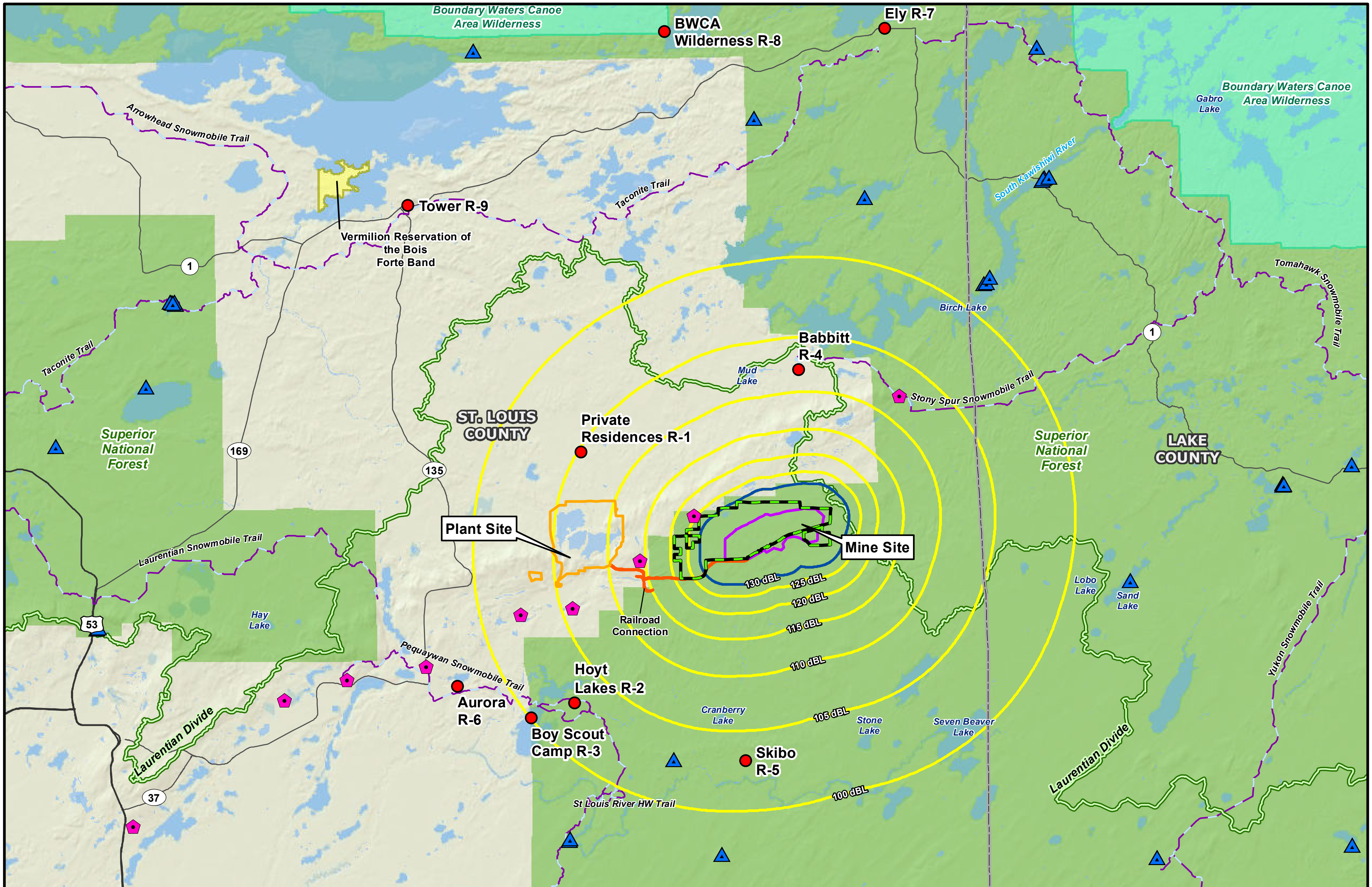
Figure 5.2.8-1 shows that there are no residences, recreational sites, trails, or MPCA staff recommended wild rice waters within the Minnesota ground vibration impact area (i.e., the Minnesota ground vibration limit of 25.4 mm/s, which is the blue contour line on the figure [11,334 acres]). The closest recreational site is a family picnic area located approximately 9 miles south of the Mine Site and Plant Site (near Skibo). This family picnic area as well as other recreational sites located further away such as those near Birch Lake and South Kawishiwi River are outside the impact area. The closest wildlife corridor located northeast of the Mine Site is also outside the impact area. The Upper St. Louis River contains wild rice beds used by tribal members for traditional resource harvests. The wild rice beds are usually in close proximity to MPCA staff-recommended wild rice waters such as Mud Lake and Birch Lake (north of Mine Site), Lobo Lake and Sand Lake (east of Mine Site), Stone Lake and Seven Beaver Lake (southeast of Mine Site), Cranberry Lake (south of Mine Site), and Hay Lake (west of Plant Site). There are no wild rice beds or MPCA staff-recommended wild rice waters within the impact area.

Though not depicted on Figure 5.2.8-1 due to sensitivity regarding cultural resources and locations, three archaeological sites have been identified within the NorthMet Project area: Spring Mine Lake Sugarbush, *Mesabe Widjiu* [Laurentian Divide], and BBLV Trail Segment #1 (USFS #01-569). The Spring Mine Lake Sugarbush and the *Mesabe Widjiu* are located more than 2 miles away from the Mine Site (approximately 1 mile from the Plant Site). Since ground vibration impacts from blasting at the Mine Site would be experienced less than a mile from the blast site, both archaeological sites are expected to be outside the ground vibration impact area (11,334 acres). The BBLV Trail Segment #1 (USFS #01-569), used by the Ojibwe people during early mineral exploration hundreds of years ago, remains an important cultural and spiritual connection for the Bands. The BBLV Trail Segment #1 (USFS #01-569) crosses the NorthMet Project area. Portions of the trail segment that cross the Mine Site are expected to be within the ground vibration impact area and may experience ground vibration levels close to the Minnesota standards. Details of the location and uses of the archaeological sites are discussed in Section 4.2.9, Cultural Resources.

Based on the information above, ground vibration levels from mine blasting are expected to be below the Minnesota ground vibration standards for humans and structures (*Minnesota Rules,* part 6132.2900, subpart 2), including people that use the Superior National Forest for recreational activities such as family campgrounds, camp sites, fishing, boating, swimming, and family picnic areas. Immediate access to areas around the Mine Site would be restricted, but tribal members who may have a cultural and spiritual connection to archaeological sites in the Superior National Forest, in areas immediately near the mine, may occasionally experience ground vibration associated with the NorthMet Project Proposed Action. Mitigation measures for the impacted cultural resource areas are discussed in Section 5.2.9, Cultural Resources. During the closure and post-closure phases (i.e., after year 20), blasting at the Mine Site would cease, so no blast-related ground vibration would occur. Machinery, such as planters used to restore and rehabilitate the Mine Site during the closure phase, would not generate a significant amount of ground vibration. Therefore, potential ground vibration levels during the closure and post-closure phases are expected to be below the Minnesota ground vibration standards for humans and structures (*Minnesota Rules,* part 6132.2900, subpart 2).

Airblast Overpressure from Blasting at the Mine Site

The airblast overpressure (or blasting noise) effect from the Mine Site was assessed using the Terrock model, as described in Section 5.2.8.1. Using this analytical method for ore and/or waste rock blasts at the Mine Site, the 120 dBL distance for the assumed blast specifications is a maximum of 3,451 meters (2.2 miles) in front of the blast (see Table 5.2.8-6). The incremental distances for airblast overpressure levels from 100 to 130 dBL were calculated using an attenuation rate of a 9 dBL decrease per doubling of distance (Terrock Consulting Engineers 2009). Airblast contours for these overpressure levels from blasting at the Mine Site are shown on Figure 5.2.8-2.



Noise Sensitive Receptor
Plant Site
Mine Site
Transportation and Utility Corridor
Federal Lands
Wildlife Travel Corridor
Native American Reservation
Boundary Waters Canoe Area Wilderness
Recreational Site
Airblast Contour
Minnesota Airblast Limit (130 dBL)
National Forest

US Army Corps of Engineers St. Paul District

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N W E S

0 1 2 4 6 Miles

Figure 5.2.8-2
Predicted Airblast Contours from Blasting at the Mine Site
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

406

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Table 5.2.8-6 Limiting Distances for Ore and Waste Rock Blasts at Incremental Airblast Overpressure Levels

Hole Diameter, d (mm)	Burden, B (mm)	Charge Mass per Hole, M (kg/hole)	Distance to the 120 dBL Contour, D_{120} (m)	Distance to the 130 dBL Contour, D_{130} (m)	Distance to the 125 dBL Contour, D_{125} (m)	Distance to the 115 dBL Contour, D_{115} (m)	Distance to the 110 dBL Contour, D_{110} (m)	Distance to the 105 dBL Contour, D_{105} (m)	Distance to the 100 dBL Contour, D_{100} (m)
311	8,839	3,388	3,451	1,602	2,351	5,065	7,434	10,912	16,016

Note: Based on the computed distance for the 120 dBL contours, the distances for the other airblast contour levels (130 dBL, 125 dBL, 115 dBL, 110 dBL, 105 dBL, and 100 dBL) were calculated using an attenuation rate of 9 dBL decrease per doubling of distance.

As with ground vibration, the environmental effects of airblasts are regulated by the MDNR. According to *Minnesota Rules*, part 6132.2900, subpart 2, air overpressure on lands not owned or controlled by the permittee shall not exceed 130 dBL. The distance from the Mine Site to the 130 dBL compliance level is 1,602 meters (1 mile) and the impact area for this Minnesota airblast overpressure limit is approximately 11,469 acres. None of the receptors (buildings or structures) is close enough to the Mine Site to achieve this level of exposure (Figure 5.2.8-2). The maximum airblast overpressure level for the closest receptor in the City of Babbitt is predicted to be approximately 106 dBL. The predicted airblast overpressures at all nearby receptors resulting from blasting activities at the Mine Site would be below the applicable limits in Minnesota. Blasting would not occur at night.

Figure 5.2.8-2 shows that there are no residences, recreational sites, trails, or state wild rice beds within the Minnesota airblast overpressure impact area (11,469 acres). The closest recreational site is a family picnic area located approximately 9 miles south of the Mine Site and Plant Site (near Skibo). This family picnic area as well as other recreational sites located further away such as those near Birch Lake and South Kawishiwi River are outside the impact area. The closest wildlife corridor located northeast of the Mine Site is also outside the impact area.

Though not depicted on Figure 5.2.8-2 due to sensitivity regarding cultural resources and locations, three archaeological sites have been identified within the NorthMet Project area: Spring Mine Lake Sugarbush, *Mesabe Widjiu* [Laurentian Divide], and BBLV Trail Segment #1 (USFS #01-569). The Spring Mine Lake Sugarbush and the *Mesabe Widjiu* are located more than 2 miles away from the Mine Site and (approximately 1 mile from the Plant Site). Since airblast impacts from blasting at the Mine Site would be experienced approximately 1 mile from the blast site, both archaeological sites would be outside the airblast impact area (11,469 acres). As noted previously, the BBLV Trail Segment #1 (USFS #01-569) crosses the NorthMet Project area. Portions of the trail segment that cross the Mine Site would be within the airblast impact area and may experience airblast levels close to the Minnesota standards. Details of the location and uses of the archaeological sites are discussed in Section 4.2.9, Cultural Resources.

Based on the information above, airblast overpressure levels from mine blasting would be below the Minnesota airblast standards for humans and structures (*Minnesota Rules,* part 6132.2900, subpart 2); including people that use the Superior National Forest for recreational activities such as family campgrounds, camp sites, hiking, fishing, boating, swimming, and family picnic areas. Immediate access to areas around the mine would be restricted, but tribal members who may have a cultural and spiritual connection to archaeological sites in the Superior National Forest, in areas immediately near the mine, may occasionally experience airblast overpressures associated with the NorthMet Project Proposed Action. Mitigation measures for the impacted cultural resource areas are discussed in Section 5.2.9, Cultural Resources.

During the closure and post-closure phases (i.e., after year 20), blasting at the Mine Site would cease, so no airblast overpressures would occur during the closure and post-closure phases.

Vibration and Airblast Overpressure from Rail Transport

The transport of ore via trains from the Mine Site to the Plant Site could generate ground vibration within a few ft of the rail ROW, but due to the low volume of trains, such vibration levels are expected to be below the Minnesota ground vibration standards for humans and structures (*Minnesota Rules,* part 6132.2900, subpart 2). No blasting would occur along the Transportation and Utility Corridor, so ground vibration or airblast overpressure effects are not expected in this area.

Vibration and Airblast Overpressure at Plant Site

The crushers, water pumps (near the Tailings Basin) and other large stationary equipment that would be located at the Plant Site are designed to ensure that potential ground vibration effects are minimized to acceptable levels. Therefore, during operation, vibration levels at the receptors closest to the Plant Site would be below the Minnesota vibration standards for humans and structures (*Minnesota Rules,* part 6132.2900, subpart 2). No blasting would occur at the Plant Site, so ground vibration or airblast overpressure effects are not expected.

5.2.8.2.3 Total Noise Effects from NorthMet Project Proposed Action Operations

To determine the combined noise effect of the NorthMet Project Proposed Action, the total noise generated from operations at both the Mine Site and Plant Site was logarithmically added to the existing ambient daytime and nighttime baseline levels. Noise effects from rail transport were also assessed, but qualitatively.

Operations at the Mine Site and Plant Site would occur 24 hours per day. The total noise that would be experienced at any receptor location during the daytime (7 a.m. to 10 p.m.) and nighttime (10 p.m. to 7 a.m.) would be equal to the combined noise from both the mining and hauling operations at the Mine Site and the ore-crushing operations at the Plant Site, plus baseline noise levels.

Decibels are logarithmic values, so calculating the additive effect of two separate noise sources is a logarithmic calculation rather than an algebraic addition. This means that individual sound levels cannot be added directly to get the combined sound level. This also means that the greater the distance between two sound levels, the smaller the effect the lesser dB level would have on the total sound level.

The total noise associated with NorthMet Project Proposed Action operations when mining, hauling, and ore-crushing operations occur concurrently was calculated using data from Tables 5.2.8-3 (Mine Site) and 5.2.8-4 (Plant Site), along with baseline noise levels, and is summarized in Table 5.2.8-7. The calculations for daytime and nighttime noise levels are presented for comparison with the Minnesota noise standards. Aside from comparison to absolute noise limits, the NorthMet Project Proposed Action was also evaluated based on projected noise increases above baseline levels (i.e., 3 dB threshold of perception per MPCA 2008a). In all cases, the

NorthMet Project Proposed Action, when in operation, would comply with the applicable standard. Figures 5.2.8-3, 5.2.8-4, 5.2.8-5, and 5.2.8-6 show L_{50} and L_{10} noise contours at 5 dBA intervals during the daytime and nighttime.

Table 5.2.8-7 Total Noise Associated with Concurrent Operations at the Mine Site and Plant Site (includes Baseline Levels)

Receptor	Daytime and Nighttime Baseline Noise Levels (dBA)			Daytime Noise Levels at Closest Receptors to Mine Site and Plant Site Operations (plus Baseline Levels)[1], (dBA)			Nighttime Noise Levels at Closest Receptors to Mine Site and Plant Site Operations (plus Baseline Levels), (dBA)			Minnesota Daytime and Nighttime Noise Standards for Residential Areas (dBA)		
	L_{eq}	L_{50}	L_{10}	L_{eq}	L_{50}	L_{10}	L_{eq}	L_{50}	L_{10}	L_{eq}	L_{50}	L_{10}
Private Residences (R-1)	45.0 dBA (D); 35.0 dBA (N)	44.0 dBA (D); 34.0 dBA (N)	48.8 dBA (D); 37.8 dBA (N)	45.0	44.0	48.8	35.1	34.1	37.9	NA	60.0 dBA (D); 50.0 dBA (N)	65.0 dBA (D); 55.0 dBA (N)
Hoyt Lakes (R-2)	45.0 dBA (D); 35.0 dBA (N)	44.0 dBA (D); 34.0 dBA (N)	48.8 dBA (D); 37.8 dBA (N)	45.0	44.0	48.8	35.0	34.0	37.8	NA	60.0 dBA (D); 50.0 dBA (N)	65.0 dBA (D); 55.0 dBA (N)
Boy Scout Camp (R-3)	45.0 dBA (D); 35.0 dBA (N)	44.0 dBA (D); 34.0 dBA (N)	48.8 dBA (D); 37.8 dBA (N)	45.0	44.0	48.8	35.0	34.0	37.8	NA	60.0 dBA (D); 50.0 dBA (N)	65.0 dBA (D); 55.0 dBA (N)
Babbitt (R-4)	45.0 dBA (D); 35.0 dBA (N)	44.0 dBA (D); 34.0 dBA (N)	48.8 dBA (D); 37.8 dBA (N)	45.0	44.0	48.8	35.0	34.0	37.8	NA	60.0 dBA (D); 50.0 dBA (N)	65.0 dBA (D); 55.0 dBA (N)
Skibo (R-5)	45.0 dBA (D); 35.0 dBA (N)	44.0 dBA (D); 34.0 dBA (N)	48.8 dBA (D); 37.8 dBA (N)	45.0	44.0	48.8	35.0	34.0	37.8	NA	60.0 dBA (D); 50.0 dBA (N)	65.0 dBA (D); 55.0 dBA (N)
Aurora (R-6)	45.0 dBA (D); 35.0 dBA (N)	44.0 dBA (D); 34.0 dBA (N)	48.8 dBA (D); 37.8 dBA (N)	45.0	44.0	48.8	35.0	34.0	37.8	NA	60.0 dBA (D); 50.0 dBA (N)	65.0 dBA (D); 55.0 dBA (N)
Ely (R-7)	45.0 dBA (D); 35.0 dBA (N)	44.0 dBA (D); 34.0 dBA (N)	48.8 dBA (D); 37.8 dBA (N)	45.0	44.0	48.8	35.0	34.0	37.8	NA	60.0 dBA (D); 50.0 dBA (N)	65.0 dBA (D); 55.0 dBA (N)
BWCA Wilderness (R-8)	34.0 dBA (D); 34.0 dBA (N)	23.4 dBA (D); 23.4 dBA (N)	33.2 dBA (D); 33.2 dBA (N)	34.0	23.4	33.2	34.0	23.4	33.2	NA	60.0 dBA (D); 50.0 dBA (N)	65.0 dBA (D); 55.0 dBA (N)
Tower (R-9)	45.0 dBA (D); 35.0 dBA (N)	44.0 dBA (D); 34.0 dBA (N)	48.8 dBA (D); 37.8 dBA (N)	45.0	44.0	48.8	35.0	34.0	37.8	NA	60.0 dBA (D); 50.0 dBA (N)	65.0 dBA (D); 55.0 dBA (N)

Notes:

D= Daytime; N = Nighttime; NA = Not applicable (there are no L_{eq} standards for noise under the Minnesota Noise Standards).

[1] Total noise levels during daytime and nighttime were estimated by logarithmically adding the predicted noise levels from operations at the Mine Site (Table 5.2.8-3) and Plant Site (Table 5.2.8-4) with the existing baseline noise levels (baseline levels are provided in Table 4.2.8-3).

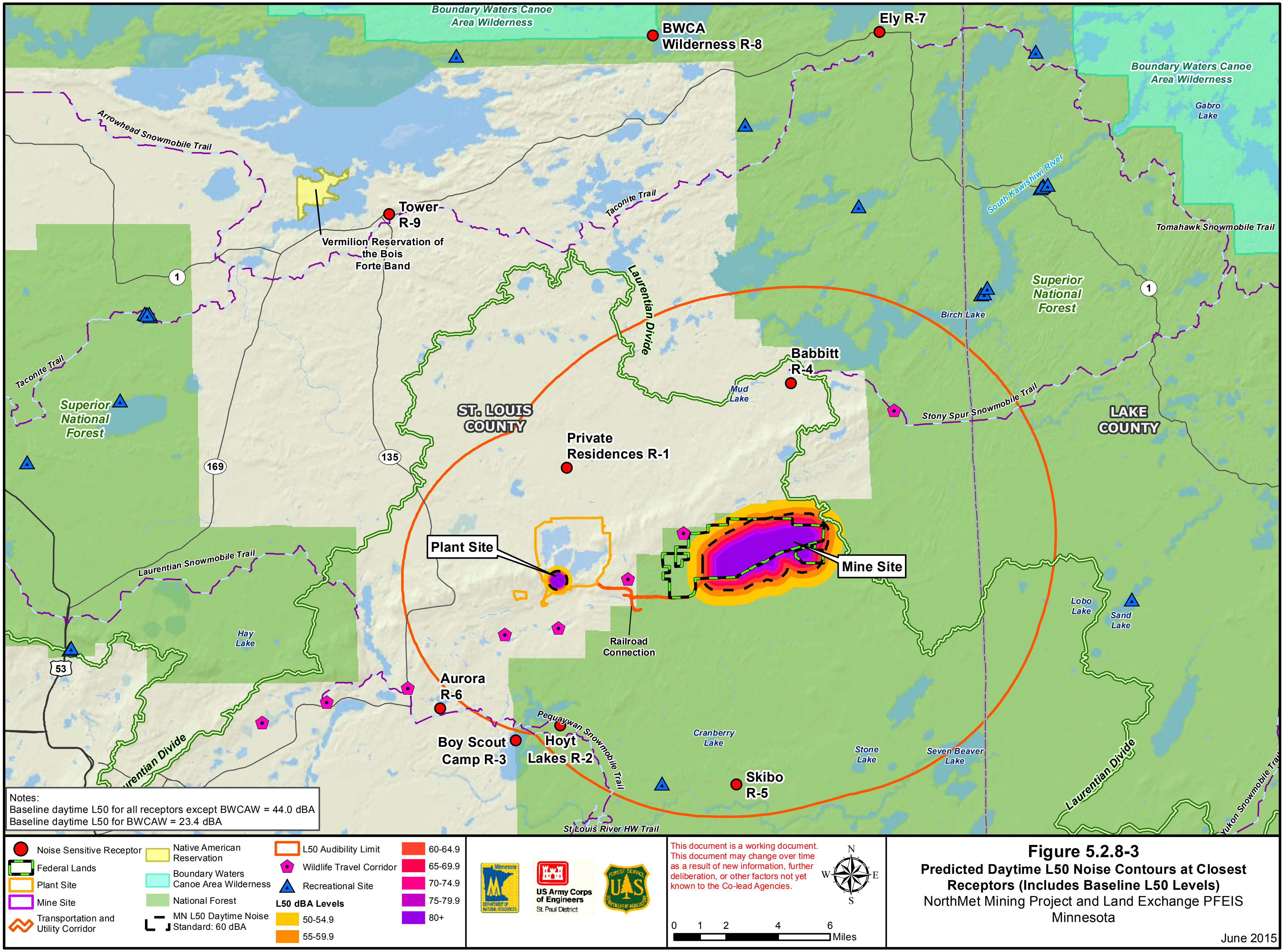

Figure 5.2.8-3

Predicted Daytime L50 Noise Contours at Closest Receptors (Includes Baseline L50 Levels)

NorthMet Mining Project and Land Exchange PFEIS

Minnesota

June 2015

495

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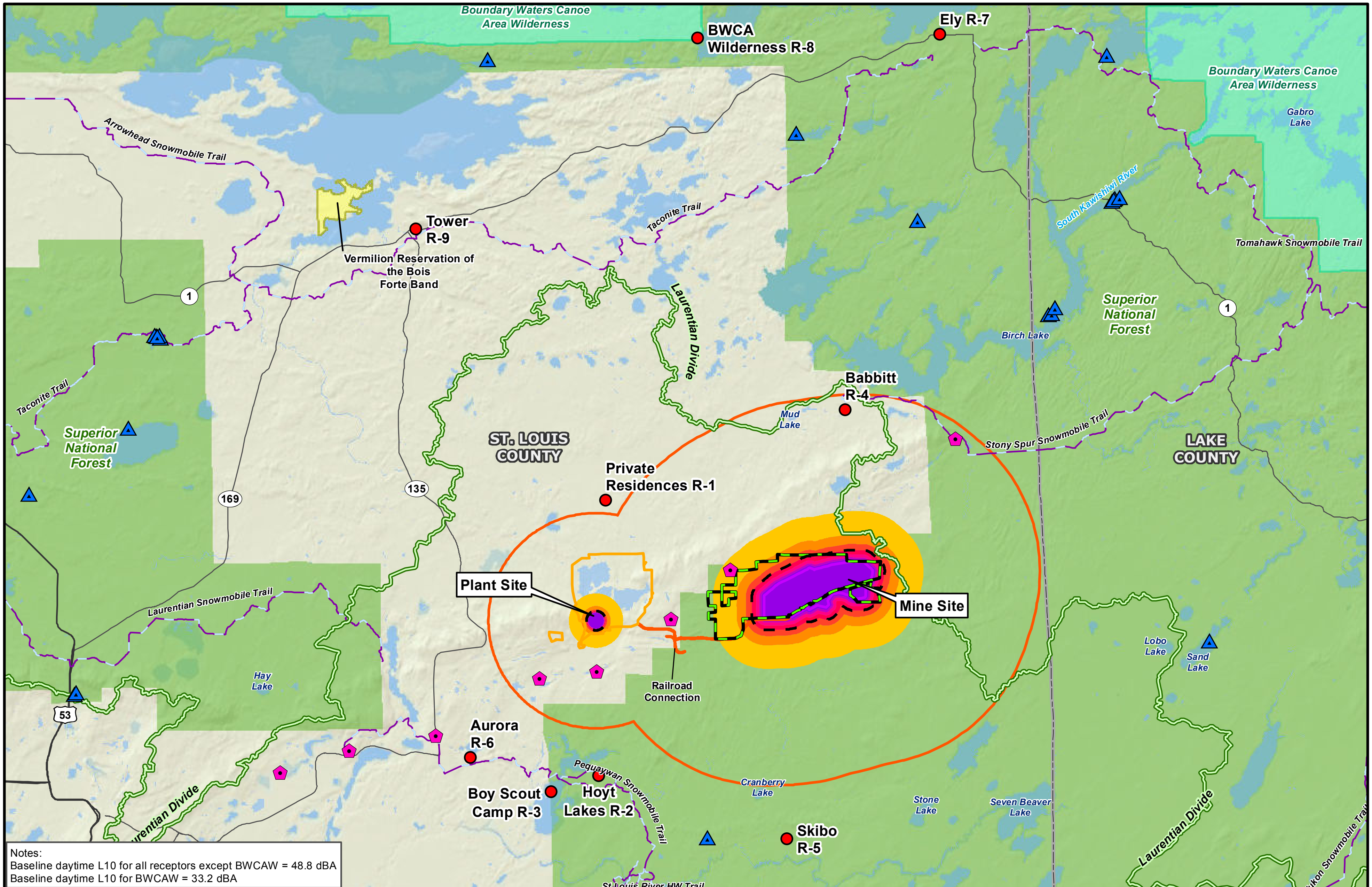

Notes:
Baseline daytime L10 for all receptors except BWCAW = 48.8 dBA
Baseline daytime L10 for BWCAW = 33.2 dBA

Noise Sensitive Receptor
Federal Lands
Plant Site
Mine Site
Transportation and Utility Corridor
Native American Reservation
Boundary Waters Canoe Area Wilderness
National Forest
MN L10 Daytime Noise Standard: 65 dBA
L10 Audibility Limit
Wildlife Travel Corridor
Recreational Site

L10 dBA Levels
50-54.9
55-59.9
60-64.9
65-69.9
70-74.9
75-79.9
80+

US Army Corps of Engineers St. Paul District

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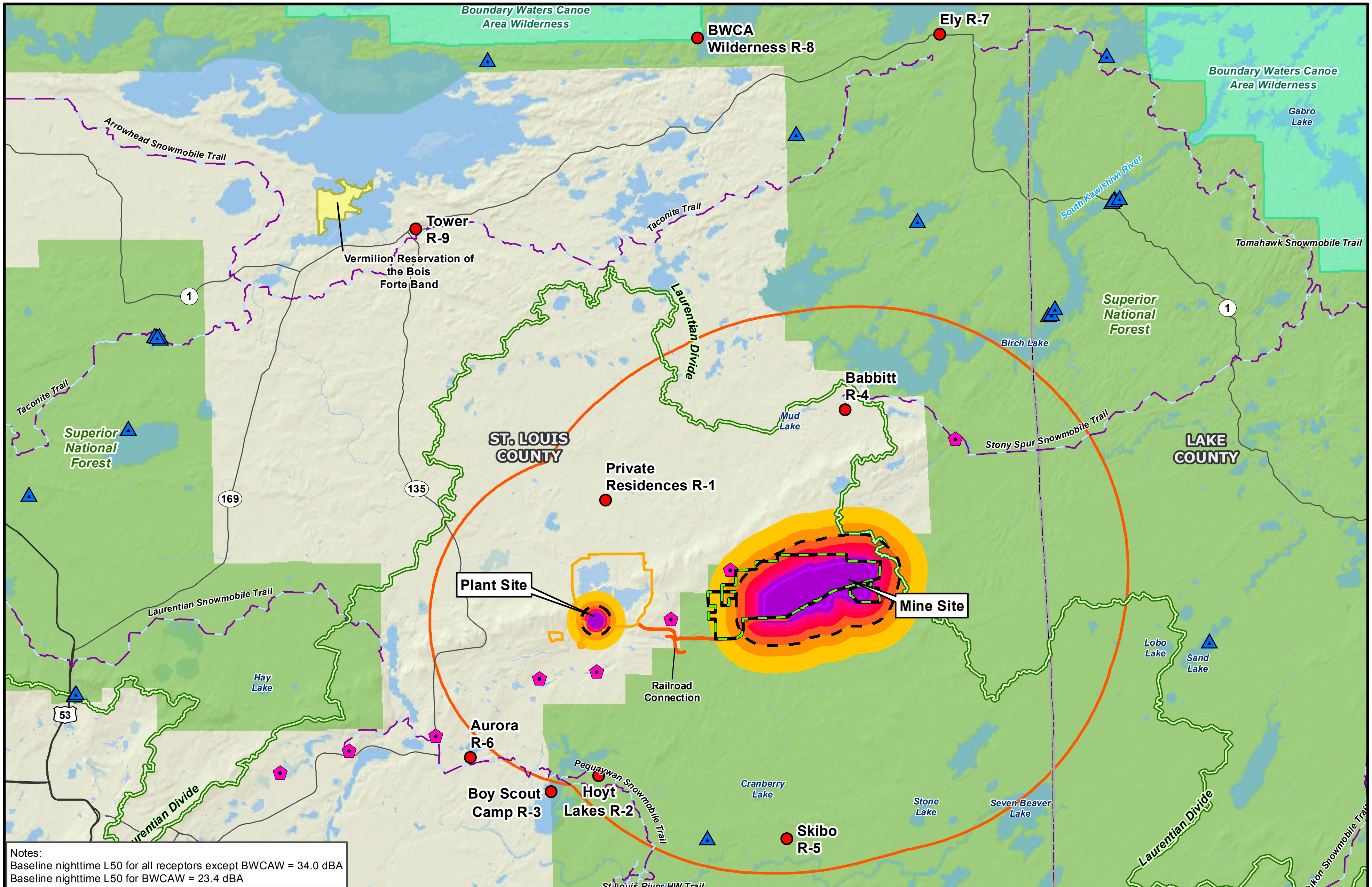
0 1 2 4 6 Miles

Figure 5.2.8-4
Predicted Daytime L10 Noise Contours at Closest Receptors (Includes Baseline L10 Levels)
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

497 -Page Intentionally Left Blank-



Noise Sensitive Receptor
Federal Lands
Plant Site
Mine Site
Transportation and Utility Corridor
Native American Reservation
Boundary Waters Canoe Area Wilderness
National Forest
MN L50 Nighttime Noise Standard: 50 dBA
L50 Audibility Limit
Wildlife Travel Corridor
Recreational Site

L50 dBA Levels

- 40-44.9
- 45-49.9
- 50-54.9
- 55-59.9
- 60-64.9
- 65-69.9
- 70+

US Army Corps of Engineers
St. Paul District

This document is a working document. This document may change over time as a result of new information, further deliberation, or other factors not yet known to the Co-lead Agencies.

N W E S

0 1 2 4 6 Miles

Figure 5.2.8-5

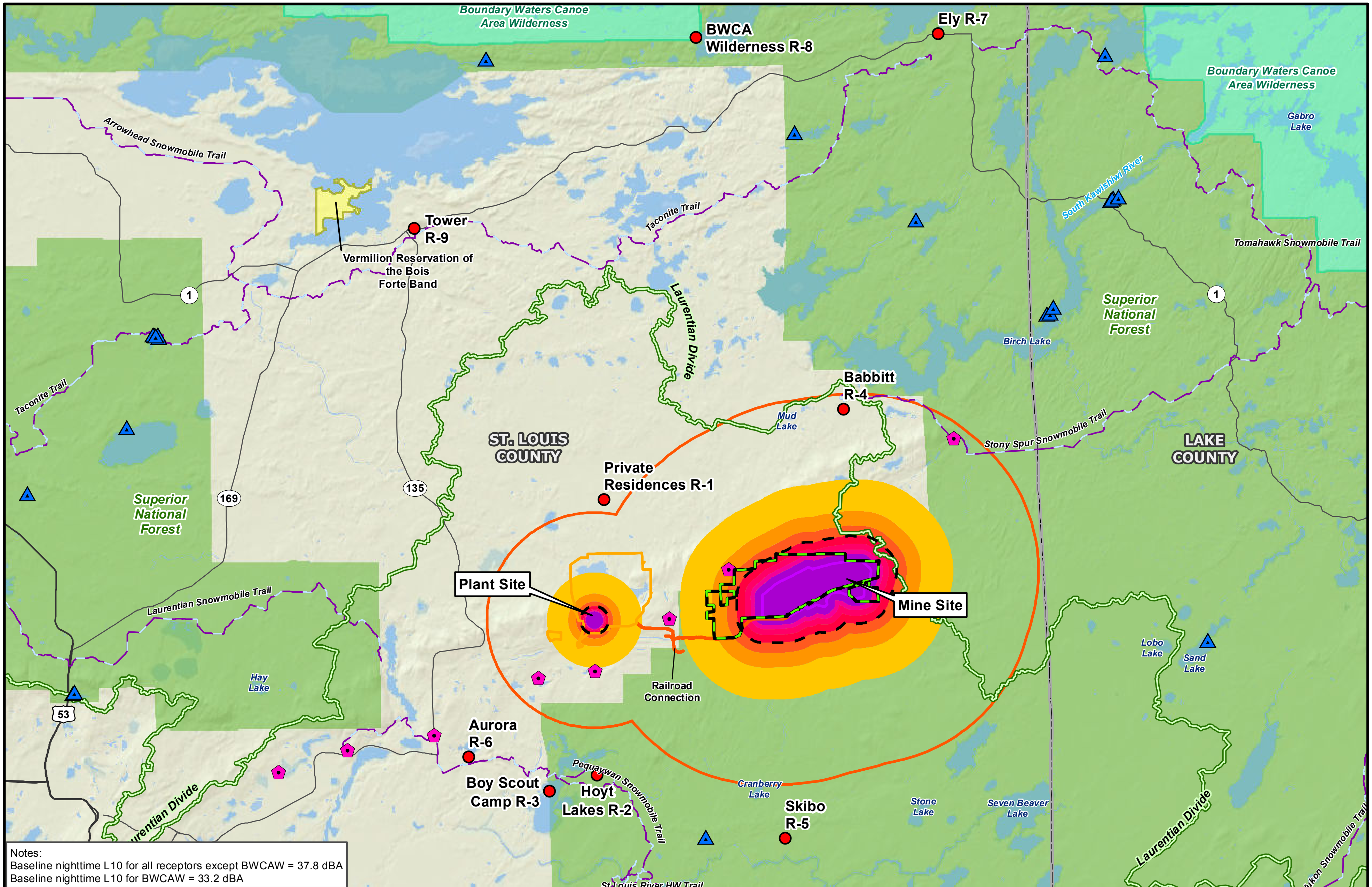
Predicted Nighttime L50 Noise Contours at Closest Receptors (Includes Baseline L50 Levels)

NorthMet Mining Project and Land Exchange PFEIS

Minnesota

June 2015

499 -Page Intentionally Left Blank-



Notes:
Baseline nighttime L10 for all receptors except BWCAW = 37.8 dBA
Baseline nighttime L10 for BWCAW = 33.2 dBA

Noise Sensitive Receptor
Federal Lands
Plant Site
Mine Site
Transportation and Utility Corridor
Native American Reservation
Boundary Waters Canoe Area Wilderness
National Forest
MN L10 Nighttime Noise Standard: 55 dBA
L10 Audibility Limit
Wildlife Travel Corridor
Recreational Site

L10 dBA Levels
40-44.9
45-49.9
50-54.9
55-59.9
60-64.9
65-69.9
70+

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St. Paul District

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N W E S

0 1 2 4 6 Miles

Figure 5.2.8-6
Predicted Nighttime L10 Noise Contours at Closest Receptors (Includes Baseline L10 Levels)
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

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Daytime Operation Impacts (7 a.m. to 10 p.m.)

Table 5.2.8-7 and Figures 5.2.8-3 and 5.2.8-4 present the total estimated daytime L_{50} and L_{10} levels that would be experienced at the closest receptors to the Mine Site and Plant Site. Noise from Mine Site and Plant Site operations, plus baseline levels, are predicted to be well below the Minnesota daytime noise standards of 60 dBA (L_{50}) and 65 dBA (L_{10}) for residential areas, trails, recreational sites (family campgrounds, campsites, boating, fishing, swimming, and family picnic areas), and MPCA staff-recommended wild rice waters and beds (used by tribal members for traditional resource harvests).

As an example of how the total noise level is calculated, the L_{50} daytime level of 44 dBA for private residences shown in Table 5.2.8.7 is the result of adding 10.9 dBA (daytime L_{50} levels from Mine Site operations only, excluding Plant Site operations and baseline levels), 13.5 dBA (daytime L_{50} levels from Plant Site operations only, excluding Mine Site operations and baseline levels), and 44 dBA, which is the assumed daytime L_{50} baseline level. The result of the logarithmic addition indicates that noise from the Mine Site and Plant Site has no measureable effect on the baseline conditions of the closest receptors. Figure 5.2.8-3 shows that the daytime L_{50} impact area for the closest receptors would be 6,629 and 255 acres at the Mine Site and Plant Site, respectively. Similarly, Figure 5.2.8-4 shows that the daytime L_{10} impact area for the closest receptors would be 6,266 and 242 acres at the Mine Site and Plant Site, respectively. These receptors are well outside the daytime impact areas. The closest recreational site is a family picnic area located approximately 9 miles south of the Mine Site and Plant Site (near Skibo). This family picnic area as well as other recreational sites located further away such as those near Birch Lake and South Kawishiwi River are outside the daytime impact area.

The Upper St. Louis River contains wild rice beds harvested by tribal members. The wild rice beds are usually in close proximity to MPCA staff-recommended wild rice waters such as Mud Lake and Birch Lake (north of Mine Site), Lobo Lake and Sand Lake (east of Mine Site), Stone Lake and Seven Beaver Lake (southeast of Mine Site), Cranberry Lake (south of Mine Site), and Hay Lake (west of Plant Site). Details of the location and uses of the cultural/tribal resource areas are discussed in Section 4.2.9, Cultural Resources.

The closest wildlife corridor located northeast of the Mine Site is also outside the daytime impact area. The highest daytime noise levels, including baseline levels, predicted for the closest NAC 1 receptor to the Mine Site (i.e., Babbitt (R-4)) were 44 dBA (L_{50}) and 48.8 dBA (L_{10}). The daytime noise effect of the Mine Site on Babbitt is an increase of 0 dBA (L_{50}) and 0 dBA (L_{10}) from baseline levels. Similarly, the highest daytime noise levels, including baseline levels, predicted for the closest NAC 1 receptor to the Plant Site (i.e., Private Residences (R-1)) were 44 dBA (L_{50}) and 48.8 dBA (L_{10}). The daytime noise effect of the Plant Site on the private residences is an increase of 0 dBA (L_{50}) and 0 dBA (L_{10}) from baseline levels. This 0 dBA increase is below the 3 dBA threshold of perception per the MCPA's *Guide to Noise Control in Minnesota* (MPCA 2008a) and would not be perceptible to residents, recreational users, or tribal members that use the MPCA staff-recommended wild rice waters and beds for harvesting purposes.

As discussed earlier, noise from trains and train horns during ore transportation during the day from the Mine Site to the Plant Site is expected to be minimal because the railroad route between the two is approximately 4 to 5 miles from the nearest receptors. Up to 22 trains per day are expected to deliver ore to the Plant Site. This frequency of traffic is less than that experienced on the rail line during past mining operations.

Blasting at the Mine Site is a source of impulsive or non-continuous noise. Blasting noise is not included in the noise level estimates shown in Table 5.2.8-7 because mine-blasting is typically an instantaneous event (not continuous or steady), and would occur only during daytime periods. PolyMet expects that blasting of ore and waste rock would take place approximately once every 2 or 3 days. This would usually include separate blasts of ore and waste rock benches. Rock-blasting could potentially have noise levels ranging from 111 to 115 dBA at 50 ft from the blasting site. With modern blasting techniques, the blasting would be experienced by the nearest receptors as a faint warning whistle or siren, followed by a very brief, muted clap of thunder.

Public acceptance is generally improved by scheduling blasting at the same time every day to further reduce the startle factor. The closest receptor (City of Babbitt) is located 6.5 miles from the Mine Site, so noise effects from blasting are not expected to be significant. In addition, noise effects from blasting would only occur during the early stages of mining, when blasting occurs at the surface down to a few ft below ground levels. As the depth of the pit increases over the life of the mine, noise effects from blasting would be attenuated by the pit walls.

Though not depicted on Figures 5.2.8-3 and 5.2.8-4 due to sensitivity regarding cultural resources and locations, three archaeological sites have been identified within the NorthMet Project area: Spring Mine Lake Sugarbush, *Mesabe Widjiu* [Laurentian Divide], and BBLV Trail Segment #1 (USFS #01-569). The Spring Mine Lake Sugarbush and the *Mesabe Widjiu* are located more than 2 miles away from the Mine Site and approximately 1 mile from the Plant Site (approximated 2 miles from the plant crushers). Based on these distances, both archaeological sites are expected to be outside the daytime noise impact area for the Mine Site (6,629 acres) and Plant Site (255 acres). As noted previously, the BBLV Trail Segment #1 (USFS #01-569) crosses the NorthMet Project area. Portions of the trail segment that cross the Mine Site and Plant Site are expected to be within the daytime impact area and may experience daytime noise levels close to the Minnesota standards.

Details of the location and uses of the archaeological sites are discussed in Section 4.2.9, Cultural Resources.

Nighttime Operation Impacts (10 p.m. to 7 a.m.)

Table 5.2.8-7 and Figures 5.2.8-5 and 5.2.8-6 indicate that the total estimated nighttime L_{50} and L_{10} levels that would be experienced at the receptors closest to the Mine Site and Plant Site are expected to be below the Minnesota nighttime noise standards of 50 dBA (L_{50}) and 55 dBA (L_{10}). Figure 5.2.8-5 shows that the nighttime L_{50} impact areas for the closest residential areas, trails, MPCA staff-recommended wild rice waters (used by tribal members for traditional resource harvests), and recreational sites would be 11,456 acres and 568 acres at the Mine Site and Plant Site, respectively.

Similarly, Figure 5.2.8-6 shows that the nighttime L_{10} impact areas for the closest residential areas, trails, MPCA staff-recommended wild rice waters, and recreational sites would be 10,695 acres and 503 acres at the Mine Site and Plant Site, respectively. These receptors are well outside the nighttime impact areas. As indicated above, the closest recreational site is a family picnic area located approximately 9 miles south of the Mine Site and Plant Site (near Skibo). This family picnic area as well as other recreational sites located further away such as those near Birch Lake and South Kawishiwi River are outside the nighttime impact area. There are no MPCA staff-recommended wild rice waters or beds within the nighttime impact area. Details of the location and use of cultural/tribal resource areas are discussed in Section 4.2.9 and 5.2.9. The closest wildlife corridor located northeast of the Mine Site is also outside the impact area. The highest nighttime L_{50} and L_{10} levels, including baseline levels, predicted for the closest receptor to the Mine Site (i.e., Babbitt (R-4)) were 34 dBA and 37.8 dBA, respectively. The nighttime noise effect of Mine Site operations on Babbitt is a net increase of 0 dBA (L_{50}) and 0 dBA (L_{10}) from baseline levels. Similarly, the highest nighttime L_{50} and L_{10} levels, including baseline levels, predicted for the closest receptor to the Plant Site (i.e., Private Residences (R-1)) were 34.1 dBA and 37.9 dBA, respectively. The nighttime noise effect of the Plant Site on the private residences is an increase of 0.1 dBA (L_{50}) and 0.1 dBA (L_{10}) from baseline levels. This increase of 0.1 dBA is below the 3 dBA threshold of perception per the MCPA's *Guide to Noise Control in Minnesota* (MPCA 2008a) and would not be perceptible to residents, recreational users, and tribal members that use MPCA staff-recommended wild rice waters and beds for traditional resource harvests. It should be noted that the noise model conservatively assumes that all mine equipment shown in Table 5.2.8-2 would be operating simultaneously during daytime and nighttime. Under actual conditions, the predicted noise levels would be lower because not all equipment would be operating simultaneously and some equipment would not operate at all during nighttime.

Though not depicted on Figures 5.2.8-5 and 5.2.8-6 due to sensitivity regarding cultural resources and locations, three archaeological sites have been identified within the NorthMet Project area: Spring Mine Lake Sugarbush, *Mesabe Widjiu* [Laurentian Divide], and BBLV Trail Segment #1 (USFS #01-569). The Spring Mine Lake Sugarbush and the *Mesabe Widjiu* are located more than 2 miles from the Mine Site and approximately 1 mile from the Plant Site (approximated 2 miles from the plant crushers). Based on the distances, both archaeological sites are expected to be outside the nighttime noise impact areas for the Mine Site (11,456 acres) and Plant Site (568 acres). As noted previously, the BBLV Trail Segment #1 (USFS #01-569) crosses the NorthMet Project area. Portions of the trail segment that cross the Mine Site and Plant Site are expected to be within the nighttime impact area and may experience nighttime noise levels close to the Minnesota standards. Details of the location and uses of the archaeological sites are discussed in Section 4.2.9, Cultural Resources.

Mine-blasting and ore transportation via trains along the Transportation and Utility Corridor would not occur between 10 p.m. and 7 a.m., so there would not be noise effects associated with these activities at night.

Summary of Daytime and Nighttime Operation Noise Impacts

Based on the information above, the total predicted daytime and nighttime noise (L_{50} and L_{10}) level experienced at NAC 1 areas such as the closest residential areas (the City of Babbitt north of the Mine Site, and private residences located north of the Plant Site), trails, recreational sites (including recreational sites at Birch Lake and South Kawashiwi River), and MPCA staff-recommended wild rice waters and beds used by tribal members for traditional resource harvests would meet the Minnesota daytime and nighttime noise standards. In addition, the projected noise increase above baseline levels would be below the 3 dBA threshold of perception. Immediate access to areas around the mine would be restricted, but tribal members who may have a cultural and spiritual connection to archaeological sites in the Superior National Forest, in areas immediately near the Mine Site or Plant Site, may occasionally experience noise associated with the NorthMet Project Proposed Action. Mitigation measures for the impacted cultural resource areas are discussed in Section 5.2.9, Cultural Resources.

During closure and post-closure (i.e., after year 20), the major noise sources and activities at the Mine Site and Plant Site (e.g., drilling, blasting, mining, excavation work, hauling, and crushing operations) would cease. Progressive reclamation would occur throughout the 20-year mine life for features such as the permanent stockpile and pit areas at the Mine Site and at the exterior slopes of the Tailings Basin at the Plant Site. This would leave a smaller portion of the Mine Site and Plant Site needing to be reclaimed at closure. During the closure phase, machinery, such as planters, used to restore and/or rehabilitate the Mine Site and Plant Site and conduct other reclamation activities (e.g., structure demolition, dike removal, etc.) would generate some noise; however, such noise would occur over a short time period and mostly during daytime periods when increased noise levels would be more tolerable. Therefore, noise levels at the Mine Site and Plant Site during the closure and post-closure phases are expected to be below the Minnesota noise standards and below the 3 dBA threshold of perception.

Area of Audibility for the Boundary Waters Canoe Area Wilderness

The L_{50} audibility area would be approximately 247,612 acres around the Mine Site and Plant Site, assuming all noise sources are operating simultaneously during daytime and nighttime (Figure 5.2.8-3 and 5.2.8-5). Similarly, the L_{10} audibility area would be approximately 131,035 acres around the Mine Site and Plant Site, assuming all noise sources are operating simultaneously during daytime and nighttime (see Figures 5.2.8-4 and 5.2.8-6). The BWCAW is outside this area of audibility. Therefore, sound from the Mine Site and Plant Site operations would not be audible at the BWCAW. While some receptors (e.g., residential areas like Babbitt and Hoyt Lakes and a family picnic area near Skibo) are within this area of audibility shown on Figures 5.2.8-3 to 5.2.8-6, it should be noted that the area of audibility was calculated based on the low measured baseline levels for BWCAW, which is a place of natural quiet (L50 of 23.4 dBA and L10 of 33.2 dBA). The baseline levels for the recreational sites and residential areas are likely higher than the BWCAW baseline levels (though actual measurements have not been taken at these areas), so actual area of audibility for these other receptors would be much smaller than that for BWCAW.

Noise Effects on Off-Site Transportation

Transportation of NorthMet Project Proposed Action consumables and products could result in some noise from increased traffic on public roads and commercial railroads. Public roads could also experience minor increase in noise levels due to additional traffic from employees and service providers, particularly along State Highway 135 and County Road 666.

Traffic noise from employee vehicles, service provider vehicles, and trucks transporting process consumables and products result in a small increase in daily traffic volumes (approximately 7 trucks per day and 149 employee and service provider vehicles per day along State Highway 135; and approximately 42 employee and service provider vehicles per day along County Road 666 [see BA provided in Appendix D]) in comparison to the existing annual average daily traffic (AADT) volumes of State Highway 135 and County Road 666. Based on AADT data that Barr Engineering Company obtained from the Minnesota Department of Transportation (Barr 2014a), the NorthMet Project offsite traffic volumes are approximately 2 to 18 percent and 5 to 30 percent of existing AADT at State Highway 135 (850 to 8300 vehicles per day) and County Road 666 (140 to 810 vehicles per day), respectively.

Similarly, railway noise from trains carrying process consumables and concentrates from the Plant Site to Virginia, Minnesota, and/or vice versa (via Canadian National Railroad) are not expected to be significant due to the small increase in monthly railway traffic volumes (approximately 100-car train once per month and a 30-car train four times per month, year round, for product shipment; and approximately 100-car train once per week, April through October, for process consumables [see BA provided in Appendix D]) in comparison to the existing monthly traffic volumes of the Canadian National Railroad Based on existing rail traffic information that Barr Engineering Company obtained from Canadian National Railway Company (Pat Sheehy, Senior Environmental Specialist, Barr, Pers. Comm., November 6, 2014) the NorthMet Project Proposed Action off-site traffic volumes are approximately 3.0 and 3.8 percent of existing rail traffic near the Plant Site (i.e., the Iron Junction to Allen Junction rail segment) during non-summer months (8 trains per day or approximately 240 trains per month) and during summer months (10 trains per day or approximately 300 trains per month), respectively.

Based on the off-site traffic information described above, noise effects on off-site transportation are not expected to be significant. In addition, all NorthMet Project Proposed Action-related off-site roadway and railway traffic would occur during daytime hours only, and the off-site trucks would not exceed 40 miles per hour and would avoid densely populated areas to the extent practicable. Any noise sensitive receptor near the Canadian National Railroad, State Highway 135, and County Road 666 would not be exposed to a new noise source since these infrastructures have been in operation for decades.

5.2.8.3 NorthMet Project No Action Alternative

Under the NorthMet Project No Action Alternative, the NorthMet Project Proposed Action would not occur and there would be no increase in noise and vibration levels in any of the areas proposed for project development Therefore, there would be no change in existing noise and vibration levels at the closest receptors.

703 -Page Intentionally Left Blank-

5.2.9 Cultural Resources

This section summarizes the environmental consequences of the NorthMet Project Proposed Action on historic properties, including the potential effects, types of avoidance, effect minimization measures, and potential mitigation measures that are relevant to these historic properties. Additionally, this section summarizes the environmental consequences of the NorthMet Project Proposed Action on 1854 Treaty resources—i.e., those areas and species that are traditionally or culturally important to the Bands.

The federal Co-lead Agencies have identified several historic properties in consultation with the SHPO, Bands, and PolyMet. The federal Co-lead Agencies have also consulted with the SHPO, Bands, and PolyMet concerning NRHP eligibility of the Spring Mine Lake Sugarbush; *Mesabe Widjiu*; BBLV Trail Segment; Erie Mining Company Railroad Mine and Plant Track, Main Line Segment, and Dunka Railroad Segment; Erie Mining Company Concentrator Building; Erie Mining Company Administration Building; Erie Mining Company Landscape Historic District; Erie Mining Company Railroad Corridor Historic District; and DM&IR Segment. All other cultural resources identified as part of the NorthMet Project Proposed Action, as identified in Section 4.2.9.2.4, were determined to be not eligible for inclusion in the NRHP, and therefore will not receive further consideration under Section 106 during review of the NorthMet Project Proposed Action. The federal Co-lead Agencies are currently refining statements of significance and boundaries for these properties.

Effect determinations have been drafted by the federal Co-lead Agencies for review and comment by the SHPO, Bands, and PolyMet. The federal Co-lead Agencies believe that there would be no adverse effect on the Erie Mining Company Railroad Mine and Plant Track, Main Line Segment, and Dunka Railroad Segment; Erie Mining Company Administration Building; Erie Mining Company Railroad Corridor Historic District; and DM&IR Segment. However, the *Mesabe Widjiu*, BBLV Trail Segment, Spring Mine Lake Sugarbush, Erie Mining Company Concentrator Building, and Erie Mining Company Landscape Historic District would be adversely affected by the NorthMet Project Proposed Action. These determinations would be used to facilitate ongoing consultation with the SHPO, Bands, and PolyMet pertaining to the application of adverse effect criteria to these properties. Mitigation measures to resolve adverse effects would be developed after consultation on the effect determinations and consideration of any measures to avoid or minimize adverse effect.

Although not required by NEPA and MEPA, the Co-lead Agencies committed to providing an appendix in the FEIS that contains the Tribal Cooperating Agencies' comments and supporting documentation representing MDOs. See Appendix C for comments and supporting documentation from the Bois Forte, Grand Portage, Fond du Lac, GLIFWC, and the 1854 Treaty Authority. These take the form of eight position papers and a Co-lead Agency Preliminary SDEIS comment disposition spreadsheet for the Tribal Cooperating Agencies.

The Tribal Cooperating Agency submittals in Appendix C are provided verbatim and in identical form as they were for the SDEIS. They were considered in the development of the FEIS. Refer to Chapter 8 for more information.

5.2.9.1 Methodology and Evaluation Criteria Overview

In consultation with the SHPO, the Bands, and PolyMet, the federal Co-lead Agencies must apply the criteria of adverse effects to historic properties within the APE to evaluate the potential effect of the NorthMet Project Proposed Action on the historic properties, as codified in 36 CFR 800.5.

An adverse effect is found when an undertaking may alter, directly or indirectly, any of the characteristics of a historic property that qualify the property for inclusion in the NRHP in a manner that would diminish the integrity of the property's location, design, setting, materials, workmanship, feeling, or association. These elements of integrity are discussed at length in Section 4.2.9. Adverse effects may include reasonably foreseeable indirect effects that occur later in time, are farther removed, or are cumulative.

Direct effects caused by the undertaking occur at the same time and place. Indirect effects caused by the undertaking are later in time or further removed in distance but are still reasonably foreseeable. The federal Co-lead Agencies confer with consulting parties to determine the undertaking's effects on historic properties, to resolve adverse effects, and to develop mitigation measures as necessary. For the NorthMet Project Proposed Action, the following is a summary of potential effect types:

- physical disturbance or damage to all or part of the property caused by ground disturbance (e.g., digging, trenching, etc.);
- introduction of visual, atmospheric, or audible elements that could diminish the integrity of the property's significant historic features during short-term NorthMet Project Proposed Action-related construction and operation of aboveground facilities and roads, as well as long-term effects from operation;
- change in the character of the use or of physical features within the property's setting that contribute to its significance; and
- transfer of property out of federal ownership without adequate conditions to ensure consideration of historic properties.

Effects determinations have the following three possible outcomes:

1. Finding of no historic property affected – The undertaking does not have the potential to cause effects on historic properties that may be present.
2. Finding of no adverse effect – The historic property would be affected; however, the effects of an undertaking do not meet the criteria of adverse effect, or measures have been taken to avoid or minimize adverse effects.
3. Finding of adverse effect – The undertaking may affect the integrity, which would alter, directly or indirectly, any of the characteristics of a historic property that qualify it for inclusion in the NRHP. If an adverse effect is found, the federal Co-lead Agencies shall consult further to resolve the adverse effect.

5.2.9.1.1 Types of Potential Effects

The potential for the NorthMet Project Proposed Action to affect a historic property may depend on the project stage and the development and use of the NorthMet Project area. Potential effects that may occur during the construction and operations of the NorthMet Project Proposed Action are discussed in the following subsections.

Construction

NorthMet Project Proposed Action construction activities could affect cultural resources in a variety of ways, including the following:

- possible direct damage to cultural resources within the construction footprint;
- possible indirect damage to cultural resources through vibrations caused by earth-moving and heavy equipment;
- temporary loss of community access to cultural resources, such as cultural resources of traditional significance;
- potential permanent visual effects that alter the viewshed to or from a cultural resource as it pertains to the cultural resource's setting and feeling;
- potential temporary visual effects on cultural resources while heavy equipment and numerous personnel are present;
- increased dust and noise that may affect historic structures or cultural resources of traditional significance near the construction area; and
- discovery of previously unknown cultural resources within the construction footprint.

The duration of the construction phase would affect the degree of effects on cultural resources. Potential indirect effects during construction—such as noise, dust, vibrations, heavy equipment traffic, and changes in viewshed—could be temporary and would be expected to last for the duration of construction in specific areas and for discrete periods of time.

Operations

During the operations phase of the NorthMet Project Proposed Action, only previously surveyed and assessed areas would be expected to require periodic disturbance; therefore, the potential for additional direct effects to cultural resources would be limited.

Indirect effects during operations could consist of a permanent change in viewshed to historic structures near NorthMet Project area facilities, and a periodic increase in noise, vibration, and dust created by vehicular traffic conducting operation and maintenance activities.

5.2.9.1.2 Mitigation Measures

Mitigation measures would be taken to avoid or minimize effects on historic properties, to the extent practicable. The following are potential mitigation measures:

- avoidance, which could be accomplished by shifting the footprint away from the resource, limiting activities in the vicinity of the resource, monitoring construction activities near the resource to inform whether additional actions are warranted, or through any combination of these techniques;

- minimization, which would reduce the effects on the resource through avoidance measures as described above, but would not completely eliminate the effects; and
- mitigation, which would offset that effect through some of the following means:
  - protection of a similar resource nearby;
  - detailed documentation of the resource through data recovery (i.e., excavations, in the case of archaeological sites, or Historic American Buildings Survey/Historic American Engineering Record documentation, in the case of historic structures);
  - contributions to the preservation of cultural heritage in the affected community;
  - interpretative exhibits highlighting information gained about cultural resources through the NorthMet Project Proposed Action; or
  - some combination of these strategies.

The federal Co-lead Agencies would take into account the effects of the NorthMet Project Proposed Action on properties that are listed on, or considered eligible for listing on, the NRHP per Section 106 of the NHPA and consistent with USFS and USACE practices. Because the NorthMet Project Proposed Action would likely result in an adverse effect, the federal Co-lead Agencies would consult with the SHPO, the Bands, and PolyMet to identify practicable ways to avoid, minimize, or mitigate the harmful effects of the undertaking. The ACHP would become involved in consultation if requested by an agency, SHPO, Bands, other consulting parties, or member of the public with a demonstrated interest. If an adverse effect were identified, federal agencies would have to notify the ACHP, who may become involved if the effect met their criteria for involvement. The federal Co-lead Agencies are currently in the process of developing a Memorandum of Agreement (MOA), which identifies the steps the federal Co-lead Agencies would take to avoid, minimize, or mitigate the adverse effect.

5.2.9.2 Affected Cultural Resources

This section describes the environmental consequences of the NorthMet Project Proposed Action on historic properties within the APE. As outlined in Section 4.2.9, the federal Co-lead Agencies, the SHPO, Bands, and PolyMet agree that the Erie Mining Company Railroad Mine and Plant Track, Main Line Segment, and Dunka Railroad Segment; Erie Mining Company Concentrator Building; Erie Mining Company Administration Building; Erie Mining Company Landscape Historic District; Erie Mining Company Railroad Corridor Historic District; DM&IR Segment, Spring Mine Lake Sugarbush, *Mesabe Widjiu*, and BBLV Trail Segment are eligible for inclusion in the NRHP. The federal Co-lead Agencies, in consultation with the SHPO, Bands, and PolyMet, have determined effects for the eligible properties and are currently working to resolve adverse effects.

5.2.9.2.1 Historic Properties

Erie Mining Company Concentrator Building

The Concentrator Building is a key property and reflects Erie Mining Company's decades of experimentation in production and engineering design (Zellie 2007). The Co-lead Agencies have determined the Concentrator Building eligible for inclusion in the NRHP under Criterion A in the areas of industry and engineering, and also under Criterion C in the area of engineering.

Direct effects to this property would consist of interior and exterior refurbishment and use. For example, emission controls on ore grinding equipment would be replaced with components that meet or exceed the particulate emission standard required of new sources at taconite plants. To reduce space heating requirements, the building insulation would be improved. Additionally, the concentrator building would be demolished at mine closure and decommissioning, consistent with Minnesota state mining standards. There would be minor exterior and interior alterations to the other primary plant buildings and structures. The NorthMet Project Proposed Action would include the construction of several new buildings adjacent to the Concentrator Building. Based on the above considerations, the federal Co-lead Agencies believe that the NorthMet Project Proposed Action would adversely affect the Concentrator Building.

Erie Mining Company Railroad Mine and Plant Track, Main Line Segment, and Dunka Railroad Segment

The federal Co-lead Agencies have determined the Erie Mining Company Railroad Mine and Plant Track, Main Line Segment, and Dunka Railroad Segment (SL-HLC-015) eligible for inclusion in the NRHP under Criterion A in the areas of Commerce, Industry, and Transportation. Although the majority of the main track of railroad is outside of the NorthMet Project area, the segments of the Erie Main Line Railroad and Mine and Plant Track, and Dunka Railroad within the APE would be directly affected near the NorthMet Project area.

Direct effects to this property would consist of refurbishment and use. Refurbishment, however, is not expected to result in significant alterations. Nonetheless, the Erie Mining Company railroad would be removed at mine closure and decommissioning, consistent with Minnesota state mining standards. There would be no expected indirect effects, as the use of the Plant Site and mining activities would be consistent with the railroad's original use. Based on the above considerations, the federal Co-lead Agencies believe that the NorthMet Project Proposed Action would not adversely affect the Erie Mining Company railroad. The federal Co-lead Agencies, in consultation with the SHPO, Bands, and PolyMet, are currently working to resolve adverse effects.

Erie Mining Company Administration Building

The Erie Mining Company Administration Building remains a well-preserved component of the original taconite plant design. It is significant under NRHP Criterion A in the areas of Industry and Engineering and is associated with the statewide historic context, "Minnesota's Iron Ore Industry, 1880s-1945." The Administration Building is within the APE for the NorthMet Project Proposed Action; however, refurbishment is not part of the current undertaking. While the federal Co-lead Agencies believe the Administration Building would need to be updated subsequent to mine permitting, no plans have been provided to the Co-lead Agencies for analysis of effects. The Co-lead Agencies have evaluated the potential for ambient air quality to adversely affect the structure pursuant to air modeling data analyzed during the FEIS process. The Administration Building would not be affected by isopleths (dust particulate) as modeled. The Administration Building is located in an area of the APE where air quality is not expected to exceed current background levels; therefore, no adverse effect is anticipated from changes in air quality. Therefore, the federal Co-lead Agencies believe that the NorthMet Project Proposed Action would not adversely affect the Erie Mining Company Administration Building. The federal Co-lead Agencies, in consultation with the SHPO, Bands, and PolyMet, are currently working to resolve adverse effects.

Erie Mining Company Railroad Corridor Historic District

The federal Co-lead Agencies have considered the available information concerning potential effects on the Erie Mining Company Railroad Corridor Historic District. The NorthMet Project Proposed Action would reuse many of the facilities and transportation infrastructure associated with the Erie Mining Company period of significance (circa 1954 to 1969). The NorthMet Project Proposed Action does not include plans to alter the alignment, grade, or setting of the extant rail line; however, a new connection would be constructed to connect the Erie Plant track to the mainline in the vicinity of Erie Mining Company Mine Area No. 2. This connection would minimally alter the historic patterns of circulation, as they relate to the 1957 to 1969 period of significance. However, it would not materially diminish the setting, feeling, and or association of the district as a whole. As was the case with Erie during the period of historic significance, the NorthMet Project Proposed Action would continue to transport ore to the Erie Plant Site for additional processing and subsequent rail shipment. During the period of significance, mine track placement was constantly evolving and shifting in response to development of new ore bodies and abandonment of areas already mined. When viewed in light of this historic use, the proposed connection between the plant track and the mainline would not be incompatible; therefore, the federal Co-lead Agencies have determined that there would be no adverse effect.

Erie Mining Company Landscape Historic District

The NorthMet Project Proposed Action is contingent upon reuse of the Erie Plant Site and existing railroad infrastructure. Proposed new construction within the Erie Plant Site area includes an oxygen plant, Hydrometallurgical Plant, Hydrometallurgical Residue Facility, and WWTP. The Erie Heating and Additive Plan (SL-HLC-049), which is considered as a contributing element of the Erie Mining Company Landscape Historic District, is proposed for demolition under the NorthMet Project Proposed Action. Several non-contributing temporary structures associated with the LTVSMC period of use (from 1986 to 2001) within the footprint of the proposed WWTP would be relocated and repurposed on site. Key infrastructure at the Plant Site would be refurbished and reused under the NorthMet Project Proposed Action.

Processes at the Beneficiation Plant would include ore crushing, grinding, floatation, dewatering, storage, and shipping. Crushing and grinding would occur at the existing coarse-crusher building, fine-crusher building, and concentrator building, all of which are associated with the overall industrial processes of Erie operations during the period of significance. The Co-lead Agencies believe that the proposed refurbishment and reuse of these facilities is compatible with the industrial processes that occurred during the period of historic significance. Ore would continue to be transported to the Plant Site by rail from an adjacent Mine Site, and the buildings would continue to function in a similar fashion as they did during the period of historic significance. Dewatering would take place at a new concentrate dewatering and storage building. This building would be constructed near the new Hydrometallurgical Plant, on the footprint of the Erie (LTVSMC) Heating and Additive Plant (SL-HLC-049), which would be demolished. The Area 1 Shop, rail car maintenance shop (Area 2 Shops), and Colby Lake pumphouse would be reused under the current proposal. The expected activities at each location would be consistent with those carried out during the period of significance. The current information suggests that refurbishment would be limited to painting and exterior rehabilitation, as needed. Refurbishment would likely include updates to building interiors; however, outside of the concentrator building, these interior renovations are not expected to diminish the integrity of those structures that contribute to the Erie Hoyt Lakes Operation mining landscape historic district.

The Co-lead Agencies have considered the potential effects on both the properties determined to be individually eligible and to those properties considered as contributing elements to the larger mining landscape historic district. Given that both new construction and demolition of contributing buildings is proposed within the Plant Site boundaries, the federal Co-lead Agencies have determined that an adverse effect finding is warranted for this larger mining landscape historic district.

DM&IR Segment

The Canadian Northern Railway currently owns the DM&IR segment of track within the APE of the NorthMet Project Proposed Action. While PolyMet asserts that reuse of part of the DM&IR segment is "likely," there are no immediate plans for reuse of this railroad as part of the current NorthMet Project Proposed Action. Although it is possible that the DM&IR segment would be reused if permitting proceeds, since there are no reasonably foreseeable proposals, there are no adverse effects to be identified in this analysis. Therefore, the federal Co-lead Agencies have determined that there would be no adverse effect. The federal Co-lead Agencies, in consultation with the SHPO, Bands, and PolyMet, are currently working to resolve adverse effects.

Spring Mine Lake Sugarbush

The federal Co-lead Agencies have determined the Spring Mine Lake Sugarbush eligible for inclusion in the NRHP under Criterion A for its association with important Ojibwe spiritual and cultural practices. Under Criterion D, the site is significant for its potential to answer important questions about possible 19^{th} century and 20^{th} century Ojibwe maple sugaring practices.

Direct effects on this property would not result from the NorthMet Project Proposed Action. The Spring Mine Lake Sugarbush is not within the footprint of the Mine Site, the Plant Site, or any other ancillary NorthMet Project area features.

Based on an indirect visual effects analysis conducted for the NorthMet Project Proposed Action and the site visits conducted in 2010, the federal Co-lead Agencies believe that the NorthMet Project Proposed Action would not result in a visual intrusion that would diminish the integrity of setting, feeling, or associations. The Spring Mine Lake Sugarbush is a number of miles from the Mine Site and sufficiently screened from the Plant Site and the Tailings Basin where those project features are not visible. The Plant Site and Tailings Basin are existing LTVSMC mine features. Their footprint would not be expanded to any significant extent, nor would the addition of material be visible from the Spring Mine Lake Sugarbush to a significantly greater extent than current conditions.

The analysis of possible atmospheric effects that was completed for the NorthMet Project Proposed Action indicates that the Spring Mine Lake Sugarbush is not in an area expected to be affected by dust deposition. The Spring Mine Lake Sugarbush and its grove of mature maple trees has existed throughout the past 50 years of mining, which included the use of the existing Plant Site and Tailings Basin as well as numerous mineral extraction locations (mine pits) in close proximity to the Spring Mine Lake Sugarbush in comparison to the Mine Site.

The Spring Mine Lake Sugarbush may be associated with the trail systems, such as the BBLV Trail Segment, that are known to have traversed this area. The portion of that trail corridor in proximity to the Spring Mine Lake Sugarbush has been for the most part destroyed by past mining operations. The NorthMet Project Proposed Action would not result in the loss of any additional portions of that corridor, or trails, in proximity to the Spring Mine Lake Sugarbush. For further discussion, see the discussion of effects on the BBLV Trail Segment.

Based on this analysis, the federal Co-lead Agencies made the determination that there would be no direct effects resulting from the NorthMet Project Proposed Action nor would there be any significant changes to the setting, feeling, or associations of the Spring Mine Lake Sugarbush.

After consultation with the Bands concerning effects on the Spring Mine Lake Sugarbush, the federal Co-lead Agencies acknowledged that the analysis of atmospheric effects on the Spring Mine Lake Sugarbush was an estimation based on modeling and that dust deposition is expected to occur near this property. The Co-lead Agencies, through consultation with the Bands, are also aware of concerns among the consulting parties for potential inadvertent damage to the site given the proximity of the site to key operational areas associated with the proposed Plant Site. After consideration of concerns and perceptions raised by the consulting parties, the federal Co-lead Agencies have determined that the NorthMet Project Proposed Action would adversely affect the Spring Mine Lake Sugarbush.

Mesabe Widjiu

The federal Co-lead Agencies have determined the *Mesabe Widjiu* eligible for inclusion in the NRHP under Criterion A for its association with important Ojibwe spiritual and cultural practices. Although the federal Co-lead Agencies are assessing the effects of the NorthMet Project Proposed Action on only the portion of the *Mesabe Widjiu* within the APE, it is recognized that the property and its significance extends beyond the APE.

Direct effects on the *Mesabe Widjiu* would occur at the Tailing Basin, which currently abuts a portion of that land form. Expansion of the Tailings Basin would intrude on that portion of the *Mesabe Widjiu*. Direct effects on the *Mesabe Widjiu* at the Mine Site would not occur as the *Mesabe Widjiu* is not considered to be within the footprint of the Mine Site. However, the boundaries of the *Mesabe Widjiu* are still the subject of consultation with the SHPO and the Bands.

Indirect effects to the *Mesabe Widjiu* would result from the features at the Mine Site location. Although there are existing mine features between the *Mesabe Widjiu* and the Mine Site location, the NorthMet Project Proposed Action would further diminish the integrity of setting and feeling. The large-scale alterations to the landscape resulting from mine pits, stockpiles, material handling facilities, etc., would be long-term changes that would further diminish the association of the *Mesabe Widjiu* with the natural features of the Partridge River headwaters. Although the Mine Site has been disturbed by logging, roads brushed out for mineral exploration, and linear features, such as Dunka Road or the railroad, these disturbances are smaller. The effect of the NorthMet Project Proposed Action would also remove a portion of the BBLV Trail Segment corridor, further diminishing the *Mesabe Widjiu*'s association with that historic property.

Although the federal Co-lead Agencies are not aware of specific locations adjacent to the NorthMet Project area that are used by the Bands, this does not diminish the significance of effects for that portion of the *Mesabe Widjiu*. Given the nature of Ojibwe spiritual practices, which is a personal connection to the natural elements of the environment, locations of this type are very difficult to identify. The *Mesabe Widjiu* is a historic property to which the Ojibwe have had a spiritual connection for hundreds of years.

Based on the above considerations, the federal Co-lead Agencies believe that the NorthMet Project Proposed Action would adversely affect the *Mesabe Widjiu*.

BBLV Trail Segment

The federal Co-lead Agencies have determined that the BBLV Trail Segment is significant for the role it played in the broad patterns of Ojibwe land use and early mineral exploration. It is eligible for inclusion in the NRHP under Criteria for Evaluation A and D.

The portion of the BBLV Trail Segment that lies within the Mine Site would be directly affected by the NorthMet Project Proposed Action, which would result in its permanent removal. Based on this, the federal Co-lead Agencies believe that the NorthMet Project Proposed Action would adversely affect the BBLV Trail Segment.

Potential for Properties of Tribal Significance Constituting a Historic District

The federal Co-lead Agencies have consulted with the Bands regarding the possibility of the historic properties of tribal significance being considered as part of a National Register District. A District, as defined in National Register Bulletin 15 *How to Apply the National Register Criteria for Evaluation*, in addition to having integrity, "possesses a significant concentration, linkage, or continuity of sites, buildings, structures, or objects united historically or aesthetically by plan or physical development" (NPS 1995). While the BBLV Trail Segment and the Spring Mine Lake Sugarbush appear to share a similar period of significance and are related to 19th century Ojibwe land use and transportation contexts, the federal Co-lead Agencies do not believe that these properties collectively retain integrity of setting and association nor are they arranged in such a way that they could be considered a "unified entity" *(ibid)*. In addition, prior resource extractive developments have significantly altered the landscape within and adjacent to the NorthMet Project area. These developments and landscape alterations make it difficult to ascertain the linkages that may have historically existed between these properties. The federal Co-lead Agencies do not find that the identified historic properties constitute a "significant concentration" of sites, as further defined in Bulletin 15 (*ibid*). While the federal Co-lead Agencies recognize and affirm that overland trails (and at least one reported "encampment") existed in the NorthMet Project area at the time of the initial Government Land Office surveys, the level of post-19th century development has destroyed and largely obscured the ability of the extant historic properties to convey a sense of continuity and linkage. The oral interview information that has been provided to the Co-lead Agencies does not contain details that speak specifically to these sites; however, the information provided in the oral interviews regarding the *Mesabi Widjiu* was fully considered, and played a key role in the federal Co-lead Agencies prior determination of adverse effect. That said, the federal Co-lead Agencies recognize the position of the consulting Bands regarding the connected nature of cultural resources throughout the 1854 Ceded Territory and affirm that the historical context of these properties should be a key component of resolution of adverse effects discussions going forward.

The federal Co-lead Agencies have previously commented on the consulting Bands request (Grand Portage 2013) to consider a much larger historic district that extends down to the north shore of Lake Superior for the purposes of Section 106 review for the NorthMet Project Proposed Action. For the reasons stated in the above paragraph, the Co-lead Agencies, at this time, believe that additional identification and evaluation efforts within this area would be outside of the scope of NorthMet Project Proposed Action.

5.2.9.2.2 Treaty Resources

Natural resources important to Ojibwe culture can be recognized even when tribal use of a natural resource may not qualify that resource as a historic property for further consideration under Section 106. The right to hunt, fish, and gather on lands within the 1854 Ceded Territory is protected by the 1854 Treaty. Limitation or elimination of access to public lands within the 1854 Ceded Territory for these purposes may be considered an effect on 1854 Treaty rights. The loss of 1854 Treaty resources may also have an effect on the Bands' ability to exercise 1854 Treaty rights.

An analysis of effects on 1854 Treaty resources, as described and discussed in Section 4.2.9, is limited by the lack of available information concerning the use of such resources. To help determine how the Bands have traditionally exercised their usufructuary rights on or near the NorthMet Project area, the Bands conducted interviews of individual members of Bois Forte, Fond du Lac, and Grand Portage, although only the results of interviews with Bois Forte were made available.

There is little specific information concerning the use of natural resources by the Bands in the NorthMet Project area, other than the Spring Mine Lake Sugarbush, which is being considered under Section 106 of the NHPA. This likely reflects limited present day or recent past subsistence gathering in the NorthMet Project area due to general inaccessibility. This lack of data also precludes the quantitative analysis of how Band members would be affected socioeconomically by effects on 1854 Treaty resources, further discussed in Section 5.2.10. The primary source of data for assessing effects from the NorthMet Project Proposed Action on 1854 Treaty resources is from the analysis of the environment discussed in detail in Section 4.2.9 of this FEIS.

As stated in Table 5.2.9-1 below, the NorthMet Project Proposed Action would affect 4,028.3 acres within the Nashwauk Uplands and Laurentian Uplands subsections, which constitutes a total of 0.3 percent of these two subsections.

Table 5.2.9-1 Acres of the Laurentian Uplands and Nashwauk Uplands Subsections Affected by the NorthMet Project Proposed Action

Land Cover	Total Acres	Acres Affected by the NorthMet Project Proposed Action	Percent of Combined Nashwauk Uplands and Laurentian Uplands Subsections Affected by the NorthMet Project Proposed Action
Aquatic Environments	396,966	581.7	0.1
Disturbed	46,174	1,242.4	2.7
Forest	885,566	1,908.6	0.2
Cropland/Grassland/ Shrubland	48,602	295.6	0.6
Total	1,377,308	4,028.3	0.3

Source: MDNR 2011f; MDNR 2011i.

The cover type most affected by the NorthMet Project Proposed Action is disturbed land, which includes reuse of the existing LTVSMC Tailings Basin. Less than 1 percent of each of the remaining cover types would be affected. Effects on the 1854 Treaty resources associated with these cover types are discussed below.

Vegetation

Vegetation that would be affected by the NorthMet Project Proposed Action is covered in the vegetation analysis in Section 5.2.4. Consequences of the NorthMet Project Proposed Action would include direct effects on land cover types.

The NorthMet Project Proposed Action would disturb 1,718.6 acres of land at the Mine Site, with the largest effects to upland conifer forest and lowland conifer forest. Consequently, the plant species or resources regulated by the 1854 Treaty Authority for gathering within these cover types would likely be most affected (see Table 5.2.9-2). The Plant Site contains 2,189.7 acres that would be disturbed, although most effects occur in areas already previously disturbed. Though the aquatic environment cover type would be heavily affected at the Plant Site, it consists mostly of tailings ponds where no regulated plant species or resources would be present. The majority of the 120.1 acres of the Transportation and Utility Corridor has also already been disturbed.

Table 5.2.9-2 Affected Cover Types of Associated Species and Resources Regulated by the 1854 Treaty Authority at the NorthMet Project Area

Cover Types	**Associated Plant Species or Resource**	**Affected Mine Site (Acres)[1]**	**Affected Transportation and Utility Corridor (Acres)[1]**	**Affected Plant Site (Acres)[1]**
Upland coniferous forest	Conifer boughs, princess pine, birch bark, firewood, other plants or forest products	741.9	2.6	52.0
Lowland coniferous forest	Conifer boughs, princess pine, firewood, other plants or forest products	437.2	0.2	20.7
Upland deciduous forest	Princess pine, ginseng, birch bark, firewood, other plants or forest products	354.7	2.7	295.1
Shrubland	Firewood, other plants or forest products	133.0	7.7	144.9
Disturbed	NA	44.0	94.4	1,104.0
Aquatic environments	Wild rice, other plants or forest products	6.0	2.7	573.0
Cropland/Grassland	NA	0.2	9.8	0.0
Upland conifer-deciduous mixed forest	Conifer boughs, princess pine, ginseng, birch bark, firewood, other plants or forest products	1.5	0.0	0.0
Lowland deciduous forest	Princess pine, birch bark, firewood, other plants or forest products	0.0	0.0	0.0
Total		**1,718.6**	**120.1**	**2,189.7**

Source: 1854 Treaty Authority 2007.

[1] Acres from Section 5.2.4.

In addition to the direct effects discussed above, there may also be indirect effects on cover types. Hydrology changes and dust from traffic and mining operations could affect plant communities near the NorthMet Project area, which could further reduce plant species or resources regulated by 1854 Treaty Authority. Mitigation measures, which would minimize these effects, are discussed in Section 5.2.4. Subsistence gathering at these locations is probably limited because of general inaccessibility.

According to the NorthMet Project Cultural Landscape Study (Zellie 2012), some of the most common species include balsam fir, speckled alder, and low-bush blueberry (see Table 4.2.9-4). These species were identified in multiple community types and are more likely to remain within the NorthMet Project area, despite the direct and indirect effects from the NorthMet Project Proposed Action. Within the combined Laurentian Uplands and Nashwauk Uplands ecological subsections, less than 0.3 percent would be affected by the NorthMet Project Proposed Action. As an estimate, the species or resources listed in Table 4.2.9-4 could likely decrease by the same margin within these Ecological Classification System (ECS) subsections.

Wildlife

Similar to the effects on SGCNs discussed in Section 5.2.5, the NorthMet Project Proposed Action would affect 1854 Treaty Authority-regulated species as a result of increased human activity and noise, potential collisions with vehicular and rail traffic, and decrease of habitat. Generally, effects on common and/or game animals (such as white-tailed deer, fox, grouse, waterfowl, etc.) would be similar to the effects on ETSC species (e.g., gray wolf, moose, etc.), which are discussed in Sections 5.2.5.2.1 and 5.2.5.2.2. Local effects are expected due to competition from migrating individuals, but these would not threaten overall populations. See Section 5.2.5 for a more thorough discussion of the types of effects on wildlife.

As there is likely limited present day or recent past subsistence gathering in the NorthMet Project area due to general inaccessibility, the NorthMet Project Proposed Action is unlikely to further diminish the exercise of 1854 Treaty rights in the area.

Increased Human Activity

The 1854 Treaty Authority-regulated species would be directly and indirectly affected through increased human activity due to mining activities. Factors such as noise, dust, light, and vehicle traffic may frighten some species and discourage their use of otherwise suitable habitat. Displaced to other habitat, individuals could face increased competition for resources. Less mobile species, such as herptiles (e.g., frogs, turtles), would likely incur relatively high mortality rates due to less ability to leave the affected area. Cliff-nesting birds could be affected by disturbance if they were to nest along the cliffs created by the pit rims.

Noise Effects

Noise associated with mining activities, including noise from vehicle and rail traffic, would likely affect wildlife, including 1854 Treaty Authority-regulated species. Section 5.2.8 provides further discussion on the noise modeling predictions for the NorthMet Project area. Though wildlife species are likely to be sensitive to changes in noise levels, there are no local, national, or international standards or limits that are applicable to the NorthMet Project Proposed Action. State standards are discussed Section 5.2.8, Noise. Wildlife species may be affected by noise in the NorthMet Project area, though adjacent habitat is available.

Vehicular and Rail Traffic Effects

Traffic effects from collisions with wildlife depend upon factors such as traffic volume, traffic speed, and the species involved. Species that utilize the small preserved forest island remnants between haul roads at the Mine Site would be most affected. Indirect effects from vehicle activities are expected locally at the Mine Site for 1854 Treaty Authority-regulated species and the overall local ecosystem. Effects at the Transportation and Utility Corridor are primarily related to vehicle and rail traffic. The 1854 Treaty Authority-regulated species may be affected by noise and light associated with vehicle and rail traffic, and by collisions with vehicles or trains. Transportation effects at the Plant Site are primarily related to vehicle traffic associated with the construction of the Tailings Basin embankments and bentonite application, primarily during the construction phase of the NorthMet Project Proposed Action. The 1854 Treaty Authority-regulated species may be affected by noise and light associated with vehicle traffic and by collisions with vehicles.

Habitat Effects

The direct effect on wildlife habitat, and thus on species regulated by the 1854 Treaty Authority, was assessed by evaluating the acres of habitat types that would be lost under the NorthMet Project Proposed Action. The changes in cover type are summarized in Table 5.2.9-3.

Table 5.2.9-3 Direct Effects on Key Habitat Types

Key Habitat Types	Total Acres[1] of Cover Type Directly Affected at the Mine Site	Total Acres[1] of Cover Type Directly Affected at the Transportation and Utility Corridor	Total Acres[1] of Cover Type Directly Affected at the Plant Site
Mature Upland Forest, Continuous Upland/Lowland Forest (MIH1-13)	1,535.3	5.5	367.8
Open Ground, Bare Soils (no MIH)	44.0	94.4	1,104.0
Grassland and Brushland, Early Successional Forest (no MIH)	133.2	17.5	144.9
Aquatic Environments (MIH 14)	6.0	2.7	573.0
Total	**1,718.6**	**120.1**	**2,189.7**

Data from Tables 5.2.4-1, 5.2.4-4, and 5.2.4-6.

[1] Total acres may be more or less than presented due to rounding.

Mature Upland/Lowland Forest

At the Mine Site, 1,535.3 acres of the mature forest would be lost as a result of the NorthMet Project Proposed Action. All 5.5 acres of mature upland/lowland forest along the Transportation and Utility Corridor would be affected. Approximately 368 acres of forest habitat at the Plant Site would be disturbed, most of which is in small or isolated patches of aspen-birch forest that are in poor to fair condition (MDNR 2013a).

The 1854 Treaty Authority-regulated species consist of several common and/or game animals. These species are largely mobile and would likely be displaced, not injured or killed, during mine construction and operation. Reclamation of the Mine Site would include revegetating nearly all disturbed ground according to *Minnesota Rules*, part 6132.2700. Reclamation and revegetation of the NorthMet Project area would improve wildlife habitat relative to conditions during mine operations; however, the quality of habitat for 1854 Treaty Authority-regulated species would remain degraded for decades after closure relative to pre-mining conditions.

Open Ground/Bare Soils

No 1854 Treaty Authority-regulated species are identified as utilizing open ground or bare soils habitat at the Mine Site, Transportation and Utility Corridor, or Plant Site. These areas were the result of past mining activity, are generally of low-quality, and are expected to decrease after mine closure as a result of reclamation.

Brush/Grassland

Approximately 133 acres of brush/grassland at the Mine Site would be directly affected by the NorthMet Project Proposed Action. Young trees (less than 4 inches dbh) make up most of this habitat type (ENSR 2005). Although all 17.5 acres of brush/grassland at the Transportation and Utility Corridor would be directly affected, activities at the Transportation and Utility Corridor would not affect grassland/brush 1854 Treaty Authority-regulated species based on the fragmented nature of this habitat. Approximately 145 acres of brush/grassland at the Plant Site would be directly affected by the activities at the Plant Site. The reclaimed Plant Site, specifically the Tailings Basin, would be revegetated with grassland vegetation species. Overall, the NorthMet Project Proposed Action would have a minimal effect on grassland/brush 1854 Treaty Authority-regulated species.

Open Water

The NorthMet Project Proposed Action would create approximately 321 acres of open water at the Mine Site by eventually flooding the West Pit, which is estimated to fill between years 40 and 45. At the Plant Site, open water habitat primarily occurs in the existing LTVSMC Tailings Basin. Existing open water habitat would be maintained during operations, though the acreage of open water would fluctuate according to processing needs. See Section 5.2.5 for further discussion of wildlife use of the open water at the NorthMet Project area.

Wetlands

Based on the site-specific wetland delineation, the NorthMet Project Proposed Action would directly affect 758.2 acres of wetlands at the Mine Site, though surrounding similar wetland habitat would likely be adequate to absorb the displaced wildlife. There are 7.2 acres of wetlands along the Transportation and Utility Corridor, all of which would be affected by activities along the corridor. There would be 148.4 acres of wetland at the Plant Site directly affected (see Section 4.2.3 and 5.2.3). On-site wetland use by 1854 Treaty Authority-regulated species may be limited. Wetlands at the Mine Site are considered 99 percent high quality and 1 percent moderate quality, 100 percent high quality along the Transportation and Utility Corridor, and 94 percent low quality and 6 percent moderate quality at the Plant Site.

Wetland mitigation is proposed both on and off site at three mitigation sites (See Section 5.2.3). Approximately 101.8 acres of wetland creation is proposed for on-site mitigation. Off-site mitigation would consist of 1,799.8 acres of wetland restoration and preservation and upland buffer.

Aquatic Species

The potential environmental effects of the NorthMet Project Proposed Action on fish and aquatic macroinvertebrate communities found in the vicinity of the NorthMet Project area are primarily discussed in Section 5.2.6. Direct and indirect effects could include changes in water quality and alteration of physical habitat.

The NorthMet Project Proposed Action would not result in physical habitat effects on the Partridge River or Embarrass River watersheds as a result of hydrologic changes. Generally, fish species regulated by the 1854 Treaty Authority (see Table 4.2.9-7) that occur in the NorthMet Project area would not experience effects from physical habitat loss or alteration.

For the 29 solutes evaluated, the GoldSim model predicted that the NorthMet Project Proposed Action would not cause any significant water quality impacts because: 1) exceedances of the P90 threshold did not occur, 2) the NorthMet Project Proposed Action concentrations were no higher than concentrations predicted for the CEC scenario, or 3) the frequency of exceedances for NorthMet Project Proposed Action conditions was within an acceptable range or not attributable to NorthMet Project Proposed Action discharges or both. See Section 5.2.2 for a more thorough discussion of water quality effects and 5.2.6 for a discussion of water quality effects pertaining to aquatic species.

The NorthMet Project Proposed Action is expected to result in a net decrease in mercury loadings to the Partridge River from 24.2 to 23.0 grams per year, primarily as a result of a decrease in natural runoff and a proportional increase in water discharged from the West Pit via the WWTF. It is also expected to result in a net increase in mercury loadings to the Embarrass River from 22.3 to 22.5 grams per year, primarily due to the redirection of flow associated with the construction of the East Dam as part of the Tailings Basin expansion to the Embarrass River. However, the NorthMet Project Proposed Action would also result in a 45 percent reduction in sulfate loads (P50 modeling results) at PM-13, which would reduce the potential for mercury methylation. Overall, the NorthMet Project Proposed Action is not expected to increase the mercury content in fish in the St. Louis River. See Sections 5.2.2 and 5.2.6 for a more thorough discussion of mercury bioaccumulation.

Overall Effects on 1854 Treaty Resources

As discussed above, the NorthMet Project Proposed Action would have effects on 1854 Treaty resources—i.e., those areas and species that are traditionally or culturally important to the Bands. There are two categories of effects: those relating to plant and animal species of interest to Band members, and those relating to areas where these plant and animal species are hunted, fished, or gathered. As discussed above and in other resource-specific sections of the FEIS, the NorthMet Project Proposed Action would result in direct environmental effects due to ground-disturbing activities. Band members' use of the NorthMet Project area is not well-defined, and did not emerge through interviews. A good faith effort was made on the part of the Co-lead Agencies to identify use areas in or adjacent to the NorthMet Project area; however, those efforts resulted in little specific information concerning historic subsistence use and no information regarding recent subsistence activity at the Mine Site, Transportation and Utility Corridor, or Plant Site. In addition, as described in Section 5.2.11, the NorthMet Project area is surrounded by private land and cannot be easily accessed due to private roads. Without private landowner permission, there is minimal opportunity for the Bands to exercise usufructuary rights (hunting, fishing, and gathering) on this property.

Construction and operation of the NorthMet Project Proposed Action is not likely to significantly reduce overall availability of 1854 Treaty resources that are typically part of subsistence activities in the 1854 Ceded Territory. Some individuals and localized populations may be affected, but overall species populations are expected to remain available. Additionally, noise and other consequences of operations would affect migration or other animal species behavior.

The importance of fish as a subsistence resource in Ojibwe communities is well documented historically, and fish continue to be an important component of the day-to-day diet, while fishing itself remains an important socio-cultural and economic activity in Tribal communities across the Upper Great Lakes. The NorthMet Project Proposed Action could affect the availability of 1854 Treaty resources for some Band members because of real or perceived factors. For instance, bioaccumulation of mercury in fish could affect Band members' willingness to rely on subsistence fishing as a contribution to household economies, as well as affect continuation of traditional fishing practices, but there is no evidence that this availability would significantly affect subsistence use given the lack of information showing recent or historic fishing activity in the NorthMet Project area.

Effects on the environment, including any from increased mercury, are all expected to meet the standards and regulations set forth by the appropriate state or federal agency or program. These laws are intended to protect important natural and cultural resources and include, but are not limited to the ESA, CWA, and CAA. Effects on 1854 Treaty resources are difficult to quantify when the effects are within environmental standards, yet above current baseline conditions. As such, cultural effects on the Bands would be difficult to quantify in regards to such incremental increases below standards or effects to species where appropriate mitigation is used.

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5.2.10 Socioeconomics

This section describes the potential socioeconomic consequences of the NorthMet Project Proposed Action on communities in the study area (consisting of St. Louis, Lake, and Cook counties—see Section 4.2.10 and Figure 4.2.10-1). Socioeconomics includes demographic characteristics of the study area's population, economic characteristics (employment, income, market composition—i.e., the types of firms and employers located in the study area), public finance, housing, public services, and the economic characteristics of subsistence activities. The cultural aspects of subsistence, specifically for Native American populations, are discussed in the Section 5.2.9. Individual subsistence products (e.g., wild rice, game animals, etc.) are discussed in appropriate resource-specific sections of the FEIS.

Summary

The NorthMet Project Proposed Action would generate as many as 500 direct jobs during peak construction and 360 direct jobs during operation. These direct jobs would generate additional indirect and induced employment, estimated to be 332 additional construction-phase jobs and 631 additional operations-phase jobs. While some skilled workers would be involved only temporarily and possibly relocate from outside the region, the majority of the NorthMet Project Proposed Action-related jobs are expected to be filled by those currently residing in the Arrowhead region.

Federal, state, and local taxes would total up to an estimated $80 million annually. During operations, there would be approximately $231 million per year in direct value added through wages and rents and $332 million per year in direct output related to the value of the extracted minerals. As with employment, these direct economic contributions would create indirect and induced contributions estimated at $99 million in value added and $182 million in output.

The NorthMet Project Proposed Action would create slightly increased demand for housing and public services in cities and towns near the NorthMet Project area. The resulting increase in housing demand and prices could have minor effects on the Environmental Justice (EJ) populations.

The NorthMet Project No Action Alternative would have no effects.

5.2.10.1 Methodology and Evaluation Criteria

As discussed in Section 4.2.10, the study area for socioeconomics includes Cook, Lake, and St. Louis counties. Because socioeconomic consequences are measured and felt across a broad geographic area, this section does not distinguish between the Mine Site, Transportation and Utility Corridor, and Plant Site. Rather, this section describes the socioeconomic consequences of the NorthMet Project Proposed Action across the entire three-county study area and, where appropriate, includes the study area communities listed in Section 4.2.10.

5.2.10.1.1 Evaluation Criteria

Specific criteria used to evaluate socioeconomic consequences include the following:

- Changes in local population, employment, or earnings associated with NorthMet Project Proposed Action operations.
- Changes in public sector revenues, expenditures, or the underlying fiscal conditions of local governments.
- Changes in economic activity for non-mining industries in the region, particularly the tourism industry.
- Changes in demand for temporary or permanent housing during NorthMet Project Proposed Action construction, operation, and closure periods.
- Changes in long-term demands on public services and infrastructure that reduce capacities in these systems, either triggering the need for capital expansion or resulting in a discernible reduction in the level of service provided.
- Displacement or other use of property that affects residences or businesses.
- Disproportionate effects on minority (including Native American) or low-income populations, including human health or environmental effects, and subsistence—especially if the NorthMet Project Proposed Action results in large reductions in abundance or major redistribution of subsistence resources, substantial interference with harvestable access to active subsistence sites, or major increases in non-rural resident hunting (Barnard Dunkelberg 2009).

5.2.10.1.2 Determination of Study Area

As discussed in Section 4.2.10, the socioeconomic study area for this section includes all of Cook, Lake, and St. Louis counties (the three counties that comprise the Arrowhead region of Northeastern Minnesota). This study area includes the Mine Site, Transportation and Utility Corridor, and Plant Site, as well as all of the tracts involved in the Land Exchange Proposed Action. The size of this study area also captures much of the region's recreational resources (which are important economic engines) and a substantial portion of the 1854 Ceded Territory, which is important to the Bands. Finally, the three-county study area is large enough to reflect a regional economic picture against which the NorthMet Project Proposed Action's effects can be compared.

Where possible, the analysis of effects is based on a quantitative comparison of baseline conditions (see Section 4.2.10) against predicted future conditions in the entire three-county area. In cases where such quantitative data are not available for the entire region (e.g., the IMPLAN model discussed in Section 5.2.10.1.3), the evaluation of effects is either limited to St. Louis County—the site of the NorthMet Project area—or includes the other counties but only qualitatively.

5.2.10.1.3 IMPLAN Model Methodology

Many of the socioeconomic effects of the NorthMet Project such as increased population, housing demand, and effects on public facilities and services are functions of the jobs and revenue that the NorthMet Project Proposed Action creates. To model these effects, the

University of Minnesota Duluth Labovitz Bureau of Business and Economic Research (BBER) used the IMPLAN software package. IMPLAN uses an input-output approach to model the economic effects of changes in baseline conditions (e.g., a large industrial project such as the NorthMet Project Proposed Action). IMPLAN reports direct, indirect, and induced effects (definitions of these terms are provided below) in terms of employment, output (the value of production), and value added (wages, rents, taxes, etc.).

For both the SDEIS and the FEIS, BBER used version 3.0 of IMPLAN; this version uses economic baseline data from 2009, the most recent year for which data were available to BBER at the time the model was developed (BBER 2012). (The model does assume a recovery—by the mining industry, and the overall economy—from the recession that was in place in 2009.) Due to their small populations, workforces, and their distance from the NorthMet Project area, Cook and Lake counties are not expected to experience substantial additional effects from the NorthMet Project Proposed Action. As a result, the IMPLAN model includes only St. Louis County, which acts as a proxy for the entire three-county study area.

Economic effects were modeled for two construction phases: a 15-month Phase I and a 12-month Phase II that would begin 6 months after completion of Phase I. The phases represent two distinct periods of activity in mine construction involving distinct skill sets and activities. Two operations phases were also modeled: a 6-month Startup Phase and a Typical Year (BBER 2012). The IMPLAN model did not project the number of years of operation, due to the inherent difficulty of predicting how variations in the grade of the extracted material or macroeconomic forces—such as industry cycles or metal prices (see below)—would affect mine life. The Typical Year estimate is intended to model the economic effects of standard operations, recognizing that “some years will be a little better, others a little worse” (BBER 2012). The IMPLAN model also did not include effects during the closure phase or the post-closure period, again due to the difficulty of predicting the timing and extent of those phases.

The IMPLAN model focuses on three categories of economic effects:

- Employment: calculated in terms of jobs, not full-time equivalent (FTE) positions. The model does not make a distinction between full-time, part-time, permanent, or temporary jobs. Direct employment estimates were provided by PolyMet.
- Value added: measures economic contributions to the local economy through wages, rents, interest, and profits.
- Output: the value of the goods or services (e.g., minerals and processed mineral products) produced.

Each category of effects comprises three separate components:

- Direct effects: new jobs, spending, and output resulting directly from the NorthMet Project Proposed Action (e.g., PolyMet employees, salaries, spending, and sales).
- Indirect effects: additional inter-industry spending and employment resulting from direct effects (e.g., wholesale purchase of tires by tire retailers who are NorthMet Project Proposed Action vendors).
- Induced effects: additional household expenditure resulting from the direct and indirect effects (e.g., increased patronage of local restaurants by employees of PolyMet or affiliated industries).

The findings of the IMPLAN model are presented in section 5.2.10.2.

5.2.10.1.4 Sources of Uncertainty and Variability

The anticipated socioeconomic effects of the NorthMet Project Proposed Action are based on the best available data, economic modeling, and lessons learned from the history of metal mining in the Mesabi Iron Range. As this history shows, there are numerous sources of economic uncertainty surrounding a project such as the NorthMet Project Proposed Action. The largest overarching socioeconomic concerns related to the NorthMet Project Proposed Action are listed below. Their relationship to the determination of effects is discussed, as appropriate, throughout the remainder of Section 5.2.10.

Industry Cycles

The feasibility of mining is strongly tied to the market price of the commodities being extracted. When prices are high, mining activity is high (the "boom"); when prices drop, mining activity can often slow down or cease entirely (the "bust"). Such changes in mining activity would have effects on host communities. The diverse economy of the study area could offset the degree to which the effects of a bust are experienced. Though this "boom and bust" phenomenon is often present in mining economies, IMPLAN does not model this phenomenon (or assume that it would occur) because the duration of a boom or bust and the severity relative to modeled commodity prices cannot be predicted. Table 5.2.10-1 shows the metal prices assumed in the IMPLAN model, along with recent average prices and the lowest prices experienced during the 2008-9 recession. The potential effects of major changes in commodity prices are addressed in the discussions of effects during the operations phase.

Table 5.2.10-1 Comparison of Assumed (IMPLAN) and Actual Commodity Prices

Commodity	Price Assumed in IMPLAN[1]	Average Actual Price[2]	Recent Low Price[3]
Copper	$2.90/lb	$3.56/lb	$1.39/lb
Nickel	$12.20/lb	$9.47/lb	$4.39/lb
Cobalt	$23.50/lb	$111.69/lb	$13.56/lb
Platinum	$1,230.00/oz	$1,689.00/oz	$843.00/oz
Gold	$635.00/oz	$1,485.00/oz	$755.00/oz

Sources: BBER 2012 (commodity prices); Foth 2012 (average actual price); PolyMet, Pers. Comm., March 29, 2012 (recent low price).

[1] Prices based on PolyMet's 2008 Bankable Feasibility Study (PolyMet 2008b). This is the most detailed published information available, and PolyMet is legally bound to these data.
[2] Three-year rolling average metal prices as of June 30, 2012 (Foth 2012).
[3] Monthly low during 2008-2009 recession.

Changes in Industrial Productivity

Throughout the nation, "regional labor productivity [in mining and overall]…has increased dramatically" since publication of the 2009 DEIS (BBER 2012). Over the longer term (since approximately 1980), mining productivity in the Arrowhead region has also increased, due to mechanization and technological innovation (Powers 2007). As a result, far fewer miners are now required per unit of extracted material than before, which therefore lessens the effects of booms and busts in mining communities. Continued technologically driven productivity increases could lead to lower employment than assumed by IMPLAN or other projections.

Local Employment

The NorthMet Project Proposed Action's socioeconomic effects may be influenced by the degree to which PolyMet hires employees who already live in the socioeconomic study area. The FEIS assumes that at least some (but not all) direct and indirect jobs would be filled by current study area residents; more specific assumptions about the construction, operations, and closure phases are discussed in subsequent portions of this section, as are the ways in which changes in "local" employment shares would affect different aspects of the study area's socioeconomic character.

Environmental Costs and Non-market Value

The FEIS contains extensive discussion of the environmental and social effects of the NorthMet Project Proposed Action (and the Land Exchange Proposed Action) in this section and other resource-specific sections. These effects could, in turn, have real and/or perceived economic costs. Non-market values refer to the importance given to characteristics of the land that have personal or community value, but that are not typically expressed in monetary value. Beauty, quiet, and the ability to view nature are examples of non-market values.

Neither NEPA nor CEQ requires the cost and benefits of a proposed action to be quantified in dollars or any other common metric; however, this FEIS acknowledges that economic costs and loss of non-market value may result from environmental and social effects. Also acknowledged is that the agreement on the value (i.e., the "cost") of environmental effects is often difficult to achieve. Therefore, the approach of this FEIS is to evaluate environmental and social effects directly, in the appropriate resource-specific section (e.g., the impacts on wildlife are discussed in the Wildlife section, and impacts on water quality are discussed in the Water Resources section).

5.2.10.2 NorthMet Project Proposed Action

This section evaluates the NorthMet Project Proposed Action's effects on socioeconomics in the three-county study area.

5.2.10.2.1 Population and Population Trends

This section discusses the changes in the study area's population resulting from the NorthMet Project Proposed Action. These population changes would be driven primarily by NorthMet Project Proposed Action-related changes in employment.

Construction

IMPLAN modeling estimates that construction activities would create an average of 500 direct and 128 indirect construction jobs over the 18-month Phase I period (the most labor-intensive portion of the construction phase). The 204 induced jobs during this phase are likely to be existing residents hired to accommodate the additional demand from direct and indirect jobs.

Typical mine construction involves fluctuating work flows and specialized crews that may be employed for short duration tasks within the construction time frame. Very few construction phase employees would work within the NorthMet Project area for the entire 30-month construction period (including Phase I, the 6-month gap, and Phase II).

Given the NorthMet Project area, most construction employees would likely be from Minnesota, and many would already live in the study area. Many direct and indirect employees are likely to reside outside of the communities in the immediate vicinity of the NorthMet Project area (e.g., Hoyt Lakes, Babbitt, Biwabik, Aurora). However, mine workers in the Arrowhead region and beyond "are willing to commute considerable distance to…well-paid jobs…to protect investment in their homes" (Powers 2007). This finding is generally true of mine construction workers as well. As a result, most employees (regardless of project phase) would not need to relocate.

Due to the proximity of the NorthMet Project area to population centers such as Duluth (80 miles), Hibbing (50 miles), and Virginia (25 miles), the FEIS assumes that 80 percent of direct and indirect construction labor (approximately 500 employees during Phase I of construction, which requires more workers than Phase II) would commute to the NorthMet Project Proposed Action construction site on a regular basis (PolyMet 2012d). The FEIS assumes that another 5 to 10 percent of direct and indirect workers (approximately 25 to 50 employees) would temporarily reside in the study area, at local hotels or in designated mobile home facilities, but would not relocate their families to the region.

The remaining 10 to 15 percent of the direct and indirect workforce (as many as approximately 100 employees) would relocate to the study area for portions (or all) of the construction process (PolyMet 2012l). An influx of 100 workers would equate to as many as 225 total new residents (including family members—see the average population per housing unit in Table 4.2.10-14) who would seek long-term (e.g., more than a few months) residences in nearby communities. This represents an increase of less than one quarter of 1 percent over the 2010 population of the study area (approximately 216,000 residents—see Table 4.2.10-1), and slightly more than a 2 percent increase in the population of nearby cities (Aurora, Babbitt, Biwabik, Hoyt Lakes, Tower, and Virginia). Such a small increase would not meaningfully change the demographic composition of the study area; thus, construction of the NorthMet Project Proposed Action would have negligible effects on population.

Operations

During typical operations, the NorthMet Project Proposed Action would generate 360 direct and 330 indirect jobs. Direct and indirect employees are likely to work at the Mine Site, Plant Site, and in the study area for a substantial period of time (perhaps as long as the 20-year projected life of the mine). Direct and indirect employees who do not already live within commuting distance of the Mine Site and Plant Site (i.e., in the study area) are likely to relocate to the study area. It is not known how many direct employees would be current study area residents. PolyMet estimates that as many as 338 of the 360 new direct operations-phase positions (94 percent of these positions) could be filled by study area residents (PolyMet 2012c).

For purposes of this analysis, the FEIS assumes that approximately 75 percent of direct and indirect operations phase employees would be local residents who would not need to relocate as a result of employment. The FEIS also assumes that the vast majority of the 301 induced jobs created during operations would be filled by existing residents or the spouses and children of new NorthMet Project Proposed Action employees.

The remaining 25 percent of operations-phase workers (approximately 175 employees) would relocate to the study area with their families, causing a total increase of approximately 400 new residents (see the average population per housing unit in Table 4.2.10-14). This is less than one quarter of one percent of the study area population (approximately 216,000 residents).

These workers are likely to be younger, on average, than the existing populations of the study area communities, and may have higher overall incomes. Other demographic characteristics (race, level of education) cannot be determined. The effect of such a shift on housing and public services is discussed below.

Increases in worker productivity spurred by technological change could reduce the anticipated number of direct, indirect, and induced employees. The effect of such reductions would be to reduce the overall new population of the study area. This in turn would diminish the NorthMet Project Proposed Action's demographic effects.

Reclamation and Closure

During the closure of the NorthMet Project Proposed Action, PolyMet estimates that a reduced number of employees and contractors would remain employed for approximately 3 to 4 years for building demolition, but other closure activities would likely be followed by several years of reclamation activities (e.g., surface water quality monitoring). PolyMet is in the process of finalizing reclamation designs and estimates. Current estimates are based on experience at closure of the former LTVSMC processing plant and include 30 to 50 FTEs for the first 7 years, which includes demolition, remediation, reclamation, construction, and monitoring, and 5 to 10 FTEs for the following 30 years, which includes a period of monitoring, reporting, and active water treatment. During closure, direct, indirect, and induced employment associated with the project would decline. All other factors being equal, by the end of the seven-year closure period, the demographic characteristics of the study area would likely revert to levels that could be expected under the NorthMet Project No Action Alternative.

5.2.10.2.2 Employment and Income

Table 5.2.10-2 shows the anticipated economic contributions of the NorthMet Project Proposed Action, as modeled using IMPLAN. Detailed estimates of jobs by type are provided in the IMPLAN Report (BBER 2012). The IMPLAN model includes assumptions about the portion of employment, value added, and output that accrues to the study area (in the case of the IMPLAN model, this is limited to St. Louis County), as opposed to the amount that "leaks" to locations outside of St. Louis County (BBER 2012). While the data in Table 5.2.10-2 depict the economic effects of the project specifically on St. Louis County alone, they capture the vast majority of the NorthMet Project Proposed Action's effects in the entire three-county study area. By comparison, the total value added to the Minnesota economy in 2009 (from all sources) was \$268 billion (Henry Eichman, USFS Economist, Pers. Comm., July 26, 2013).

Table 5.2.10-2 Summary of IMPLAN Model Results

Phase[1]	Direct Effect	Indirect Effect	Induced Effect	Total
Construction Phase I				
Value Added[2]	$143,637,243	$41,774,260	$61,120,854	**$246,532,357**
Output[3]	$312,000,009	$75,343,964	$101,199,927	**$488,543,900**
Employment	500	128	204	**832**
Construction Phase II				
Value Added	$75,501,628	$21,958,266	$32,127,628	**$129,587,122**
Output	$164,000,005	$39,603,897	$53,194,833	**$256,798,717**
Employment	264	68	107	**439**
Operations Phase – Startup				
Value Added	$44,619,571	$12,117,664	$6,865,833	**$63,603,068**
Output	$64,122,003	$23,821,174	$11,367,855	**$99,311,032**
Employment	300	275	251	**826**
Operations Phase – Typical Year				
Value Added	$231,315,193	$62,819,962	$35,593,610	**$329,728,765**
Output	$332,418,993	$123,492,880	$58,932,833	**$514,844,706**
Employment	360	330	301	**991**

Source: BBER 2012.

[1] The IMPLAN model did not include effects during the closure phase or post-closure period.
[2] Defined in BBER 2012 as "a measure of the affecting industry's contribution to the local community; it includes wages, rents, interest and profits."
[3] Defined in BBER 2012 as "the value of local production required to sustain activities."

Construction

Construction of the NorthMet Project would create as many as 832 jobs during the peak of Phase I, of which 500 would be mine construction jobs. Indirect and induced employment would be spread across a variety of industries, such as engineering, restaurants, medical providers, and hospitals (see Table 10 in BBER 2012). The NorthMet Project Proposed Action-related construction employment would increase overall study area employment by less than one percent at its peak (less during Phase II).

As discussed in Section 5.2.10.2.1, the FEIS assumes that a substantial share of direct construction jobs would be filled by study area residents—particularly those with construction experience—while other study area residents would obtain indirect and induced jobs. Construction is therefore expected to at least marginally reduce the unemployment rate in the study area.

It is not known how much of the estimated $376 million in total value added during the two parts of the construction phase would be dedicated to employee salaries, although employee pay is assumed to be a substantial share. The value added from the NorthMet Project Proposed Action is likely to be substantial compared to other non-ferrous (e.g., copper, nickel, lead, zinc) mining activity, but would be limited to the construction phase.

While employment related to the construction phase of the NorthMet Project Proposed Action would have minimal effects, the earnings from construction employees would be positive, albeit relatively short-lived (e.g., for no more than the 36-month overall construction phase).

Operations

Overall Effects

During typical year operations, the NorthMet Project Proposed Action would generate nearly 1,000 total direct, indirect, and induced jobs. This would increase study area employment by approximately one percent. One-third of new employment (360 jobs) would be direct mine-related jobs. The remainder would be spread among a variety of industries, such computer programming, restaurants, engineering, and health care (BBER 2012).

As discussed in Section 5.2.10.2.1, the FEIS assumes that a substantial share of direct operations jobs would be filled by study area residents, particularly those with mining experience. In 2009, there were approximately 3,000 mining jobs in the study area (U.S. Census Bureau 2009). This figure does not include residents who have skills appropriate for the mining sector but who are not currently employed in mining. Other local residents are likely to obtain indirect and induced jobs. Operation of the NorthMet Project Proposed Action could reduce unemployment in the study area by nearly one percent (991 new jobs out of 111,090 members of the workforce, see Table 4.2.10-9).

It is not known how much of the estimated $330 million in total value added during typical operations would be dedicated to employee salaries, although employee pay is assumed to be a substantial share. The NorthMet Project Proposed Action's estimated value added (and thus earnings) is substantial compared to the 2007 estimate of $250 million in annual statewide value added economic effects from non-ferrous mining (BBER 2009).

Earnings and all economic contributions of the NorthMet Project are influenced by external market factors, such as those discussed in Section 5.2.10.1.4. Significant decreases in metal prices and/or competition from other regions or countries can lead to reduced production. PolyMet states that, due to its structure as a "low-cost producer," the NorthMet Project Proposed Action would be unlikely to completely cease operations during a recession (PolyMet, Pers. Comm., March 29, 2012). That statement notwithstanding, complete suspension of mining activity is not an uncommon response to recession or significant drops in commodity prices. This "bust" aspect of the cyclical economy is familiar to mining regions in Minnesota and beyond (Powers 2007; Freudenberg and Wilson 2002). Increases in productivity may not affect the output of the NorthMet Project Proposed Action (i.e., the sales price of the extracted and processed materials), but could reduce employment and value added.

To account for some of these concerns, commodity prices in the IMPLAN model are generally conservative, compared to price trends. In particular, copper, gold, and platinum prices used in the IMPLAN model are significantly below recent average prices. Nickel and cobalt, which are expected to comprise a small share of the total volume extracted by PolyMet, are significantly above current average prices, but were also conservative compared to contemporary prices that formed the basis of PolyMet's 2008 Bankable Feasibility Study (see notes in Table 5.2.10-1) (PolyMet 2008b). Section 5.2.10.1.4 provides more information about sources of uncertainty and variability.

Effects on Regional Tourism

Effects on species (game animals, fish, and vegetation) and resources (water quality, air quality, and noise) that contribute to the tourism industry are discussed in appropriate sections of Chapter 5. Housing is also an important component of the tourism industry—the Arrowhead region is often regarded as a location for long vacations, rather than short day-trips—and is discussed in Section 5.2.10.2.4. To the degree that the NorthMet Project Proposed Action adversely affects those resources, then it also has the potential to affect the tourism industry. However, the presence of the NorthMet Project Proposed Action would not significantly affect regional recreation or visual resources (see Section 5.2.11.2.1), nor would it affect air or water quality or increase noise levels in popular regional recreation resources such as BWCAW (see Section 5.2.12). Consequently, there is also insufficient evidence to suggest that the presence of the NorthMet Project Proposed Action would affect the tourism industry as a whole.

As discussed in 5.2.10.2.1, the NorthMet Project Proposed Action would retain a small workforce, generating a corresponding small number of indirect and induced jobs, to perform post-mining activities such as demolition and reclamation as well as to maintain a very small post-closure staff. Using the IMPLAN model's construction-phase employment multipliers (BBER 2012) a 50-person closure staff (direct employment) could equate to as many as 30 indirect and induced jobs (a decline, compared to the 1,000 operations-phase jobs generated by the NorthMet Project Proposed Action). Because no minerals or other commodities would be extracted, the value added from the closure phase would be limited to employee salaries, rents, and other contributions.

<u>Closure</u>

Overall, the employment, output, and value added from the closure phase would be small compared to the study area's overall economy. More important, at mine closure, workers who held operations-phase direct, indirect, and induced jobs would be expected to secure alternative local employment, retire, or relocate out of area. There would likely be a spike in unemployment and a resulting decline in income during the transition between the operations and closure phases. The 991 operations-phase jobs (including direct, indirect, and induced jobs) collectively account for less than one percent of the overall study area workforce (111,090 individuals—see Table 4.2.10-9). Any increase in study area unemployment during and after closure—resulting from individuals who remain in the study area workforce but who cannot find jobs—would be minimal. As former employees moved, found new work in the area, or retired, unemployment and income would normalize to levels predicted for the NorthMet Project No Action Alternative (holding all other economic variables constant).

5.2.10.2.3 Public Finance

The IMPLAN model estimates the value of several federal and state taxes, including personal income taxes (i.e., taxes paid by employees on their salaries), indirect business taxes, and other taxes paid as a result of the NorthMet Project Proposed Action for the duration of the project (BBER 2012). PolyMet provided the tax estimates for taxes that would be paid directly by the company (PolyMet, Pers. Comm., March 29, 2012). The remainder of this section discusses those tax estimates.

Construction

Construction of the NorthMet Project Proposed Action would generate approximately $51 million in federal tax revenue, and $24 million in state tax revenue (combined, both construction phases) (BBER 2012). A portion of these tax contributions would be returned to the study area through various federal programs (e.g., grants to school systems and state governments) and through distributions from the state's general fund. However, such effects on local public finances are indirect and difficult to quantify. Other construction-phase revenues could include sales and use tax on some materials used for NorthMet Project Proposed Action construction, although most such materials and supplies are exempt from the tax (MDR 2011).

Operations

The majority of economic benefits to the local community through taxes would be realized during the operations period. IMPLAN modeling estimates that, during a typical year of operation, the federal government would receive approximately $30 million, and the state and local governments would receive approximately $39 million in taxes from the operation of the NorthMet Project Proposed Action.

PolyMet estimates that, if the NorthMet Project Proposed Action was currently in operation, its direct federal and state tax payments would have ranged from approximately $37 to $80 million per year during the previous 5-year period (PolyMet, Pers. Comm., March 29, 2012). Table 5.2.10-3 details how these direct tax payments would be divided among different state and federal taxes (as described in Section 4.2.10.1.3), if the NorthMet Project Proposed Action would have been in full operation in 2011. A substantial portion of state taxes would be returned to study area school systems, local governments, and local general funds.

Table 5.2.10-3 Estimated Annual NorthMet Project Proposed Action Taxes Paid, 2011 Dollars (millions)

	Minnesota Taxes[1]	Federal Taxes[1]
Net Proceeds Tax	$5.9	NA
Occupation Tax	$7.1	NA
Sales and Use Tax	$2.4	NA
Withholding Tax on Royalty Payments[2]	Undetermined	Undetermined
Ad Valorem Tax	$0.2	NA
Total	**$15.6**	**$64**

Source: PolyMet, Pers. Comm., March 29, 2012.

[1] Assumes-full operation at 2011 metal prices.
[2] Royalty payments would be subject to a 6.25% withholding tax. The value of this tax cannot be calculated or estimated at this time.

The magnitude of tax contributions is strongly linked to commodity prices. A significant drop in commodity prices would likely result in a significant reduction in tax revenue generated by the NorthMet Project Proposed Action. Even under such circumstances, operation of the NorthMet Project Proposed Action would benefit the local economy.

Reclamation and Closure

Closure activities would last approximately 20 years after cessation of operations. The first seven years of this period would be the most active, and would include reclamation, demolition, and restoration of the site. Years 7 to 20 of closure would include low-intensity monitoring, maintenance, and water treatment activities, followed by covering of the Tailings Basin at the end of this period. Low-intensity post-closure activities (such as long-term monitoring and maintenance) would extend indefinitely beyond year 20 of closure.

During closure and post-closure, the NorthMet Project Proposed Action would generate a small amount of tax revenue from the above activities, primarily from income taxes and business taxes. Other revenue sources, such as net proceeds taxes, and local ad valorem taxes would no longer apply. By the end of the closure phase, contributions to public finances would return to levels that would be expected for the NorthMet Project No Action Alternative. Relative to existing conditions, closure of the NorthMet Project Proposed Action would generate a negligible benefit for public finances in the study area.

5.2.10.2.4 Housing

Housing effects are tied to both employment and earnings; increases in both of these factors can cause increased demand for housing. There are more than 24,000 vacant housing units in the study area, of which approximately 7,000 are “permanent” (not seasonal) vacant units (see Table 4.2.10-14). Of that total, approximately 4,000 non-seasonal vacant units are located in the individual study area communities listed in Section 4.2.10 (the remainder are scattered throughout St. Louis, Lake, and Cook counties). All of these communities are within a reasonable commuting distance of the NorthMet Project area (Powers 2007).

Construction

As described in Section 5.2.10.2.1, 75 percent of the construction-phase employees are expected to commute to their jobs from existing residences in or near the study area. Relatively few construction-phase employees (approximately 100) are expected to permanently relocate to the study area, due to the short-term and transient nature of mine construction. Given the existing vacant housing stock (and including seasonal units, which could be converted to permanent units at the owners’ discretion), this added demand in permanent housing in the study area would be largely imperceptible.

Approximately 25 to 50 employees may choose to procure temporary housing. This could consist of short-term rentals of available housing units (seasonal or otherwise), and use of mobile home parks or hotels/motels. Lodging and mobile home facilities close to the NorthMet Project area, such as those in Aurora, Hoyt Lakes and Babbitt, could be more heavily occupied throughout both phases of the construction period, affecting both availability and pricing for the region’s tourist demand. However, there are approximately 5,400 hotel rooms and more than 1,400 mobile home berths (as well as park facilities that permit mobile homes) in the study area (Northland Connection 2012). Construction-phase demand for these accommodations would not substantially limit availability.

Operations

Demand for permanent housing is likely to increase during the operations phase. As discussed in Section 5.2.10.2.1, approximately 175 workers would choose to relocate to the study area. The actual number of housing units required to accommodate this demand may be lower (less than 380), due to the presence of two-worker in-migrating households (e.g., the spouse of a direct employee may obtain an indirect or induced job). Even if there are no multiple-worker in-migrating households (an unlikely scenario), the study area has approximately 7,000 vacant non-seasonal housing units. Thus, the study area has adequate housing to accommodate the influx of workers associated with the NorthMet Project Proposed Action.

Individual communities close to the NorthMet Project area may experience more competition for available housing units. While it is unlikely that any single community would achieve 100 percent non-seasonal occupancy, such competition could drive up housing prices and could also encourage the renovation of existing housing units and/or construction of new housing units (either on vacant land or as replacements of older housing units). Given the small number of new residents, such effects would be minor.

As with other economic effects of the NorthMet Project Proposed Action, effects on housing are tied to market fluctuations and workforce productivity. Major changes in levels of production (caused by major changes in commodity prices) could cause effects on housing demand and value. However, the total estimated new housing demand associated with the NorthMet Project Proposed Action is relatively small compared to the region's existing housing supply. Even a market "bust" (a drop in commodity prices so severe that it causes shutdown of the NorthMet Project Proposed Action) should not dramatically alter the housing market in any single community, let alone the study area as a whole.

There are concerns that the presence of the NorthMet Project Proposed Action could reduce housing demand (and thus housing value) in the study area, because of the conflict between the NorthMet Project Proposed Action's heavy industrial character and the high-quality natural environment that supports the region's tourism economy and thus the housing market. As described in Section 5.2.11, the NorthMet Project Proposed Action's effects on recreation and visual resources would be very limited.

Given the coexistence of mining and tourism in the Arrowhead region, the NorthMet Project Proposed Action's effects on the study area's housing values would be minimal. The most likely result of the operation of the NorthMet Project Proposed Action is a minor increase in housing demand and prices in study area communities, with moderate effects in individual communities closest to the NorthMet Project area. Increased housing prices may or may not be a negative effect; average housing values in the communities closest to the NorthMet Project area are relatively low compared to other study area communities. Minor to moderate increases in housing value would likely be seen as a benefit by homeowners, and the opportunity to add newer housing stock (either through rehabilitation of existing units or the construction of new units) to the study area would generally improve property values, thus improving local property tax revenues in those communities.

Reclamation and Closure

During and following reclamation and closure of the NorthMet Project Proposed Action, it is likely that the demand for housing would drop as workers migrate from the area. Housing characteristics (vacancy rates and values) would likely revert to levels that would be expected for the NorthMet Project No Action Alternative. However, increases in housing demand spurred by the strength of the tourism industry and the increasing popularity of the study area for retirement could obscure any such declines.

5.2.10.2.5 Public Services and Facilities

The NorthMet Project Proposed Action would affect public services and facilities in the study area both directly and indirectly. Direct effects would include services provided to the NorthMet Project Proposed Action itself, and would largely be limited to demand for emergency response in the case of an accident. Indirect effects would include increased demand for public services such as potable water, sewer, emergency services, and schools in communities where direct, indirect, and induced employees and their families live.

Most public water and sewer infrastructure in the study area was designed to accommodate larger populations than currently exist; therefore, the NorthMet Project Proposed Action would generally have no effect on these services (see Table 4.2.10-15). As Section 4.2.10.1.5 shows, emergency and medical services are equipped to handle existing demand, and most have mutual aid agreements in place with nearby cities to cooperatively respond to major emergencies.

The public schools in the study area were constructed to accommodate larger populations than currently exist in the study area (e.g., the larger populations that were associated with the iron and taconite mining industry in the 1960s and 1970s). Collectively, public schools in the study area have capacity for nearly 22,000 students, with existing enrollment of nearly 16,000 students. Thus, these schools are able to support new students without building new facilities. To address concerns about maintenance of older buildings, several school facilities in the region have already established renovation programs, and some schools in Duluth plan to downsize (see Section 4.2.10.1.5). These plans predate the NorthMet Project Proposed Action, and would not be accelerated or changed by new population associated with any phase of the NorthMet Project Proposed Action.

The five technical and community colleges and two four-year colleges located throughout the study area provide a variety of degree programs. These schools would continue to provide educational opportunities to new and existing study area residents seeking further education, including high school graduates and existing employees seeking to enhance their job skills. Several community colleges and universities in the study area offer, or are developing, educational curriculum related to jobs in the mining industry.

Construction

Direct demands from construction of the NorthMet Project Proposed Action would primarily fall on local emergency service providers who would respond to any emergencies at the NorthMet Project area.

A small number of construction-phase employees and their families (approximately 225 total new residents, as described in Section 5.2.10.2.1) are expected to permanently relocate to the study area, while another 150 employees would stay in the study area for moderate periods of time (from several weeks to several months), in hotels or mobile homes. All of these employees would generate indirect demand for drinking water, wastewater capacity, and emergency services; the relocated residents would also generate demand for space in public schools.

Public schools in the study area generally have sufficient capacity to accommodate new students. As described in Section 4.2.10.1.5, several school facilities in the region are in need of renovation. This need predates the NorthMet Project Proposed Action, and would not be exacerbated by the relatively small number of new students added by NorthMet Project Proposed Action construction.

Operations

Direct demands from operation of the NorthMet Project Proposed Action would primarily fall on local emergency service providers who would respond to any emergencies within the NorthMet Project area. Approximately 400 operation-phase employees and family members are expected to relocate to the study area (see Section 5.2.10.2.1). All of these employees and their families would generate demand for drinking water, wastewater capacity, emergency services, and school capacity.

Additional police, fire, and ambulance staff may be required to service increased populations in study area cities, particularly in smaller cities. However, these expansions are likely to consist of one to two employees per service (e.g., one new police officer, two new firefighters), per city, as well as upgrades of existing equipment, rather than wholesale expansions of police and fire departments. Increased tax revenues from the NorthMet Project Proposed Action would be expected to cover the costs of these expansions.

Reclamation and Closure

During reclamation and closure of the NorthMet Project Proposed Action, direct and indirect demands for public service would decrease to baseline levels (those present at the start of the NorthMet Project Proposed Action) due to the anticipated decrease in population and activity at the Mine Site and Plant Site. Any cap upgrades to public services and facilities constructed to accommodate operations-phase demands, such as newer police and fire vehicles, would be available to the remaining residents of the study area during closure and post-closure activities.

5.2.10.2.6 Environmental Justice and Subsistence

Evaluation of EJ effects—the degree to which the potential effects of the NorthMet Project Proposed Action or any alternative are felt disproportionately across a community, considering ethnicity, age, and income—follows criteria set forth in the following federal EOs:

- EO 12898, (*Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations,* 1994), directs federal agencies to incorporate EJ into their mission and activities. Federal agencies are to accomplish this by conducting programs, policies, and activities that substantially affect human health or the environment in a manner that does not exclude communities from participation in, deny communities the benefits of, or subject communities to discrimination under such actions, because of their race, color, or national origin.
- EO 13045, (*Protection of Children from Environmental Health Risks and Safety Risks,* 1997), requires each federal agency give high priority to the identification and assessment of environmental health and safety risks to children.

In particular, this EJ analysis focuses on the degree to which the NorthMet Project Proposed Action could disproportionately affect the populations described above and includes residents of the study area, as well as Band members who use the study area for subsistence, regardless of where they live.

Minority (non-white) populations comprise less than 5 percent of the study area, and less than 5 percent of the individual communities listed in Table 4.2.10-3 (except for the three reservations). By comparison, the minority population of Minnesota was approximately 15 percent. The following groups in the study area meet the criteria described above:

- Approximately 13.5 percent of the study area population is below the federal poverty level, compared to 10 percent for the state.
- Native Americans comprise 2.3 percent of the study area, compared to 1.1 percent of the state population.
- Children (individuals under 18 years of age) comprise nearly 29 percent of the study area population, compared to 24 percent for the state.

Native American tribes exercise usufructuary rights to hunt, fish, and gather plants within the 1854 Ceded Territory, which includes the study area. This section discusses the degree to which the NorthMet Project Proposed Action would disproportionately affect these subsistence practices, with the understanding that these practices have both socioeconomic and cultural value for the Native American tribes. Section 5.2.9 discusses the cultural aspects of subsistence in greater detail.

Construction

As described in Section 5.2.10.2.2, the economic effects of construction of the NorthMet Project Proposed Action would be largely positive. Construction would provide new jobs, substantial new earnings, and indirect contributions to public finances. Potential negative socioeconomic effects of construction of the NorthMet Project Proposed Action include increased demand for short-term housing (hotels and mobile home facilities)—although this is a benefit for the owners of those facilities—and increased demand for public services (especially emergency services). These negative effects are generally minor.

Increased public service demands would not disproportionately affect EJ populations. Increased prices would negatively affect the study area's poorest residents who did not receive a commensurate direct or indirect economic benefit from the NorthMet Project Proposed Action. Approximately 150 workers are expected to relocate to or occupy short-term housing in the study area during construction. This number of new and temporary residents, and therefore demand for public services, is small compared to available vacant housing, although poor residents closer to the NorthMet Project area may experience higher prices and demand than in the study area as a whole.

The NorthMet Project area is within the 1854 Ceded Territory. Section 4.2.10.1.6 and Table 4.2.9-1 in Section 4.2.9 summarize available information about subsistence patterns and resources within the 1854 Ceded Territory. Construction of the NorthMet Proposed Action would make the Mine Site unavailable for subsistence use. The degree to which construction of the NorthMet Project Proposed Action would affect individual subsistence resources (i.e., fish, game, and plant species) outside of the Mine Site, Transportation and Utility Corridor, and Plant Site is discussed in Section 5.2.9 (Cultural Resources).

Operations

As described in Section 5.2.10.2.2, the economic effects of operation of the NorthMet Project Proposed Action would be largely positive. Operations would provide new jobs, substantial new earnings, and substantial direct and indirect contributions to public finances. In addition, the Bands operate four casinos in or near the study area (the Fond-du-Luth Casino in Duluth, operated by the Fond du Lac Band; the Black Bear Casino in Carlton, operated by the Fond du Lac Band; the Fortune Bay Resort Casino in Tower, operated by the Bois Forte Band; and the Grand Portage Lodge and Casino in Grand Portage, operated by the Grand Portage Band). While the Black Bear Casino is outside of the study area, it is nonetheless close enough to study area communities to potentially benefit from increased visitation and spending. Increased employment and income associated with the NorthMet Project Proposed Action could increase visitation and revenues at these facilities.

Potential negative socioeconomic effects of operation of the NorthMet Project Proposed Action include increased demand for housing (which could negatively affect the study area's poorest residents who did not receive a direct or indirect commensurate economic benefit from the NorthMet Project Proposed Action) and increased demand for public services and facilities.

Increased public service demands would not disproportionately affect minority and low income populations. The influx of direct, indirect, and induced NorthMet Project Proposed Action employees could cause demand for as many as 175 housing units across the study area. While this number is small compared to available vacant housing in the study area, some marginal increase in housing demand and cost, as well as demand for public services, is possible, particularly in communities closer to the NorthMet Project area. Increased housing competition would likely affect the study area’s poorest residents, particularly renters (whose housing costs are more volatile), and particularly those living closer to the NorthMet Project area.

Operation of the NorthMet Project Proposed Action would make the Mine Site unavailable for subsistence use; noise and other consequences of operations could affect migration or other animal species behavior in the vicinity of the Mine Site and Plant Site (see Section 5.2.5, Wildlife).

Operations could affect individuals who consume fish harvested from nearby waterbodies. The NorthMet Project Proposed Action would increase mercury concentrations in the Embarrass River Watershed, as well as some nearby lakes, although it would decrease mercury concentrations in the Partridge River watershed (see Section 5.2.2.3.4). As described in Section 4.2.10.1.6, subsistence fishing and consumption is a common activity for Native American bands in the 1854 Ceded Territory. Members of the Grand Portage and Fond du Lac bands are known to consume substantially more fish than the assumed statewide average. As a result, increased mercury concentrations, and potential increases in mercury bioaccumulation in fish tissue could therefore constitute an EJ impact for Band members and other subsistence consumers of fish. However, the AERA assessed health effects for recreational and tribal fishermen and their families consuming fish that could potentially contain elevated bioaccumulated levels of methylmercury. A potential small change in fish mercury concentration was estimated based on modeled emissions and deposition. The potential change in methylmercury concentration is not statistically measureable given variability in background concentrations and current laboratory analytical methods (Barr 2013j). Therefore, there is no expected change in fish mercury concentrations, and no subsequent change in human health risks related to fish consumption (see Section 5.2.7.2.5). This information is summarized in Section 7.3.4.4.3 of the FEIS.

Reclamation and Closure

During reclamation and closure, socioeconomic characteristics of the study area would revert to conditions that would be expected for the NorthMet Project No Action Alternative. Employment, earnings, and contributions to public finances generated by the NorthMet Project Proposed Action would end (potentially with a phase-out period); housing demand and prices would ease as would demands for public services and facilities. Poorer residents of the study area would have more difficulty coping with this transition if they hold lower-paying, less secure "induced" jobs (as opposed to direct or indirect jobs), as they may have more difficulty moving out of the study area to secure new jobs (particularly if housing values drop). However, given the relatively small number of jobs generated by the NorthMet Project Proposed Action (compared to the total number of jobs held by study area residents), these difficulties would not be substantially higher than existing conditions.

As during other phases, the NorthMet Project area would remain closed to the public—and thus unavailable for subsistence use—during and following the closure phase, thus preventing subsistence activities. Deposition of mercury from the NorthMet Project Proposed Action would cease at closure, but mercury bioaccumulation in fish tissue and existing fish consumption limits are not anticipated to persist beyond the mine's operational life. Per the AERA assessment, there is no expected change in mercury concentrations in fish, and no subsequent change in human health risks related to fish consumption (see Sections 5.2.7.2.5).

5.2.10.3 NorthMet Project No Action Alternative

Under the NorthMet Project No Action Alternative, the NorthMet Project Proposed Action would not be developed. There would be no NorthMet Project Proposed Action-related change to the study area. Externally existing demographic trends such as population growth or decline, and shifts in employment patterns would continue. The study area would not accrue the economic benefits of the NorthMet Project Proposed Action, nor would it experience any of the negative effects identified in this FEIS. As described in Section 5.2.10.2, the presence of the NorthMet Project Proposed Action would not hamper growth of the Arrowhead region's tourism industry; the NorthMet Project No Action Alternative would not hasten this growth, either. Overall, the NorthMet Project No Action Alternative would have no effect on socioeconomics in the study area.

5.2.11 Recreation and Visual Resources

This section describes the potential environmental effects of the NorthMet Project Proposed Action on recreational facilities and activities that typically take place in the NorthMet Project area, as well as the surrounding Arrowhead region. Recreation in this region is strongly tied to the aesthetic condition of the landscape so this section also describes the effects of anticipated project activities on visual resources in the NorthMet Project area and surrounding land.

Summary

Most of the Mine Site, a part of the Superior National Forest, is currently public land. However, the Mine Site is surrounded by private land that lacks public roads or trails and is therefore not publicly accessible by land. The Transportation and Utility Corridor and Plant Site are privately owned lands and are not open to the public for recreation. Direct effects on recreation in this area from the NorthMet Project Proposed Action would be limited. With the exception of the Skibo Vista Scenic Outlook, views of project activities would be limited by topography and distance. The NorthMet Project could reduce recreational use of nearby lands, including portions of the Superior National Forest, but would not affect recreational patterns and facilities in the Arrowhead region as a whole. The BWCAW and Voyageurs National Park (recreational resources that are discussed in greater detail in Section 5.2.12) are each more than 19 miles from the NorthMet Project Area. An analysis of potential air quality effects demonstrated that there are no expected effects on visibility in these areas when compared to pristine conditions.

5.2.11.1 Methodology and Evaluation Criteria

5.2.11.1.1 Recreation

The primary issues related to recreational facilities and activities on and near the proposed project facilities include the following:

- direct effects due to construction, operation, and closure of the NorthMet Project Proposed Action resulting in the reduction of the number and/or acreage of recreational facilities (parks, lakes, trails, etc.) potentially available for public use;
- indirect effects of the NorthMet Project Proposed Action, including reduction in the use of recreational facilities in areas surrounding the proposed project facilities due to noise, dust, and other disturbances; and
- the net effect of local (i.e., the area surrounding the Mine Site and Plant Site) and regional recreation during post closure.

Evaluation of the NorthMet Project Proposed Action against these criteria was based on comparison to the USFS ROS for land that is controlled by USFS. The USFS uses the ROS to inventory recreational settings and characteristics (see Section 4.2.11.1 for further explanation of the ROS).

Effects on the region's overall recreation resources (e.g., lands not necessarily controlled by USFS) are based on qualitative analysis of NorthMet Project Proposed Action activities, as they relate to the region's recreational opportunities (as summarized in Section 4.2.11). Specific considerations include distance (both direct and via road or trail) between the NorthMet Project and various recreation resources, and the likelihood that the NorthMet Project Proposed Action would change the noise or visual environment, or the character of water, flora, and fauna present in these resources. These evaluations are based on extensive touring of the region and review of available mapping and descriptive material about the region's recreation resources.

5.2.11.1.2 Visual Resources

The primary issues related to visual resources on and near the Mine Site and Plant Site include the following:

- the nature and severity of effects of the NorthMet Project Proposed Action on sensitive viewpoints, including nearby homes, businesses, and vistas;
- changes to the extent or scale of visible mining disturbances; and
- the ultimate appearance of the NorthMet Project Proposed Action after reclamation is completed versus current and interim stages of active mining.

Evaluation of the NorthMet Project Proposed Action against these criteria was based on comparison to the USFS Scenery Management System classes for land that is or would be controlled by the USFS. The USFS uses the Scenery Management System to identify desired visual conditions, as expressed by SIOs (see Section 4.2.11.1 for further explanation of SIOs).

Effects on the region's overall visual environment (e.g., lands not necessarily controlled by USFS) are based on qualitative analysis of the NorthMet Project's activities (particularly structures, stockpiles, and other visible activities), as they relate to what observers are likely to see in the region. This understanding is based on extensive touring and photo-documentation of views and visual conditions in the region. In addition, GIS, printed maps, and aerial photography were used to identify potential sensitive viewpoints, for which visual simulations of future mine facilities were developed.

5.2.11.2 NorthMet Project Proposed Action

5.2.11.2.1 Recreation

Surface rights to most of the Mine Site are held by the USFS, as part of the Superior National Forest. As described in Section 4.2.11, the ROS classes for the portion of the Mine Site located on federal lands are Semi-Primitive Motorized and Roaded Natural. The setting and characteristics of the portion of the Mine Site located on private lands is similar to the Roaded Natural class. However, there is no officially established public access (e.g., roads or trails) to the Mine Site (see Section 4.2.11.1), and thus limited opportunity for recreational activity. No access (or recreational opportunities) would be allowed during construction, operation, or closure of the NorthMet Project Proposed Action. Accordingly, the NorthMet Project Proposed Action would have no effect on recreation within the Mine Site.

Construction and operation of the NorthMet Project Proposed Action would be entirely contained within the NorthMet Project area (i.e., the Mine Site, Transportation and Utility Corridor, and Plant Site). Thus, the NorthMet Project Proposed Action would not directly affect access to or use of regional recreational facilities such as other portions of the Superior National Forest, nearby parks and other public lands, or the BWCAW.

The public's enjoyment of recreational activities in the region—such as hunting, fishing, boating, hiking, and winter sports—is tied in part to visual resources, as discussed below, and also to a wide variety of factors evaluated in other sections of Chapter 5.0. Such factors include, but are not limited to, the availability and quality of fish and other aquatic species, vegetation, wildlife (particularly game species), noise, air quality, water quality, and wetlands. Effects on these resources are presented in the corresponding sections in Chapter 5.0.

The mine facilities such as mine pits, stockpiles, and associated facilities would be set back from most publicly accessible land, including portions of the Superior National Forest south of the Transportation and Utility Corridor. In addition, the lack of designated trails in these portions of the Superior National Forest means that the number of recreational users who would approach the Mine Site would be limited. Nonetheless, the presence of the NorthMet Project Proposed Action would likely make recreational activities in the immediate vicinity of to the Mine Site, Transportation and Utility Corridor, and Plant Site less enjoyable (and therefore less likely) for some observers. In particular, three potential effects of the NorthMet Project Proposed Action could reduce recreational activity: noise, effects on fish populations (related to recreational fishing), and effects on wildlife populations (related to recreational hunting).

The presence of noise could discourage use of the portions of the Superior National Forest closest to the Mine Site and Plant Site (e.g., immediately south of the Transportation and Utility Corridor). Noise levels, including operational noise, ground vibration, and airblast overpressure, that exceed the most stringent category of state noise standards generally would not extend more than 0.9 mile from the Mine Site during the day and 2.3 miles at night (see Figures 5.2.8-1 through 5.2.8-4).

The ROS classes for those portions of the Superior National Forest within 2.3 miles of the Mine Site are Semi-Primitive Motorized and Non-Motorized. NorthMet Project Proposed Action-related noise would affect up to 6,450 acres of the Superior National Forest within this 2.3 mile area. In these areas, project-related noise could limit full realization of the intended ROS classifications. Outside of the 2.3 mile area, NorthMet Project Proposed Action-related noise would not be inconsistent with ROS classes.

NorthMet Project Proposed Action-related noise, air emissions, and water discharges could potentially influence wildlife behavior in portions of the Superior National Forest closest to the Mine Site and Plant Site, as discussed in the wildlife Section 5.2.5. To the degree that game species are disturbed by NorthMet Project Proposed Action-related noise, they could choose to avoid this portion of the Superior National Forest, leading to reduced hunting opportunities in these areas. However, the area affected by noise comprises approximately 0.2 percent of the more than 3 million acres of the Superior National Forest. Species displaced by noise are likely to remain in surrounding areas of the Superior National Forest; overall opportunities for hunting and wildlife viewing on public lands in the region are not expected to change substantially.

Excluding effects related to noise, fisheries, air quality, and other effects described elsewhere in Chapter 5.0, and given the proximity of active and past mining and industrial activity to high-quality recreational activity in the Arrowhead region (such as the BWCAW), there is no evidence that the presence of the NorthMet Project Proposed Action in and of itself would affect the public's ability to hunt, fish, and conduct other recreational activities, or that it would affect the overall recreational experience (apart from specific activities) in the Arrowhead region as a whole.

After closure, PolyMet would retain ownership of the Mine Site and the federal lands, and public access would likely remain restricted.

The Plant Site is located at the former LTVSMC processing plant. It is owned by PolyMet, and it is not open to the public. Entry roads are gated and/or guarded. No recreational activity is permitted at this site, nor would it be permitted during construction, operation, and closure of the NorthMet Project Proposed Action.

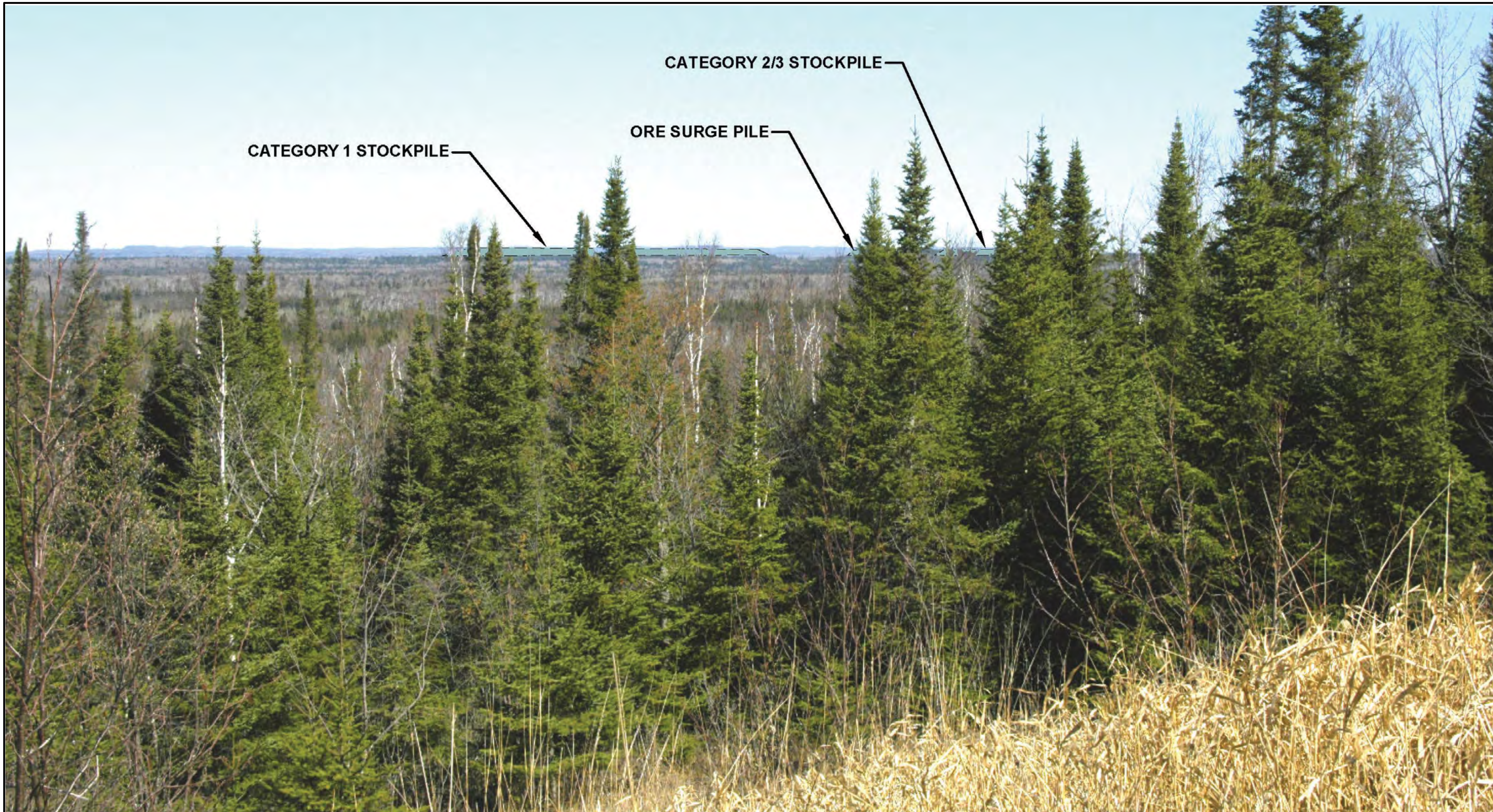
5.2.11.2.2 Visual Resources

At the Mine Site, the maximum height of the waste rock stockpiles would range from approximately 1,840 ft amsl (Category 1 Stockpile and Category 4 Stockpile) to 1,770 ft amsl (Category 2/3 Stockpile), or a maximum stockpile elevation of 180 to 240 ft above ground surface (PolyMet 2015a). The Giants Range rises sharply to the north of the Mine Site, blocking views of the mine, stockpiles, and safety lights (used when the stockpiles are active) from receptors to the north and west, including the BWCAW.

The Mine Site would be in operation 24 hours per day; therefore, nighttime safety lighting of the active stockpiles would potentially contribute to a localized "glow" effect that could be visible in the night sky. Light sources at the Mine Site would be similar to light levels at other mining projects across the Iron Range. For example, most of the lighting at the Mine Site would be directed downward, such as at the digging area in the case of the shovels and loaders, at the driving surface in the case of the haul trucks and locomotives, and at the dumping area at the stockpiles and the rail transfer hopper. The area around the blasthole drills would be illuminated so the drill can maneuver around the pattern. PolyMet does not propose any further specific mitigation measures with respect to light effects (Kevin Pylka, Pers. Comm., July 25, 2012).

The upland forest surrounding the Mine Site to the east, south, and west would shield ground-level views of the Mine Site (including mine, stockpiles, and associated facilities) in those areas. These forest stands are a mix of coniferous and deciduous forests upwards of 60 ft in height and would provide year-round screening within several miles of the Mine Site (except, perhaps, from portions of the Superior National Forest that are very close to the southern boundary of the Transportation and Utility Corridor).

Viewers at elevated vistas to the south would have clearer views of the Mine Site. Figure 5.2.11-1 simulates the profile of the maximum extent of stockpiles (the largest visible component of the Mine Site) from the Skibo Vista Overlook on the Superior National Forest Scenic Byway, approximately 12 miles south-southwest of the Mine Site. Given the 180- to 240-ft height of the stockpiles, a portion of these would be visible above the treeline. The stockpiles would not project above Giants Range or alter the silhouette of the skyline.



US Army Corps of Engineers
St. Paul District

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Figure 5.2.11-1
Photo Simulation - View of Mine Site from Skibo Overlook
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

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Visual conditions would vary throughout the course of the mine's life. Initially, stockpiles would be less visible until heights exceed the surrounding treeline. The Category 2/3 Stockpile and Category 4 Stockpile would reach their maximum heights in year 11, after which they would be relocated into the East Pit. The Category 1 Stockpile would reach its maximum and permanent height in year 12 (excluding the cover material placed over the stockpile at mine closure). The height, shape, and coloring of the stockpiles would vary throughout the life of the mine; however, the coloring of the stockpiles would likely differ from the surrounding landscape, and would likely be more visible during winter months when screening from deciduous trees is at a minimum (although snow cover could tend to make the stockpiles look more like natural landforms). Viewers on elevated terrain to the east, north, or west of the Mine Site would generally have more limited views of the mine and stockpiles, although there could be sporadic direct views of the Mine Site, depending on exact location and vegetative screening

Mining and associated industrial activities are long-established aspects of the Mesabi Iron Range landscape. The NorthMet Project Proposed Action would introduce visual elements to the landscape that are similar to other active mines in the region, such as the adjacent Northshore Mine. However, these visual disturbances would occur in an area that, as shown in Figure 5.2.11-1, is currently vegetated.

In addition to the new visible components of the Mine Site and Plant Site (see below), mine construction, operations, and closure would likely generate some visible diesel exhaust and fugitive dust emissions from mine vehicles. Construction and closure emissions would likely be difficult to discern from the Skibo Vista Overlook and other distant viewpoints (see Section 5.2.7 for more details on anticipated emissions). As with the mine facilities themselves, construction emissions would generally be difficult to see from closer viewpoints due to the screening effect of terrain and vegetation.

Evaluations of visual conditions are subjective, and are based in part on individual preferences. Many viewers consider any substantial disturbance of the existing landscape to be undesirable, but some viewers find industrial sites visually compelling. While much of northeast Minnesota's recreation and tourist economy is based on high-quality wildlife, wilderness, and vegetation, there are distinct mine-related tourism resources. The Low SIO of the federal lands associated with the Mine Site indicates that the Mine Site is an area where the USFS has determined that evidence of management activities may dominate the view.

Following the completion of the mining activities, the PolyMet reclamation plan would remove all buildings and facilities at the Mine Site, and would revegetate disturbed areas with an approved vegetation mix. The Category 1 Stockpile would remain in place, and would also be vegetated, to the degree possible. This structure would be noticeable above the treeline, especially in winter, as shown in Figure 5.2.11-1. However, other similar stockpiles are found throughout the region. Over time, this feature would take on the appearance of a vegetated hill, and would blend in with the overall landscape.

No substantial changes are anticipated to the visual character of the Plant Site during NorthMet Project Proposed Action operations. The NorthMet Project Proposed Action would use, update, and expand existing infrastructure at the former LTVSMC processing plant, including an expanded Tailings Basin, additional hydrometallurgical processing facilities, and refurbished mill buildings. Figure 5.2.11-2 shows the current view of the Plant Site from Skibo Overlook. New structures constructed as a result of the NorthMet Project Proposed Action would not be visible from the overlook. During operations, steam plumes from the Plant Site would be visible under certain conditions, particularly from distant viewpoints such as Skibo Vista. To the degree that existing processing buildings are refurbished or removed (as appropriate), the NorthMet Project area would create the appearance of an active, maintained industrial site, rather than the current dilapidated appearance.

The Tailings Basin is visible to rural residences on County Road 358, located approximately 1 mile to the north of the Plant Site. The NorthMet Project Proposed Action would raise the elevation of Cells 1E and 2E to approximately the same elevation as the existing Cell 2W. The hydrometallurgical residue cells would raise the elevation on the southern portion of Cell 2W by about 40 ft. These changes would not be out of character with the existing Tailings Basin, although the low silhouette of the Tailings Basin on the southern horizon would be noticeably expanded.

Through the closure process, all buildings and facilities at the Plant Site would be removed. At-grade (or below-grade) slabs and foundations would remain and would be covered with surface overburden. Most structures would be removed within three years of the start of closure, except for water treatment facilities necessary to maintain post-closure water quality standards. The Plant Site would be revegetated and seeded to promote a self-sustaining community of regionally-appropriate vegetation. As a result, the visual appearance of the Plant Site during and following closure would evolve rapidly from the operations-phase industrial character to a vegetated area that progressively becomes indistinguishable from adjacent vegetated areas.

5.2.11.3 NorthMet Project No Action Alternative

5.2.11.3.1 Recreation

Under the NorthMet Project No Action Alternative, the NorthMet Project Proposed Action would not be developed. The Mine Site would remain unchanged, and the USFS would continue to retain surface rights to the federal lands that comprise portions of the Mine Site. Given other private ownership (e.g., the Transportation and Utility Corridor), the federal lands would remain generally inaccessible to the public. There would be no direct or indirect effects on recreational activities at the Mine Site or the region's surrounding recreational resources. Under the NorthMet Project No Action Alternative, the NorthMet Project Proposed Action would not be developed, and the Plant Site would remain off-limits to the public for recreation or other uses.

5.2.11.3.2 Visual Resources

Under the NorthMet Project No Action Alternative, the NorthMet Project Proposed Action would not be developed, and would retain the Low SIO assigned by USFS. The Mine Site would remain unchanged, and there would be no effects on visual resources at the Mine Site. Under the NorthMet Project No Action Alternative, the NorthMet Project Proposed Action would not be developed. The former LTVSMC process facility would be reclaimed, including building removal, in accordance with a separate closure plan. Reclamation activities could create a short-term disruption of the visual landscape, while long-term effects would be to reduce the developed nature of the site sooner than under the NorthMet Project Proposed Action.

This document is a working document. This document may change over time as a result of new information, further deliberation, or other factors not yet known to the Co-lead Agencies.

Figure 5.2.11-2
Photo Simulation - View of Plant Site from Skibo Overlook
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

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5.2.12 Wilderness and Other Special Designation Areas

Designations such as Wilderness or RNAs emphasize higher restrictions on human activity and access, while other designations, such as historic landmarks or scenic byways, emphasize management that seeks to enhance public enjoyment of certain spaces. Evaluation of the effects on each type of designation considered how each set of characteristics or management objectives would be changed by the NorthMet Project Proposed Action or the project alternatives. Potential effects could occur due to mining activity or due to changes in other human activity resulting from mining activity. No specific issues related to wilderness or special designations area were identified during public scoping. As discussed in Section 4.2.12, for the purposes of this analysis, the term "wilderness" is defined by the Wilderness Act of 1964 (Public Law 88-577) (16 USC § 1131-1136). In its planning, management, and monitoring, the USFS identifies four characteristics of wilderness, as defined in the Wilderness Act: Untrammeled, Undeveloped, Natural, and Solitude or a Primitive and Unconfined Type of Recreation.

Summary

The NorthMet Project Proposed Action would have no direct effects on wilderness or special designation areas. Air quality and water quality in these areas would be virtually unchanged from existing conditions; distance from activities associated with the NorthMet Project Proposed Action would leave ambient noise levels also unchanged. The absence of these direct effects means that there would be no indirect effects on wildlife, vegetation, or aquatic species. There could be a minimal effect on the Skibo Vista Scenic Overlook along the Superior National Forest Scenic Byway, and therefore an associated indirect effect on recreation.

5.2.12.1 Methodology and Evaluation Criteria

This section uses data presented in Section 4.2.12 for all wilderness or special designation areas (including state parks) within a 25-mile radius of the NorthMet Project area. While no direct effects on wilderness character are anticipated due to changes in air quality, water quality or noise, recreation opportunities could be indirectly affected because of a small change in visual character.

For land that is or would be controlled by the USFS, the recreation evaluation criteria of the ROS system were used to determine indirect project effects (see Section 5.2.11.1.1).

5.2.12.2 NorthMet Project Proposed Action

5.2.12.2.1 Federally Managed Areas

Table 5.2.12-1 lists the federally managed wilderness and other special designation areas within or adjacent to the NorthMet Project area and indicates significant features that would have the most bearing on the potential effects of the NorthMet Project Proposed Action. Isle Royale National Park is outside of the study area for evaluation of Wilderness and Other Special Designation; however, the visibility analyses in Section 5.2.7.2.2 do include Isle Royale National Park.

Table 5.2.12-1 Federally Managed Wilderness and Other Special Designation Areas located within or Adjacent to the NorthMet Project Area

Special Designation Area	Distance (miles) to the NorthMet Project Area	Significant Feature
Boundary Waters Canoe Area Wilderness	25	Laurentian Divide
Voyageurs National Park	50	Laurentian Divide
Research Natural Areas		
Big Lake-Seven Beavers cRNA	12	Watershed, topography, vegetation
Keeley Creek RNA	25	Watershed, topography, vegetation
Dragon Lake cRNA	25	Watershed, topography, vegetation
Unique Biological Areas		
Little Isabella River UBA	25	Watershed, topography, vegetation
Harris Lake National Natural Landmark	20	Watershed, topography, vegetation
National Historic Landmark		
Soudan Iron Mine	18	Topography, vegetation
National Recreation Trail		
Taconite State Trail	15-17	Topography, vegetation

The table shows that all of the federally managed areas would be well-removed from activities related to the NorthMet Project Proposed Action, and generally would be screened by intervening topography and vegetation.

Effects from the NorthMet Project Proposed Action associated with Class I Increment, visibility, and sulfur dioxide effects on flora and fauna would be all well below their respective significance levels in all Class I areas, including the BWCAW and Voyageurs National Park. In addition, all sulfur dioxide and sulfur deposition relating to terrestrial and aquatic settings would be well below “green light” significance levels in these areas. Total nitrogen deposition effects approach their significance levels at the BWCAW (see Section 5.2.7.2.2).

Due to the presence of the Laurentian Divide, there would be no direct effects on waters of the BWCAW or Voyageurs National Park. The NorthMet Project area is in the Lake Superior Basin, while these two Class I areas are to the northeast of the Laurentian Divide where streams and rivers flow to the Hudson Bay Basin.

As described in Section 5.2.8, daytime noise standards for sensitive receptors would not be reached beyond 0.8 mile from the Mine Site and 0.5 mile from the Plant Site. The nighttime noise standards would not be exceeded beyond 2.3 miles from the Mine Site and 1.5 miles from the Plant Site. The BWCAW and Voyageurs National Park, as well as the rest of the specially designated areas within 25 miles of the NorthMet Project area are all located at distances much greater than these ranges and so would not be expected to be directly affected by NorthMet Project Proposed Action-related noise. Nighttime views from the BWCAW toward the NorthMet Project area and nearby towns are such that light from the NorthMet Project Proposed Action would be indistinguishable from other sources of illumination.

The RNAs, cRNAs, and UBAs are also in watersheds not affected by the NorthMet Project Proposed Action so there would be no direct or indirect effects on surface water or groundwater in these areas. Topography and vegetation again screen these areas from view of the NorthMet Project Proposed Action-related activities so there are no direct effects on visual resources or indirect effects on recreation.

By virtue of distance, as well as topography and vegetation, the Taconite State Trail would experience neither direct nor indirect effects from the NorthMet Project Proposed Action.

By virtue of distance, topography, watershed, or vegetation, none of the four characteristics of Wilderness defined above (Untrammeled, Undeveloped, Natural, and Solitude or a Primitive and Unconfined Type of Recreation) would be affected by the NorthMet Project Proposed Action.

5.2.12.2.2 State-Managed Areas

Table 5.2.12-2 shows that all of the state-managed wilderness and other special designation areas would be well-removed from activities related to the NorthMet Project Proposed Action and generally would be screened by intervening topography and vegetation.

Table 5.2.12-2 State-Managed Wilderness and Other Special Designation Areas located within or Adjacent to the NorthMet Project Area

Special Designation Area	Distance (miles) to the NorthMet Project Area	Significant Feature
Boundary Waters Canoe Area Wilderness	25	Laurentian Divide
State Parks		
Soudan Underground Mine State Park	18	Watershed, topography, vegetation
Lake Vermilion State Park	16	Watershed, topography, vegetation
Iron Range Off-Highway State Park	11	Watershed, topography, vegetation
Bear Head Lake State Park	17	Watershed, topography, vegetation
National Historic Landmark		
Soudan Iron Mine	18	Topography, vegetation
National Scenic Byway		
Superior National Forest Scenic Byway	9	Topography, vegetation

All of the state parks have been shown to be in areas where predicted concentrations would be below secondary air standards that are designed to protect public welfare, including decreased visibility and damage to animals, crops, and vegetation. None of the state parks are within watersheds potentially affected by the NorthMet Project Proposed Action, so there would be neither direct effects on water quality nor indirect effects on aquatic species or wetlands.

Topography and vegetation screen the parks from view of the activities within NorthMet Project area, so there would be no direct effects on visual resources and no indirect effects on recreation.

The Superior National Forest Scenic Byway is at a distance where it would be unaffected by NorthMet Project Proposed Action-related noise. Similar to other specially designated resources, there would be no direct or indirect effects due to air quality or water quality (i.e., visibility of waters potentially affected by the NorthMet Project Proposed Action). Most of the Byway is screened from view of the NorthMet Project Proposed Action by topography and vegetation. However, from Skibo Vista Scenic Overlook, which is approximately 12 miles south-southwest of the Mine Site, a portion of the stockpiles would be visible above the treeline. This direct effect would also mean a potentially small indirect effect on recreation.

By virtue of distance, topography, watershed, or vegetation, none of the four characteristics of Wilderness defined above (Untrammeled, Undeveloped, Natural, and Solitude or a Primitive and Unconfined Type of Recreation) would be affected by the NorthMet Project Proposed Action.

5.2.12.3 NorthMet Project No Action Alternative

Under the NorthMet Project No Action Alternative, the NorthMet Project Proposed Action would not be developed. The NorthMet Project No Action Alternative presents no anticipated effect on the BWCAW, Voyageurs National Park, established and candidate RNAs, UBAs, National Historic Landmarks, the Superior National Forest Scenic Byway, and a National Recreation Trail, as the Mine Site and portions of the federal lands would continue to be managed in the same way they have been.

5.2.13 Hazardous Materials

Issues relating to the presence of hazardous materials or waste may include the accidental release of these materials during transportation, storage, handling, and/or use at the NorthMet Project area and any resulting potential effects on the environment. Environmental resources that could potentially be affected by hazardous materials and hazardous waste if they are accidentally released include: air, water, soil, and ecological resources. The APE therefore corresponds to the areas defined for each specific resource.

The NorthMet Project Proposed Action would use, or generate as waste, the following hazardous materials (Barr 2007d; Kevin Pylka, PolyMet, Pers. Comm., October 19, 2011; Kevin Pylka, PolyMet, Pers. Comm., May 11, 2012):

- Fuels, equipment maintenance products, and solvents – diesel fuel, gasoline, oils, grease, lubricants, anti-freeze, solvents, and lead-acid batteries used for equipment operation and maintenance;
- Plant reagents – sodium hydrosulfide, sodium hydroxide, acids, flocculants, and antiscalants used in processing plant applications;
- Mine Site WWTF chemicals – calcium hydroxide (hydrated lime), sodium metasilicate, ferric chloride, sodium hydroxide, polymer flocculent, carbon dioxide liquid, citric acid, and sodium hypochlorite;
- Plant Site WWTP chemicals – potassium permanganate, antiscalant, carbon dioxide liquid, and calcium hydroxide (hydrated lime);
- Blasting agents – ANFO, emulsions, emulsion blends (a blend of ANFO and emulsion), blasting caps, initiators and fuses, and other high explosives used in blasting; and
- Other materials – assay chemicals, and other by-products characterized as hazardous waste.

The MPCA has determined that the hydrometallurgical residue is not hazardous by legal definition under RCRA. Mishandling of hazardous materials or wastes could result in spills, accidental release, or discharge into the environment, which could cause effects on workers, waters of the state, or the general public. Mitigation measures to prevent releases in transportation, storage, and handling or use of these materials are described in several hazardous material management plans necessary to comply with various regulatory requirements for the NorthMet Project Proposed Action. The following sections present the methodology and criteria used to estimate the risks to the public and environment from the use of hazardous materials and the generation of hazardous waste during the construction, operation, and closure phases of the NorthMet Project Proposed Action. The presentation is broken down into the major activities of transportation, storage, and handling and use.

Summary

Materials defined as hazardous are a routine part of mining and ore processing. Their handling, storage, and disposal are regulated by a number of state and federal laws. Adherence to these would limit the potential for off-site effects on only the transport of large quantities of hazardous materials. Transport routes have been defined that limit the potential for effects on population centers and sensitive resources. Given overall Project design and operational commitments, there would be no significant adverse effects from the proposed use or generation of hazardous wastes by the NorthMet Project Proposed Action.

5.2.13.1 Evaluation Criteria

Several criteria are generally used in federal and State of Minnesota regulations and statutes to define the effects from an accidental spill, release, or discharge of contaminants or hazardous material or waste to the environment. The basic principle of these criteria is the protection of people and the environment. Based on this principle, the NorthMet Project Proposed Action would have an environmental effect if the following were to occur:

- A spill, release, or discharge of any hazardous material or hazardous waste during transportation that, if not recovered in a timely manner, could cause pollution of waters of the state, or other harm to the environment or to the public;
- A spill, release, or discharge of any hazardous material or hazardous waste during handling or use, which could cause pollution of waters of the state, or other harm to the environment or to the public;
- Hazardous emissions from handling of any hazardous materials or hazardous waste that have the potential to cause harm to the public or the environment; and
- A spill, release, or discharge from on-site storage facilities exceeding the volumes of the primary and secondary containment structures, and which could not be recovered in a timely manner, and thus pollute waters of the state or cause other harm to the environment or to the public.

5.2.13.2 NorthMet Project Proposed Action

Federal and State of Minnesota regulations establish management and reporting requirements for hazardous materials. Based on current design, applicable administrative rules and statutes include the following:

- *Minnesota Statute* 115.061 – Duty to Notify and Avoid Water Pollution (*Minnesota Statues*, chapter 115, Water Pollution Control; Sanitary Districts);
- USEPA 40 CFR 302 – Designation, Reportable Quantities, and Notification, Section 6 – Notification Requirements (USEPA 40 CFR 300–399, Superfund; Emergency Planning; Community Right-to-Know Programs);
- USEPA 40 CFR 355 – Emergency Planning and Notification, Subpart C – Emergency Release Notification (USEPA 40 CFR 300–399, Superfund; Emergency Planning; Community Right-to-Know Programs);
- USEPA 40 CFR 355–372 – EPCRA (USEPA 40 CFR 300–399, Superfund; Emergency Planning; Community Right-to-Know Programs);
- USEPA 40 CFR 112 – Oil Pollution Prevention (USEPA 40 CFR 100–149, Water Programs);
- USEPA 40 CFR 68 – Chemical Accident Prevention Provisions (USEPA 40 CFR 70–99, Air Programs II);

- USEPA Clean Air Act, Section 112(b) – Hazardous Air Pollutants (42 USC chapter 85, Air Pollution Prevention and Control);
- OSHA 29 CFR 1910.120 – Hazardous Waste Operations and Emergency Response (OSHA 29 CFR 1900–1910);
- DOT 49 CFR 100–180 – Hazardous Materials Transportation (Hazardous Materials Transportation 49 CFR 100–180, Chapter I, Pipeline and Hazardous Materials Safety Administration, DOT);
- MSHA Rule 30 CFR Part 47 Hazard Communication (Mine Safety Administration 30 CFR 1–199);
- *Minnesota Statutes*, Chapter 115 and Chapters 115A–115E – Water Pollution Control, through Oil and Hazardous Substance Discharge Preparedness (*Minnesota Statues*, chapter 115, Water Pollution Control; Sanitary Districts);
- *Minnesota Rules*, Chapter 7151 – Aboveground Storage of Liquid Substances (*Minnesota Rules*, MPCA, chapter 7151);
- *Minnesota Rules*, Chapters 7045–7048 – Hazardous Waste (*Minnesota Rules*, MPCA, chapter 7045–7048);
- *Minnesota Rules*, Chapters 7507 and 7513 – Hazardous Materials (*Minnesota Rules*, MPCA, chapter 7507–7513);
- *Minnesota Rules*, Chapter 7035 – Solid Waste (*Minnesota Rules*, MPCA, chapter 7035); and
- *Minnesota Rules*, Chapter 6132 – Nonferrous Metallic Mineral Mining (*Minnesota Rules*, Department of Natural Resources, chapter 6132).

A list of the larger quantity hazardous materials transported, stored, handled, recycled, or disposed, and their classifications, that would be associated with the NorthMet Project Proposed Action construction, operation, and closure is provided in Table 5.2.13-1. The estimated delivery frequency, volumes, and annual use of these materials are also listed in Table 5.2.13-1.

The MPCA reviewed hydrometallurgical residue pilot-testing and analysis data provided by PolyMet and has established the following statements (Email from Richard Clark [MPCA] to Lisa Fay [DNR], October 24, 2014):

1. TCLP testing results of pilot test residues in 2005 and 2009 did not meet the thresholds to be regulated as a RCRA hazardous waste.
2. Elimination of the bulk hydrometallurgical mode from the NorthMet Project Proposed Action since the DEIS would not materially affect the chemical composition of residue stored in the Hydrometallurgical Residue Facility, and 2005 and 2009 testing results will be representative of the residue stored in the Hydrometallurgical Residue Facility if the current Project is approved.
3. New residue resulting from future hydrometallurgical pilot-testing and/or Phase 2 of the NorthMet Project Proposed Action should be tested to verify that the residue remains under RCRA hazardous waste thresholds.

Table 5.2.13-1 Hazardous Materials used during Construction, Operation, and Closure Phases of the NorthMet Project Proposed Action

				Deliveries (Estimated Frequency)		
Material	**Classifications & Precautions****	**Environmental Concern**	**Storage Capacity**	**Means**	**Approximate Rate**	**Annual Use (Est.)**
ANFO	Explosive 1.1D or 1.5D: Irritant to skin and eyes. May cause nausea if ingested and irritation to nose and throat if ingested.	Harmful to aquatic life at low concentrations.	No on-site storage. Vendor provided on a daily basis.	Vendor/truck	883,333 lbs/month	10,600,000 lbs/year
Booster (solid - cord sensitive)	Explosive 1.1D: Eye irritant. Skin irritant. Inhalation of dust may cause irritation, sneezing or coughing.	May cause elevated nitrate levels in water and could affect aquatic animals.	No on-site storage. Vendor provided on a daily basis.	Vendor/truck	1,555/month	18,650/year
Emulsion	Explosive 1.5D: Eye irritant. May be harmful if ingested. Inhalation may cause dizziness, nausea, or intestinal upset.	May cause elevated nitrate levels in water and could affect aquatic animals.	No on-site storage. Vendor provided on a daily basis.	Vendor/truck	387,500 lbs/month	4,650,000 lbs/year
Diesel fuel	Flammable: Continued exposure to vapors can irritate eyes and lungs. Potentially fatal if ingested.	Any spill or release may cause adsorption to sediment and soil and may cause a visible sheen or deposit of a sludge or emulsion if released to surface waters creating a hazard for plants and animals.	Mine: 3 - 12,000 gal or 2 - 20,000 gal Locomotives: 15,000 gal Plant: 12,000 gal	Tanker truck (volume/ tanker truck = 5,500-9,000 gal)	74 tanker truck loads/month	Mine: 5,910,000 gal/year Plant: Uncertain, but relatively minor Locomotives: 473,040 gal/year
Grease (385 lbs/55-gallon drum)	Mild skin irritant, ingestion may cause discomfort.	Spill or release may cause adsorption to sediment and soil and may cause a visible sheen or deposit of a sludge or emulsion if released to surface waters creating a hazard for plants and animals.	Existing bulk storage at Area 1 and Area 2 Shops.	55-gal drums	<1 truck/month	Mine: Unknown Plant: Uncertain, but relatively minor Locomotives: 16 lb/year – each locomotive

				Deliveries (Estimated Frequency)		
Material	**Classifications & Precautions****	**Environmental Concern**	**Storage Capacity**	**Means**	**Approximate Rate**	**Annual Use (Est.)**
Lubricating oil	Minimal health hazards.	Spill or release may cause adsorption to sediment and soil and may cause a visible sheen or deposit of a sludge or emulsion if released to surface waters creating a hazard for plants and animals.	Mine: 2,000 gal Plant: 2 – 7,000 gal 2 – 12,000 gal 1 – 12,338 gal	Tanker truck (typically <3,000 gal/tanker truck)	2 tanker truck loads/month	Mine: 47,000 gal/year Plant: Uncertain, but relatively minor Locomotives: 200 gal/year – each locomotive
Transmission oil	Minimal health hazards.	Spill or release may cause adsorption to sediment and soil and may cause a visible sheen or deposit of a sludge or emulsion if released to surface waters creating a hazard for plants and animals.	Mine: 1,500 gal	Tanker truck (typically <3,000 gal/tanker truck)	< 2 loads/month	Mine: 33,000 gal/year
Hydraulic oil	Minimal health hazards.	Spill or release may cause adsorption to sediment and soil and may cause a visible sheen or deposit of a sludge or emulsion if released to surface waters creating a hazard for plants and animals. Bio-accumulation is unlikely due to the very low water solubility; bio-availability to aquatic organisms is minimal.	Mine: 2,000 gal Plant: 2 - 2,500 gal	Tanker truck (typically <3,000 gal/tanker truck)	< 1 load/month	Mine: 13,000 gal/year Plant: Uncertain, but relatively minor
Coolant (ethylene glycol mix)	Harmful or fatal if swallowed; eye, skin, and respiratory irritant.	Practically non-toxic to aquatic organisms on an acute basis.	Mine: 600 gal Plant: 6,000 gal	55-gal drums and tanker truck (typically <3,000 gal/tanker truck)	1 delivery/month	Mine: 12,000 gal/year Plant: Uncertain, but relatively minor

Material	Classifications & Precautions**	Environmental Concern	Storage Capacity	Deliveries (Estimated Frequency) Means	Deliveries (Estimated Frequency) Approximate Rate	Annual Use (Est.)
Gasoline (light vehicles)	Flammable; harmful or fatal if swallowed; eye, skin, and respiratory irritant.	Spill or release may cause adsorption to sediment and soil and may cause a visible sheen or deposit of a sludge or emulsion if released to surface waters creating a hazard for plants and animals.	Plant: 2 - 6,000 gal	Tanker truck (typically <3,000 gal/tanker truck)	2 deliveries/month	Plant: 500 gal/day or 178,000 gal/year
Degreaser	Skin and eye irritant, potential inhalation hazard.	Spill or release may cause adsorption to sediment and soil and may cause a visible sheen or deposit of a sludge or emulsion if released to surface waters creating a hazard for plants and animals. Should not be released undiluted into the environment.	Plant: 1 - 400 gal 1 - 2,500 gal	55-gal drums and/or tanker truck (typically <3,000 gal/tanker truck)	As needed to keep full; < 1 delivery/month	Uncertain, likely less than 15,000 gal/year
Used oil	Minimal health hazards.	Spill or release may cause adsorption to sediment and soil and may cause a visible sheen or deposit of a sludge or emulsion if released to surface waters creating a hazard for plants and animals.	55-gal drums or storage tank	Not Applicable	Removed from site as needed typically by vendor with bulk tank truck; approximately 2 times/month	Mine: 47,000 gal/year Plant: Uncertain, but relatively minor Locomotives: 200 gal/year – each locomotive
Caustic (NaOH) (assume 10.7 lbs/gal)	Skin and eye irritant, corrosive.	No known environmental effects.	1,100-gal storage tank	Tanker truck (typically <3,000 gal/tanker truck)	1 load/month	64 t/year
Flocculant (MagnaFloc 10)	Inhalation irritant.	No known environmental effects.	1,875-lb bulk bags	Freight truck	1 truck/2 months	16.5 t/year
Flocculant (MagnaFloc 342)	Low overall toxicity.	Toxic to some species of fish if released into waters.	1,875-lb bulk bags of powder	Freight truck	< 1 truck/month	26 t/year

				Deliveries (Estimated Frequency)		
Material	**Classifications & Precautions****	**Environmental Concern**	**Storage Capacity**	**Means**	**Approximate Rate**	**Annual Use (Est.)**
Flocculant (MagnaFloc 351)	Low overall toxicity.	No known environmental effects.	1,875-lb bulk bags of powder	Freight truck	<1 truck/month	179 t/year
Sulfuric acid (assume 15 lbs/gal)	Skin and eye irritant, corrosive.	Toxic to some species of fish if released into waters.	78,700-gal storage tank with secondary containment	Bulk rail tank car (13,000-gal or 98-t capacity)	2 tank cars/year	138 t/year
Hydrochloric acid (assume 10 lbs/gal)	Skin and eye irritant, corrosive.	If released into the soil, this material is not expected to bio-degrade and may leach into groundwater.	59,500-gal storage tank with secondary containment	Bulk rail tank car (13,000-gal or 65-t capacity)	2 tank cars/month	1,485 t/year
Liquid sulfur dioxide	Extremely corrosive to exposed tissues, DOT poison gas, corrosive.	Toxic to some plants and animals if released into waters.	30,000-gal pressurized storage tank with secondary containment	Bulk rail tank car (15-55 t/car)	2 tank cars/month	1,254 t/year
Sodium hydrosulfide (assume 11 lbs/gal)	Extremely corrosive to exposed tissues. Contact with acid releases toxic gas. DOT corrosive.	Toxic to aquatic organisms if released into waters.	52,600-gal storage tank	Tanker truck (volume/tanker truck = 5,500-9,000 gal;	< 1 tanker/month	334 t/year
Potassium amyl xanthate (PAX)	DOT spontaneously combustible. Mild irritant. Heating and moisture produces H_2S, a toxic gas.	Toxic to animals in large quantities. Contact with water liberates extremely flammable gases, which can cause rapid burning and release of toxins into the air.	~30,000-gal storage tank	1,650-lb bulk bags, 25 bags/truck load	~5 trucks/month	1,075 t/year
Methyl isobutyl carbinol (assume 6.72 lbs/gal)	Flammable liquid.	This material is readily bio-degradable and practically not bio-accumulable and is slightly adsorptive in soils and sediments. Practically non-toxic to aquatic animals if released into waters.	~10,000-gal storage tank	Tanker truck (volume/tanker truck = 5,500-9,000 gal)	~ 6 trucks/month	1,124 t/year
Limestone	Harmful if swallowed; eye, skin, and respiratory irritant.	Airborne particulates may cause some harm to environment dependent on concentrations.	Bulk - stockpiled on-site	Bulk rail car (70-110 t/rail car)	Up to 100 rail cars/week from April to October	87,341 t/year

Material	Classifications & Precautions**	Environmental Concern	Storage Capacity	Deliveries (Estimated Frequency)		Annual Use (Est.)
				Means	Approximate Rate	
Lime	Eye and skin irritant; harmful if swallowed. Avoid breathing vapor or dust.	Possibly hazardous in the short term. Degradation products are not likely; however, long-term degradation products may arise.	Bulk - lime silo	Freight truck (20 – 25 t/truck)	15 loads/month	5,181 t/year
Magnesium hydroxide	Harmful if swallowed; eye, skin, and respiratory irritant.	Possibly hazardous in the short term. Degradation products are not likely; however, long-term degradation products may arise.	Storage tank	Bulk rail car (65 – 104 t/rail car)	3 tank cars/month	3,674 t/year
Grinding metals (metal alloy grinding rods and balls)	Harmful if swallowed; eye and respiratory irritant, if fine particles.	Airborne particulates may cause some harm to environment dependent on concentrations.	None required	Bulk rail car (100 t/rail car)	13 rail cars/month	15,600 t/year
Flotation activators (copper sulfate)	Harmful if swallowed; eye and respiratory irritant.	Toxic to fish and plants if released into waters.	9,200-gal activator storage tank	Reuse from Oxidation Autoclave	Not applicable	650 t/year
Ferric chloride (35%)	Very hazardous if ingested; corrosive to eyes and skin; respiratory irritant.	Mutagen; harmful to fish and invertebrates; reproductive effects, low potential for bio-accumulation; no information regarding environmental fate or toxicity.	6,000- and 1,000-gal storage tank	Tanker truck (typically <3,000 gal/tanker truck)	1,200 gal/month	14,400 gal/year
Potassium permanganate	Eye and skin irritant; respiratory irritant.	Mutagen; ecological information not available.	Bulk (dry)	Freight truck	1,300 lbs/month	16,000 lbs/year
Liquid carbon dioxide	Gas is an asphyxiant; prolonged skin or eye contact to gas, liquid or solid (crystals) may cause severe frostbite.	No adverse effects; carbon dioxide does not contain Class I or II ozone depleting chemicals.	Bulk (liquefied gas)	Tanker (cylinder) truck	105 t/month	1250 t/year

Note: t = short tons; equal to 2,000 lbs.

The United Nations hazard classification system for classifying explosive materials and explosive components is recognized internationally and is used universally by the United States Department of Defense, United States Department of Energy (USDOE) contractors, and the DOT. UN numbers however, are different from the hazard class and division designations used by the DOT.

Hazard Classification 1.1D and 1.5D: 1.1 is a Hazard Class division for Class 1 (Explosives) and is defined as a Mass Detonation Hazard. It is expected that if one item in a container or pallet inadvertently detonates, the explosion will sympathetically detonate the surrounding items. The explosion could propagate to all or the majority of the items stored together, causing a mass detonation. There will also be fragments from the item's casing and/or structures in the blast area. Hazard Class division 1.5 is an Explosive substance, very insensitive (with a mass explosion hazard).

The "D" is the Class 1 Compatibility Group defined as the secondary detonating explosive substance or black powder or article containing a secondary detonating explosive substance, in each case without means of initiation and without a propelling charge, or article containing a primary explosive substance and containing two or more effective protective features (UNO 2012).

**Precautions are described as indicated by NIOSH (2012), or those described in chemical-specific Material Safety Data Sheets (MSDSs) (Montana Refining Company 2011), (Dow 2009), (EDS 2009a), (CSCC 2005), (EDS 2009b), (Praxair Technology 2009b), (Flottec 2009), (Martin Marietta Materials 2007), (Western Lime Corporation 2009), (AluChem 2010), (Old Bridge Chemicals 1999), (H-Valley Chemical 2006), (ClearTech Industries 2010), and (Praxair Technology 2009a).

Material, Storage Capacity, Delivery Means, Delivery Approximate Rate, and Annual Use Estimate (Kevin Pylka, PolyMet, Pers. Comm., October 19, 2011), (Kevin Pylka, PolyMet, Pers. Comm., May 11, 2012)).

5.2.13.2.1 Transportation

All hazardous materials would be transported by commercial carriers in accordance with state and federal hazardous material shipping requirements. Such carriers would be licensed and inspected by the Minnesota DOT. Tanker trucks would possess a Certificate of Compliance issued by the Minnesota Motor Vehicle Division. These permits, licenses, and certificates would be the responsibility of the carrier. Federal regulations (49 CFR) require that all shipments of hazardous materials be properly identified and placarded. Shipping documents must be accessible and include MSDSs that describe the hazardous material, immediate health hazards, fire and explosion risks, immediate precautions, fire-fighting information, procedures for handling leaks or spills, first aid measures, and emergency response telephone numbers.

Hazardous waste would also be transported from the Mine Site and Plant Site for proper disposal. Transportation of these wastes would require compliance with state and federal regulations that include requirements for hazardous waste manifests with the shipments, labeling, and/or use of placards, and emergency information. PolyMet employees would be trained to manage all wastes in accordance with their specific job duties. Transportation of hazardous waste would be conducted by vendors also licensed and trained to manage hazardous waste.

As identified in Table 5.2.13-1, trucks would be used to transport a variety of hazardous materials to the Mine Site and Plant Site. Shipments of hazardous materials would originate from a number of locations. The risk of accidental truck spills was evaluated using two representative hazardous materials, diesel fuel and PAX, due to the relatively large number of deliveries and health risks associated with these materials (Rhyne 1994). Approximately 74 tanker truck loads of diesel fuel and 5 truckloads of PAX would be delivered monthly. These quantities would amount to approximately 17,800 and 1,200 shipments of diesel fuel and PAX, respectively, based on 20 years of estimated mine life.

For this evaluation, materials were assumed to be shipped from Duluth. These materials would be transported approximately 60 miles along State Highway 53 (four-lane divided highway) from Duluth to Eveleth, and then approximately 20 miles along State Highways 37 and 135 (two-lane highways) from Eveleth to the North Gate access road to the site. This route would take the materials through the towns of Duluth, Twig, Independence, Canyon, Cotton, Central Lakes, Eveleth, Gilbert, Biwabik, and Pineville and across the Cloquet, Whiteface, St Louis, and Embarrass rivers and Paleface Creek. These state highways already provide transportation routes for freight that includes hazardous materials and waste. St. Louis County Emergency Services are available for response to incidents associated with hazardous materials due to the current transport of these materials from existing businesses that use hazardous materials or generate hazardous waste within their operations. Emergency response services vary from medical rescue and ambulance services to fire-fighting and local HazMat-trained response teams stationed in various cities or districts along the defined transportation route. The locations of emergency response services are identified in multiple sectors within the county as defined by the St. Louis County Hazard Mitigation Plan prepared by the St. Louis County Emergency Management division of the St Louis County Sheriff’s Office (St. Louis County 2013). The County HazMat Response Team is stationed in Duluth.

The effect of an accidental release would depend on the location in relation to population, local activities, the quantity released, environmental factors, and the nature of the released material. The probability of an accidental release of the representative hazardous materials described above during transportation was calculated using the Federal Highway Administration truck accident statistics model (Rhyne 1994) as presented in Table 5.2.13-2. The definition of hazardous materials, per the Minnesota Hazardous Materials and Uniform HazMat Registration Program is, "a substance or material capable of posing unreasonable risk to health, safety, and property when transported in commerce, as determined by the US Secretary of Transportation." According to these statistics, the average rate of truck accidents for transport along a rural interstate highway, such as State Highway 53, is 0.64 per million miles traveled. For rural two-lane highways, such as State Highways 37 and 135, the average truck accident rate is 2.19 accidents per million miles traveled.

Table 5.2.13-2 Release Probability of Representative Materials Transported during Construction, Operation, and Closure Phases of the NorthMet Project Proposed Action

	Rural State/Interstate Highway (four lane)						Rural State Highway (two lane)						
Material Transported	**No. of Truck Deliveries**	**Haul Distance (Miles)**	**Accident Rate Per Million Miles Traveled**	**Calculated Number of Accidents**	**Probability of Release Given an Accident (%)**	**Calculated Number of Spills**	**No. of Truck Deliveries**	**Haul Distance (Miles)**	**Accident Rate Per Million Miles Traveled**	**Calculated Number of Accidents**	**Probability of Release Given an Accident (%)**	**Calculated Number of Spills**	**Combined Total Estimated Release (Freeway and Rural Two- Lane)**
Diesel Fuel	17,800.0	60.0	0.64	0.68352	18.8	0.12850	17,800.0	20.0	2.19	0.77964	18.8	0.14657	0.27
PAX	1,200.0	60.0	0.64	0.04608	18.8	0.00866	1,200.0	20.0	2.19	0.05256	18.8	0.00988	0.018

Source: Federal Highway Administration truck accident statistics model (Rhyne 1994).

The probability of a release or spill was based on accident statistics for liquid tankers carrying hazardous materials. The Federal Highway Administration statistics indicate that on average, 18.8 percent of the total accidents involving liquid tankers carrying hazardous materials resulted in a spill or release.

Using the accident and liquid tanker spill statistics, the evaluation indicates that the probability for an accidental release of liquids under truck transport during the life of the NorthMet Project Proposed Action is less than one spill accident for each of the representative materials considered. The release probability indicates there is a 1.8 percent probability of an accident resulting in a release of PAX, and a 27 percent probability of an accident resulting in a release of diesel fuel that could occur over the entire 20-year life of the NorthMet Project Proposed Action. The higher probability of a diesel fuel accident is due to the greater expected number of diesel fuel deliveries to the site.

The odds of a potential release of hazardous materials during a transportation accident would incrementally increase if the other shipments listed in Table 5.2.13-1 were included. An accidental release could range from a minor oil spill at the Mine Site and Plant Site, where cleanup equipment would be readily available, to a severe spill during transport involving a large release of diesel fuel or other hazardous material, where emergency cleanup equipment would not be readily available. Some of the chemicals could have immediate adverse effects on water quality and aquatic resources if a spill were to enter a surface water body. Considering the overall risk of an accident involving a spill, and the anticipated transport routes, the probability of a spill into a waterway would be moderate. An alternative transportation route, shorter by about 17 miles, was evaluated but rejected because of its close proximity to water bodies such as Wild Rice and Island lakes. The transportation route selected for this evaluation is longer, but is farther away from waterbodies, so in the event that an accidental spill or release of materials occurs, it could be managed in a more timely manner to reduce the likelihood of environmental harm. A shorter route could be used, but the probability of effect on a water body would be greater due to the proximity of the waterbodies.

A large-scale release of hazardous liquids delivered to the site by tanker truck (9,000-gallon capacity) or rail car (up to 13,000-gallon capacity)—such as diesel fuel, acid, or other hazardous materials—could have implications for public health and safety. The location of the release would again be the primary factor in determining potential effects. As indicated in Table 5.2.13-2, the probability of a release anywhere along a proposed transportation route was calculated to be low. Review of the Hazmat Intelligence Portal of the U.S. DOT indicates that the likelihood of a bulk rail incident is 40 percent less than that of a highway incident (PHMSA 2012b). The likelihood of a rail incident, when all incidents are included, is 82 percent less than that of a highway incident (PHMSA 2012a).

In addition to location, the potential harm presented by the material released is a factor in determining the effect of a release. A qualitative evaluation of the materials to be shipped indicates that the probability of causing harm is low for most materials. For example, though ANFO is an explosive, it will only detonate under specific conditions, such as when ignited with detonators, heat, or a sudden shock wave in a confined space. Caustic soda is corrosive and can be fatal if ingested or has prolonged contact with the skin; however, in a spill situation, emergency response would be undertaken to prevent or minimize exposure, such as restricting site access and immediate containment and removal. In the event of a release during transport, the commercial transportation company would be responsible for first response and cleanup.

Local and regional law enforcement, fire protection, and emergency planning agencies would also mobilize to secure the site and protect public safety.

In the event of an accident involving the release of hazardous material, 49 CFR requires that the carrier notify local emergency response personnel, the National Response Center (for discharge of reportable quantities of hazardous materials) (Hazardous Materials Transportation 49 CFR 100–180, Chapter I, Pipeline And Hazardous Materials Safety Administration, DOT). Minnesota Statutes require notification of the Minnesota State Duty Officer (Minnesota Statues, chapter 115, Water Pollution Control). PolyMet and its hazardous material handlers and/or DOT-regulated contractors would be required to comply with these and similar regulatory requirements, which also stipulate emergency planning and response actions.

5.2.13.2.2 Storage

The approximate capacities of hazardous material storage tanks that would be at the NorthMet Project area are listed in Table 5.2.13-1. Mobile tanker trucks may be used on site to fuel and maintain haul trucks, mobile equipment, and locomotives. The number of these trucks and their capacities would be based on NorthMet Project Proposed Action specifications. Tanks and vessels would be positioned on approved secondary containment with interior sumps to route spilled products or process solutions to lined collection areas. In addition, hazardous materials would be unloaded on an approved containment surface with sumps to route spills to lined collection areas. Some of the hazardous material storage tanks at the Mine Site would be double-walled for provision of secondary containment. Mine Site hazardous material storage tanks without double-walls and Plant Site hazardous material storage tanks would be designed to have secondary containment sufficient to hold at least 110 percent of the volume of the largest tank in the containment area. Waste materials such as used motor oil, hazardous waste, and spent hazardous materials would be managed by PolyMet employees while on-site, and shipped off-site for recycling or disposal using a DOT-licensed transporter. In addition, fire assay wastes—including cupels, crucibles, and slag—would be managed by PolyMet employees while on site and shipped off site for recycling or disposal at a licensed facility using a DOT-licensed transporter. Certain materials may be stored on-site for a period before shipment. These materials would be stored in compliance with safety storage requirements as dictated by state and federal requirements. The storage period would also comply with Minnesota and federal storage timeline stipulations. All stored wastes would be appropriately labeled and dated for timeline inspection purposes.

5.2.13.2.3 Handling and Use

Over the life of the NorthMet Project Proposed Action, the probability of minor spills of oils and lubricants would be relatively high. Releases could occur during operations because of a poor connection of an oil or hydraulic line, or as the result of equipment failure. Effects of such minor spills could include contamination of surface water and soil; however, spills of this nature would likely be small, localized, and contained.

Some of these spills may be reportable. In Minnesota, spills or discharges of more than 5 gallons of petroleum products or any quantity of chemicals or materials, whether accidental or otherwise, are required by law to be reported to the Minnesota State Duty Officer at the MPCA, by the person with control of the spill, which, if not recovered, may cause pollution of waters of the state. The responsible NorthMet Project Proposed Action person is required to recover as rapidly and thoroughly as possible such spilled material, and take immediate action as reasonably possible to minimize or abate pollution of waters of the state (*Minnesota Statutes*, section 115.061, Duty to Notify and Avoid Water Pollution).

Emergency release notification requirements under EPCRA (USEPA 40 CFR, chapter 355) exist in addition to the release notification requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (USEPA 40 CFR, chapter 302). If the NorthMet Project Proposed Action had a release of a CERCLA hazardous substance, it would be required to comply with the notification requirements of EPCRA, and the release notification requirements of CERCLA. If the reportable quantity of a substance were released within a 24-hour period at the NorthMet Project area, and the substance was on the list of extremely hazardous substances under EPCRA or the list of CERCLA hazardous substances (USEPA 40 CFR, chapter 302.4), then PolyMet would be subject to reporting requirements described in 40 CFR 355.60, 40 CFR 302, and the Emergency Notification Procedures in Minnesota as required by Title III of the Superfund Amendments and Reauthorization Act (USEPA 40 CFR, chapters 300 to 399).

The requirements for storage of oils and lubricants, including the requirement for spill prevention, control, and countermeasure (SPCC) planning are found in the Oil Pollution Prevention Act (USEPA 40 CFR, chapter 112) and MN § 115E (Minnesota Statues, chapter 115, Water Pollution Control; Sanitary Districts). Applicable Minnesota Statutes include: Prevention and Response Plans (Section 115E.04), Response Plans for Tank Facilities (Section 115E.045, Subdivision 2), and Responses to Releases (Section 115C.03). A list of hazardous material management and response plans is presented in Table 5.2.13-3.

Table 5.2.13-3 Hazardous Material Management Plans

Plans	Applicable Statute/Regulation	Materials/Applications
SPCC Plan	USEPA 40 CFR chapter 112	Oil/petroleum spills
Toxic Pollution Prevention Plan (TPPP)	Minnesota Statutes, chapter 115D Subdivision 1(a) USEPA 40 CFR 260 - 279 DOT 49 CFR	Waste minimization, handling, storage, disposal, recycling of hazardous substances, chemicals, fluids, and other wastes. Transportation of hazardous materials.
Hazard Communications Standards	MSHA Rule 30 CFR Part 47	Evaluation of the hazards of chemicals mines produce or use and the provision of information to miners.
Emergency Response Plan	OSHA 29 CFR 1910.120 USEPA 40 CFR 68	Hazardous material release response guidance.
Spill Prevention/Response Plan	29 CFR 1910.120/CAA Section 112 Minnesota Statutes, chapter 115E (may also be applicable to trucking vendors)	General guidance Minnesota state guideline for responding to spills and releases.
Risk Management Program	USEPA 40 CFR 68	Hazard assessment, accident history, prevention program and training, and emergency response program.

The threshold quantity, as defined in 40 CFR 112, for triggering the requirement for development of a SPCC plan is 1,320 gallons of petroleum products in bulk container storage greater than 55 gallons. Since the NorthMet Project area would have more than 1,320 but less than 1,000,000 gallons of oil storage, an SPCC plan would be required under 40 CFR 112. The primary goal of an SPCC plan is to develop strategies to prevent oil spills from reaching Minnesota and United States waters. An SPCC plan is thus specific to each facility, providing persons responsible for planning emergency response site-specific information such as a description of facilities, storage information, preventative measures, response action, equipment, and contact information. An SPCC plan must also provide information for routine facility inspections.

To reduce the likelihood of incidental spills of petroleum products, a preliminary SPCC plan has been prepared for the NorthMet Project Proposed Action. The plan identifies potential emergencies that may arise during operations or an activity within the NorthMet Project area. The plan establishes a framework to respond effectively to the identified potential emergencies.

The final SPCC plan would include procedures, methods, equipment, and other requirements to prevent discharges of oil from facilities, and to contain such discharges, should they occur. The SPCC plan would also contain a detailed, facility-specific description of how the operations comply with the requirements of the Oil Pollution Prevention regulation (USEPA 40 CFR, Part 112). The SPCC plan would address measures such as secondary containment, facility drainage, dikes and barriers, sump and collection systems, retention ponds, curbing, tank corrosion protection systems, liquid level devices, and emergency shut-off or release alarms. The final SPCC plan must be certified by a Professional Engineer that in their professional judgment the following are true:

- The SPCC plan is adequate for the facility;
- Technical standards have been considered;
- Inspections and tests are adequate for the facility; and
- The SPCC plan has been prepared in accordance with good engineering practices, including consideration of applicable industry practice.

A final SPCC plan is not possible for the NorthMet Project Proposed Action until construction has been completed. However, PolyMet has prepared a preliminary SPCC plan that is compliant with 40 CFR 112 requirements.

The policies and procedures set forth in the SPCC plan, inclusive of PolyMet's Standard Operating Procedure for Storage Tank Management, would be prepared to comply with *Minnesota Rules*, Chapter 7151, Aboveground Storage of Liquid Materials.

The preliminary SPCC plan would be finalized and certified by a Professional Engineer, as required, after petroleum storage and handling facilities have been constructed. Based on current planning information, the final SPCC plan would need to address at least the following areas or activities involving petroleum and other oils:

- A truck fueling station;
- Remote fueling activities (i.e., at the equipment operating location);
- ASTs;

- Large-quantity oil-filled equipment;
- Locomotive fueling (at Area 2); and
- A gasoline fueling station (at the main gate).

The fueling station would consist of an enclosed building for fueling, including floor drain sumps and holding tanks for collection of spills. The holding tanks would be cleaned out, as needed, by a contractor with appropriate certification or license, and the waste would be transported to a recycling, treatment, or disposal facility. One fueling station would typically be provided to fuel all mobile equipment with rubber tires (trucks, dumps, front end loaders, dozers, etc.). This equipment also may be fueled in place by remote fuel tankers. Remote fueling typically would be conducted for equipment located within the mine pits and at material stockpiles (e.g., excavators, dozers, and other tracked equipment). Portable spill clean-up kits would be available at the fueling stations and on the fuel tankers. Standard operating procedures, including spill response plans, would be prepared and associated training would be conducted for fueling operations. Equipment would be attended during fueling operations. When possible, remote fueling would not be performed near sensitive areas, where, if a release were to occur, surface water could be affected. At final design stage, an updated or final version of the current SPCC plan would be prepared for the NorthMet Project Proposed Action facilities, to address specific spill response, cleanup, release notifications, etc. For oil-filled equipment, an appropriate containment system would be constructed so that discharge from a primary containment system would not escape the containment system before cleanup occurs. Alternatively, facility procedures and a contingency plan would be established that define inspections and/or a monitoring program to detect equipment requiring service or failure, and/or discharge. ASTs would be located at the truck fueling station where fuel storage would meet secondary containment standards. The tanks would have a containment dike with membrane, or a concrete enclosure to contain leaks or spills. As previously indicated, double-walled ASTs would not require secondary containment.

The SPCC documents, along with manufacturer MSDSs, would be available in all areas where hazardous materials were expected to be used or produced, and at all areas of fuel and lube-oil storage.

5.2.13.2.4 Emergency Planning and Community Right-to-Know

Management of hazardous materials at the NorthMet Project area would be governed by a number of interrelated federal, state, and local regulations, as listed in the first part of this Hazardous Materials Section. The following discusses federal and Minnesota state actions under EPCRA, including its emergency response-planning activities, Hazardous Chemical Inventory Reporting (Tier II) requirements, and Toxics Release Inventory (TRI) reporting requirements. Minnesota's hazardous materials regulations are codified in the *Minnesota Rules*, chapters 7507 and 7513, and in *Minnesota Statutes*, chapter 299K.

As required by EPCRA, Minnesota has established the Minnesota Emergency Response Commission (ERC), an agency within the Minnesota Department of Public Safety, Division of Homeland Security and Emergency Management. The Minnesota ERC coordinates information specific to hazardous materials at facilities around the state so that local emergency officials are able to prepare for emergencies. The Minnesota ERC serves as the repository for the EPCRA hazardous chemical inventory reports (Tier II reports). Along with the listing of hazardous materials identified on Table 5.2.13-1, PolyMet would prepare and submit Tier II Emergency and Hazardous Chemical Inventory Report Forms for sodium hydroxide, hydrochloric acid, sodium hydroxide, sulfuric acid, and SO_2, and would be subject to reporting additional hazardous materials or chemicals maintained on-site in quantities greater than the Tier II reporting thresholds.

The Minnesota ERC also collects data from facilities reporting under the federal TRI report program mandated by SARA Title III, Section 313. The NorthMet Project Proposed Action would be subject to TRI reporting based on the quantities of sulfuric acid and SO_2 to be maintained at the NorthMet Project area and could include others depending on actual quantities.

Under the federal Pollution Prevention Act of 1990, facilities subject to TRI reporting must also provide information on the pollution prevention and recycling activities associated with the reported toxic chemicals. The NorthMet Project Proposed Action would be subject to Minnesota's Toxic Pollution Prevention Act (Minnesota Statutes, section 115D.07), and PolyMet would have to prepare a TPPP. The TPPP would describe the facility's processes and operations, and set objectives for the handling, storage, and disposal or recycling of hazardous materials and toxic chemicals to eliminate or reduce at the source, the use, generation, or release of toxic pollutants, hazardous substances, materials, and hazardous wastes.

Under the federal CAA Amendments of 1990 Section 112(r), the NorthMet Project Proposed Action would be subject to the Accidental Release Prevention/Risk Management Plan rule, based on the projected use of hydrochloric acid and other flammable and toxic substances (42 USC, chapter 85, Air Pollution Prevention and Control). PolyMet would be required to develop a Risk Management Program that would include:

- Hazard assessment and potential effects of an accidental release, accident history, and evaluation of worst-case and accidental release scenarios;
- Prevention program including safety precautions, maintenance, monitoring, and training measures; and
- Emergency response program detailing emergency health care, training, and procedures for informing the public and response agencies should an accident occur.

The hazardous material management plans include procedures for evacuating personnel, maintaining safety, cleanup, neutralization activities, emergency contacts, internal and external notifications to regulatory authorities, and incident documentation. Proper implementation of the SPCC plan, TPPP, Hazard Communications, Emergency Response Plan, Spill Response Plans, and the Risk Management Program would minimize the incidents and effects associated with potential releases of hazardous materials.

If present, other hazardous or potentially hazardous materials or wastes would be characterized and managed per the hazardous materials management plans described in Table 5.2.13-3 above, and, if applicable, would adhere to the requirements defined in *Minnesota Rules*, chapter 7045, Hazardous Waste.

5.2.13.3 Potential Mitigation Measures

Mitigation of a hazardous material release would follow the principle of prevention, minimization, and treatment. Prevention would be achieved when any hazardous material was avoided, where possible, by replacing it with a substitute material that was not hazardous. To the extent possible, this has been done; where not possible, precautions to be defined in the TPPP would be taken to properly manage hazardous materials or substances, and keep the potential risk of exposure to a minimum. Accidentally released hazardous material would be treated quickly in accordance with the described plans.

In addition, mitigation processes or procedure definitions would be included in the following:

- Hazardous communication materials, through communications and training programs;
- Overfill protection procedures;
- Provision for secondary containment;
- Establishment of leak detection systems;
- Preventative inspection and maintenance procedures; and
- Emergency response plan.

These measures would be designed to ensure that accidental releases were prevented or minimized, and when they did occur, were responded to quickly and properly.

Monitoring activities proposed for prevention of incidental releases, mitigation, or quick removal of the effects, if hazardous materials were released, include the following:

- Regular inspection and testing of storage containers and facilities;
- Inspection of vessels for leaks, drips, or loss content of containers;
- Verification of locks, emergency valves, and other safety devices, protective equipment, and floors;
- Regular checks on the operability of emergency systems;
- Periodic awareness training for employees;
- Maintaining MSDSs at visible locations for easy access at all times; and
- Regular monitoring of surface water and groundwater quality.

Monitoring and inspection would be an integral part of the hazardous material management processes at the NorthMet Project area.

Given current Project design and operational commitments, this analysis did not identify significant adverse effects from proposed hazardous materials use or hazardous waste generation by the NorthMet Project Proposed Action. Therefore, no additional mitigation measures are proposed.

5.2.13.4 NorthMet Project No Action Alternative

The NorthMet Project No Action Alternative has no risk of environmental effect since no hazardous materials would be used, and no hazardous waste would be generated under this alternative.

5.2.14 Geotechnical Stability

The geotechnical stability of the proposed large-scale material storage facilities for the NorthMet Project Proposed Action is addressed in this section. These facilities are the waste rock stockpiles that would be created at the Mine Site; the Tailings Basin, which would be constructed on top of the existing LTVSMC Tailings Basin; and the Hydrometallurgical Residue Facility, which would be constructed at the existing LTVSMC Emergency Basin.

This section provides a summary of the required design criteria and the methodology and results of the iterative modeling and design process, as well as an overview of the proposed monitoring and mitigation plans.

Summary

Designs of the waste rock stockpiles, Tailings Basin, and Hydrometallurgical Residue Facility have been developed and shown by PolyMet, through an iterative design and modeling process, to meet the minimum Factors of Safety and water quality criteria (see Section 5.2.2) acceptable to the Co-lead Agencies. The slope stability and liner integrity of these facilities would be monitored throughout operations and long-term closure. This approach would allow for identification of a need to implement adaptive mitigation measures as a contingency to improve performance should the facilities perform differently from their design.

5.2.14.1 Methodology and Evaluation Criteria

The direct environmental consequences of the proposed large-scale waste material storage facilities, including the disturbance footprint and impacts to water, are discussed under the respective environmental factors in Chapter 5.0. This section addresses the slope stability and liner integrity of the proposed facilities.

If incorrectly designed, constructed, and/or managed, or from other unforeseen circumstances, waste material storage facilities have the potential to increase hydrologic and/or water quality effects and may become unstable, potentially leading to slope or dam failure (and/or other environmental impacts to downstream areas).

The large-scale waste material storage facilities proposed for the NorthMet Project Proposed Action would require compliance with MDNR, nonferrous mining, and dam safety rules, as well as the MPCA NPDES/SDS Permit. The Dam Safety permit requires that design and safety criteria be met to reduce the risk of potential failure.

The design of geotechnical structures is typically developed using an iterative design and modeling approach where the design is amended until modeling results meet the required minimum design criteria, including Factors of Safety and other requirements for permitting. Factor of Safety is used to describe the ratio of resisting forces to driving forces along a potential failure surface, whereby a Factor of Safety of 1.0 represents equilibrium between the estimated resisting shear strength to the applied shearing load along a specific plane of potential movement. Systems are often designed to a Factor of Safety above 1.0 to allow for unexpected loading conditions, unexpected operating conditions, and variations in estimated material properties.

The specific design and minimum required Factor of Safety criteria for the proposed large-scale waste materials storage facilities and the methodology applied to develop the designs of the proposed facilities in order to meet these criteria are discussed for each facility in the respective sections below. Technical analysis was performed by PolyMet and reviewed by the Co-lead Agencies.

The potential effects of hypothetical failure scenarios have not been assessed in this FEIS, as the risk of failure is mitigated through application of design and safety requirements including adaptive management procedures.

5.2.14.2 NorthMet Project Proposed Action

5.2.14.2.1 Waste Rock Stockpiles

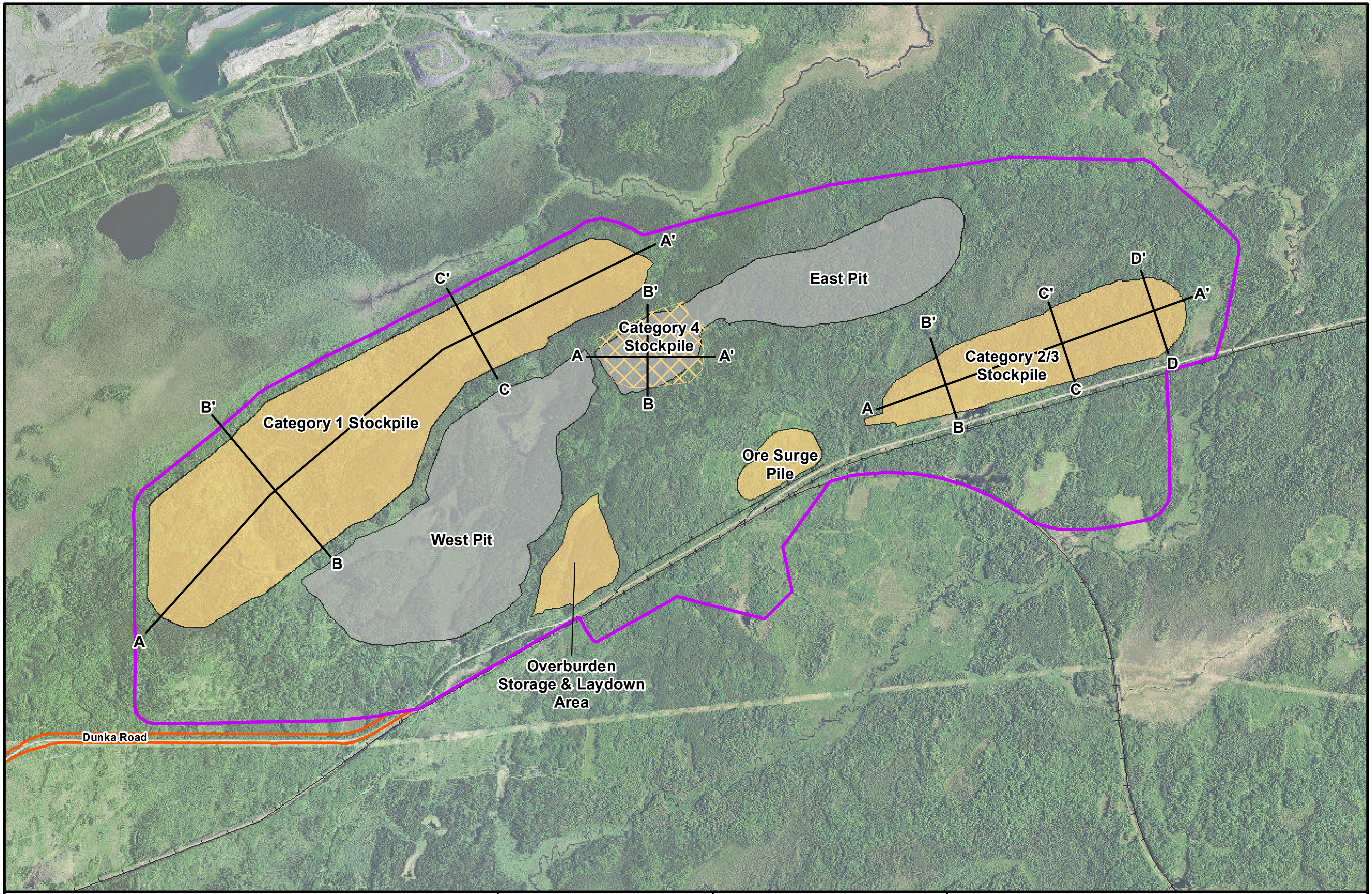
The proposed large scale waste material storage facilities at the Mine Site are:

- A permanent waste rock stockpile for Category 1 waste rock encompassed by a surface water and groundwater containment system and with an engineered geomembrane cover system at closure, and
- Temporary, lined stockpiles for Category 4 waste rock, combined Category 2/3 waste rock, and an Ore Surge Pile.

In addition to the stockpiles above, PolyMet would also prepare an Overburden Storage and Laydown Area that would be used for temporarily stockpiling overburden prior to its use.

PolyMet expects that the NorthMet Project Proposed Action would produce approximately 308 million tons of waste rock over the life of mine. Waste rock would be categorized and managed based on its potential to oxidize. The least reactive, Category 1, waste rock would be placed into a permanent stockpile, while Category 2/3 waste rock and Category 4 waste rock would be stored in temporary stockpiles before being placed as backfill into the East Pit after year 11 of operations. The location of the stockpiles is shown in Figure 5.2.14-1. The total weight of waste rock stored in a permanent stockpile (Category 1 Stockpile) would be approximately 168 million tons (see Section 3.2.2.1.7).

The data inputs, evaluation methodology, results, and design and operating requirements for the stockpiles were reported in Geotechnical Data Package Volume 3 (PolyMet 2014p) and Rock and Overburden Management Plan (PolyMet 2015h) and reviewed by the Co-lead Agencies. Additional geotechnical investigations are required to gain a better understanding of the liner interface frictional values (for the composite liners that would be used at the proposed facility), as well as the geotechnical material properties of the foundation soils in the wetland areas and stockpile geotechnical material properties prior to construction of the stockpiles. PolyMet has committed to undertake further investigations as necessary.



Mine Site

Active Stockpile

Category 4 Stockpile

Mine Pit

Stockpile Cross-Section

Transportation and Utility Corridor

Existing Railroad

This document is a working document. This document may change over time as a result of new information, further deliberation, or other factors not yet known to the Co-lead Agencies.

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Figure 5.2.14-1

Mine Site Plan - Year 11

NorthMet Mining Project and Land Exchange PFEIS

Minnesota

June 2015

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Design Criteria

Waste rock stockpiles must be designed to comply with *Minnesota Rule* 6132.2400 (stockpile slopes are required to meet *Minnesota Rule* 6132.2400 Subp. 2. B. and stockpile foundations are required to meet *Minnesota Rule* 6132.2400, Subpart 2. A. (1)). These are design requirements that have been established to attain acceptable slope stability Factors of Safety for global stability and acceptable foundation deformations, the latter of which relates to the capability of the composite geomembrane liner system to withstand the strain anticipated due to differential settlement that may occur in the stockpile foundation materials.

The NorthMet Geotechnical Modeling Work Plan (PolyMet 2015l, Attachment A) requires PolyMet to perform stockpile subgrade settlement analysis to predict magnitude of deformation and resulting strain in the stockpile geomembrane liners for comparison to allowable strain in the proposed liner system. Allowable strains are material-specific and would be determined from manufacturers specifications for the materials selected for the stockpile liners.

Methodology

In order to demonstrate that the design of the stockpiles would meet the geotechnical requirements, PolyMet completed the following:

- Collected existing conditions data needed to support foundation design (refer to Section 4.2.14);
- Configured stockpile slopes to meet or exceed the minimum dimensional requirements established by *Minnesota Rules* 6132.2400;
- Conducted a stockpile subgrade settlement analysis to predict the magnitude of deformation and resulting strain in the stockpile liners for comparison to allowable strain in the liner system;
- Completed slope stability analyses using RocScience's limit equilibrium program SLIDE; and
- Developed the stockpile design and operating requirements necessary to maintain required slope stability Factors of Safety and liner performance.

Design

The design of the stockpiles would need to conform to *Minnesota Rule* 6132.2400. Various design specifications have been established and used for the stockpile analysis (PolyMet 2014p). The following is a summary of the design characteristics applied and considered in geotechnical evaluation.

Preconstruction Design Considerations for Stability and Water Management

Additional geotechnical investigation such as soil borings, test trenches, and geotechnical laboratory tests of on-site materials are required at the locations of the proposed stockpiles to verify the geotechnical information currently available. Examples of information that the additional investigation would yield include: confirmation of the classification of native soils, identification of depths to bedrock and groundwater, identification and delineation of on-site borrow sources, and procurement of additional material samples of waste rock and overburden soils for laboratory testing. Information would be used to modify stockpile and foundation design and confirm the design assumptions and earthwork balance computations. The additional investigations would take place before stockpile construction but cannot be undertaken until the land exchange has been completed, appropriate permitting has been received, and dewatering of the wetland areas has been performed. As noted above, before construction, the sites would be dewatered and stockpile foundations would be established on soils identified through permitting, that the MDNR agree to be suitable for structural support; unsuitable soils on the stockpile's perimeter would be removed and replaced with structural fill for stability purposes.

The Category 1 Stockpile would be a permanent, unlined facility. A drainage system would be installed around the stockpile, prior to waste rock placement to capture ground and surface water flows that may extrude from the stockpile.

The temporary Category 2/3 and 4 Stockpiles would include a composite geomembrane liner systems comprised of, from the bottom up, a foundation underdrain system, an impermeable composite liner barrier, and an overliner drainage layer. The composite liner systems are designed to perform on a level commensurate with the level of environmental risk expected by the waste rock classification type. The composite liner system for each temporary stockpile consists of a minimum of one foot of compacted soil overlain by an 80-millimeter thick Linear Low Density Polyethylene (LLDPE) geomembrane liner and a minimum of two ft of granular drainage material. The liners would utilize gravity drainage to a series of collection sumps, and an overliner drainage layer would be constructed to reduce the potential for leaks due to puncturing of the geomembrane by the waste rock. For angular overliner materials, a geomembrane liner load integrity test would be conducted during the additional investigation work mentioned above to support specification of the acceptable geomembrane thickness and polymer type.

Additional information on water containment and management is provided in Section 3.2.2.1.8.

Stockpile Design and Construction

- Stockpile design geometry used for analysis is as follows: minimum width at the top of stockpile: approximately 150 ft or as controlled by the minimum safe turning radius for operating mine haulage trucks
- Perimeter access road for light truck traffic (plus allowance for berms): 20 ft
- Nominal angle of repose slopes: 1.4H:1V (horizontal:vertical) (assumed)
- Maximum slope for stockpile foundation excavation: 2H:1V
- Grading considerations at closure:
  - For the Category 1 Stockpile: 3.75H:1V regraded interbench slopes for the geomembrane cover
  - Regrading is not necessary for Categories 2/3 and 4 stockpiles or the Ore Surge Pile as these are temporary stockpiles
- Height of first lift (over geomembrane, where located): 15 ft
- Height of second lift (over geomembrane, where located): 25 ft
- Nominal lift height (after initial two lifts over geomembrane and where no geomembrane is located): 40 ft

- Maximum stockpile heights and interbench slope configurations considered for stability analyses are:
  - 160 ft at interbench slope angles of 1.4H:1V and 2.5H:1V
  - 200 ft at interbench slope angle of 3H:1V
  - 240 ft at interbench slope angle of 3.7H:1V

Stockpile liner systems and foundation designs used for analysis are as follows:

- Number of development phases: to be determined in permitting
- Minimum grade for foundation underdrains: 0.5 percent
- Minimum grade for drainage collection overliner: 0.5 percent
- Liner system design, including piping and underliner and overliner collection points
- Liner system geomembrane: 80-millimeter linear low density polyethylene (LLDPE)

Cross sections of the proposed stockpiles are shown in Figure 5.2.14-2 and Figure 5.2.14-3.

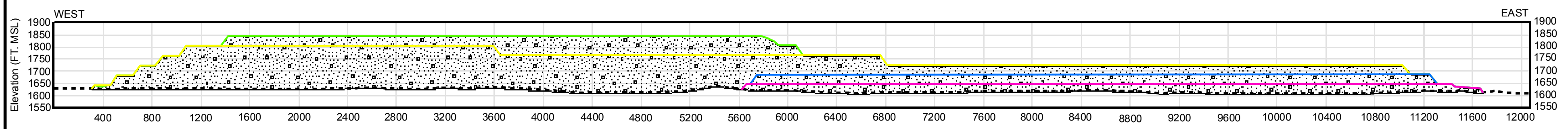
The stability model (SLIDE) assumed a geomembrane liner interface friction angle (i.e., the strength that the geomembrane possesses for resisting sliding against the adjacent earthen material) of 19 degrees, meeting the criteria of 15.7 degrees or greater.. Further geotechnical investigation and laboratory testing is required to verify the liner interface shear strength values as placed against potential borrow materials comprising the underliner material, as well as the shear strength parameters for the foundation and stockpile materials prior to construction. To mitigate associated uncertainty, PolyMet has committed to removing all unsuitable foundation soils from beneath lined stockpiles and replace them (where required) with structural fill to meet strength and grade requirements (PolyMet 2015h). PolyMet has also committed to undertaking further geotechnical investigations prior to the construction of the stockpiles to define the foundation management needs.

Temporary stockpiles at the Overburden Storage and Laydown Area have not been included in stability analysis given their temporary nature and relatively small size.

Closure of the Stockpiles

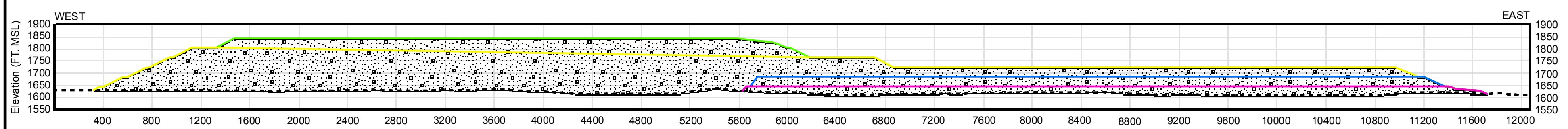
The Category 1 Stockpile would be a permanent feature that would be progressively reclaimed, starting in mine year 14, with an engineered geomembrane cover system. Reclaimed configurations are described in the section above and in the stability modeling results below. The cover would include an engineered geomembrane system that would be vegetated to meet the requirements of *Minnesota Rules*, part 6132.2200, subpart 2, item B. A subgrade layer would be placed over the Category 1 Stockpile to provide a uniform layer upon which to construct the cover system. The cover would be designed to promote runoff with reduced erosion potential. To provide an adequate base for sloping of cover materials, Category 1 Stockpile side slopes would be re-shaped to no steeper than a horizontal-to-vertical ratio of 3.75H:1V, with the cover system placed on top of the re-shaped waste rock. The outermost layer would consist of local till soils (also known as "overburden" per *Minnesota Rules*, part 6132.0100, subpart 32) adequate for native vegetation growth. To provide further erosion control, catch benches at least 30 ft in width would remain on the stockpile. Long-term maintenance of the Category 1 Stockpile would include repairing erosion and removal of woody species and trees from the stockpile cover system to mitigate against the potential for deep root systems puncturing the underlying geomembrane. Additional information on reclamation is provided in Section 3.2.2.1.10 and an overview of monitoring and maintenance actions for stability is provided below.

The Category 2/3 and 4 stockpiles and Ore Surge Pile would be temporary and would be backfilled into the East Pit following year 11. The footprint of the temporary stockpiles would be reclaimed to wetlands or other native habitats where practical.



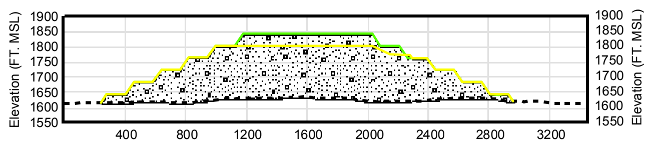
A: Operational Configuration Section

0 400 800
Horizontal Scale in Feet
2X Vertical Exaggeration



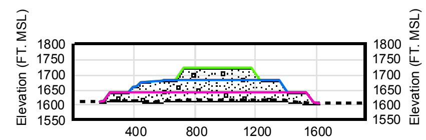
A: Reclamation Configuration Section - Interbench Slopes 3.75H:1V

0 400 800
Horizontal Scale in Feet
2X Vertical Exaggeration



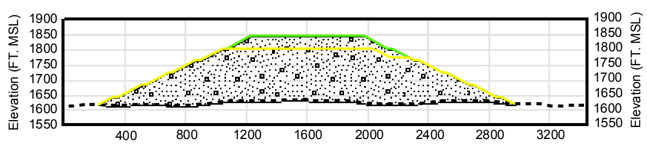
B: Operational Configuration - West Section

0 400 800
Horizontal Scale in Feet
2X Vertical Exaggeration



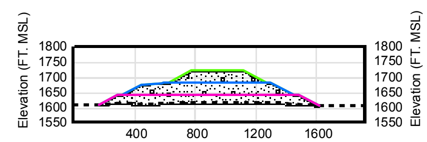
B: Operational Configuration - East Section

0 400 800
Horizontal Scale in Feet
2X Vertical Exaggeration



B: Reclamation Configuration - West Section, Interbench Slopes 3.75H:1V

0 400 800
Horizontal Scale in Feet
2X Vertical Exaggeration



B: Reclamation Configuration - East Section, Interbench Slopes 3.75H:1V

0 400 800
Horizontal Scale in Feet
2X Vertical Exaggeration

Year 1
Year 2
Year 11
Ultimate Extent
Existing Ground Surface

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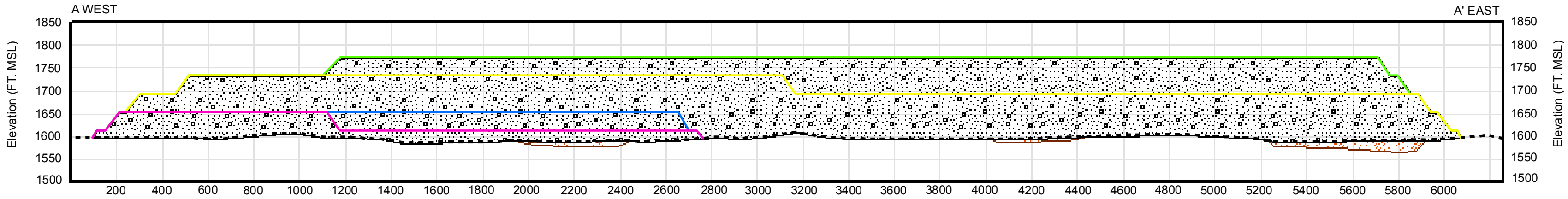
Figure 5.2.14-2
Cross Sections of the Proposed Category 1 Stockpile
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

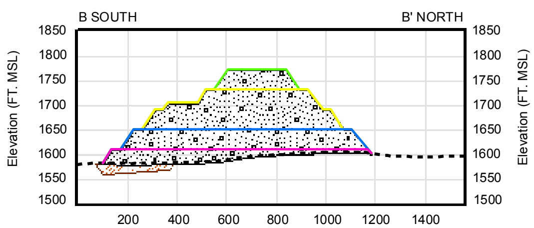
June 2015

204 -Page Intentionally Left Blank-



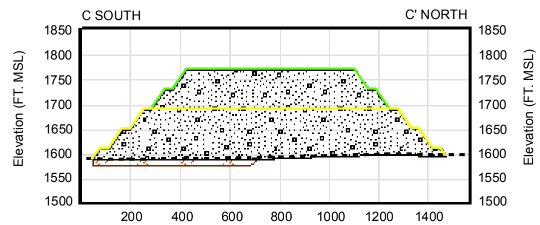
A: Category 2/3 Stockpile

2:1 Vertical Exaggeration



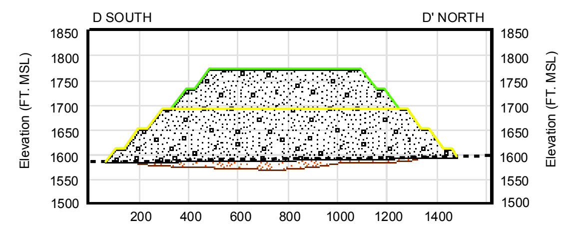
B: Category 2/3 Stockpile

2:1 Vertical Exaggeration



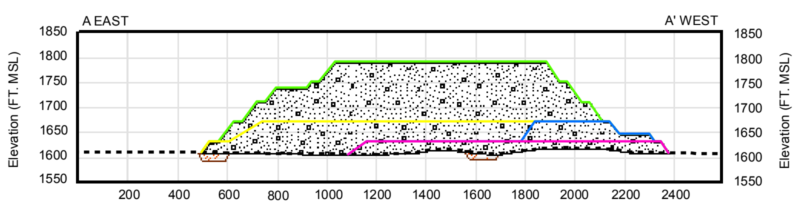
C: Category 2/3 Stockpile

2:1 Vertical Exaggeration



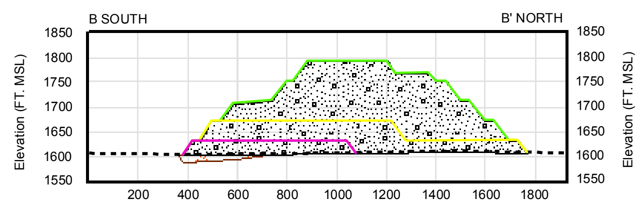
D: Category 2/3 Stockpile

2:1 Vertical Exaggeration



A: Category 4 Stockpile

2:1 Vertical Exaggeration



B: Category 4 Stockpile

2:1 Vertical Exaggeration

Year 1 — Ultimate Extent
Year 2 — Existing Ground Surface
Year 11 — Unsuitable Soil Excavation Surface

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Figure 5.2.14-3

Cross Sections of the Proposed Category 2/3 and 4 Stockpiles at Maximum Extent

NorthMet Mining Project and Land Exchange PFEIS

Minnesota

June 2015

206

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Modeling Results

The results reported in Geotechnical Data Package Volume 3 indicate that the proposed design of the stockpiles would meet the required Factors of Safety (PolyMet 2014p). The geotechnical evaluation is summarized below.

Stability

PolyMet undertook a stability analysis of the design cross sections developed to represent the following typical conditions at different phases of stockpile development:

- Temporary Category 2/3 Stockpile, Category 4 Stockpile, and Ore Surge Pile
    1. Initial operational configuration (single lift of waste rock placed in two stages).
    2. Operational configuration at proposed final buildout (excludes the Ore Surge Pile, which would fluctuate).
- Permanent Category 1 Stockpile
    1. Initial operational configuration (a single lift of waste rock with a maximum height of 40 ft placed at the angle of repose).
    2. Operational configuration at proposed final buildout prior to reclamation (assume four lifts of waste rock).
    3. Reclaimed configuration, interbench slopes regraded to 2.5H:1V.
    4. Reclaimed configuration, interbench slopes regraded to 3H:1V.
    5. Reclaimed configuration, interbench slopes regraded to 3.75H:1V.
    6. Assuming a liner interface (i.e., overliner material/LLDPE geomembrane liner/soil liner) friction angle of 19 degrees.

Results indicated that all sections analyzed met the minimum required Factors of Safety.

Estimated liner strains resulting from foundation settlement are less than 1 percent; well below the 30 percent maximum strain allowed in the LLDPE geomembrane proposed for the geomembrane barrier layer component of the basal liner system for the Category 2/3 Stockpile, Category 4 Stockpile, and the Ore Surge Pile.

Proposed Monitoring, Maintenance, and Mitigation

A Construction Quality Assurance Plan would be developed by PolyMet for the stockpile construction prior to permitting. The objective of the plan would be to assure that the construction of the soil and geosynthetic components would be in compliance with the project specifications and to demonstrate that the regulatory requirements for the construction would be achieved. The plan also would provide the means for resolution of problems that may occur during construction. The Construction Quality Assurance Plan would be independent of the quality control programs to be followed by the manufacturers, installers, and the contractor.

A Rock and Overburden Management Plan (PolyMet 2015h) has been prepared by PolyMet that includes a description of the operating plans, monitoring procedures, and adaptive management approaches for the stockpiles.

The stockpile quantities would be monitored throughout the life of the mine and the stockpile heights and footprints would be monitored to verify that they are constructed as designed. Monitoring and maintenance of the Category 1 Stockpile would also continue through the post-closure period until the MDNR determines that the cover is stable. An annual compliance report would be developed each year for submittal to the MDNR to comply with the Permit to Mine requirements.

Information gained through ongoing monitoring would also be used to advise adaptive waste management requirements should the capacity of the Category 2/3 Stockpile, the Category 4 Stockpile, and/or the East Pit be insufficient for the mined volume of Category 2/3 and Category 4 waste rock generated by mining. Adaptive waste rock management could include expansion of the waste rock stockpiles. While moving all of the Category 1 waste rock into the West Pit as backfill was eliminated as a potential alternative (refer to Section 3.2.3.4.2), it may be possible to dispose of some excess waste rock or saturated overburden in the West Pit in areas where mining has ceased, if necessary as an adaptive measure.

Each year, an operating plan and annual report would be completed, as required for the Permit to Mine, to keep the Rock and Overburden Management Plan (PolyMet 2015h) current and to track changes in the mine plan, rock type schedule, and characterization of the material. Modifications to the Rock and Overburden Management Plan based on changes to the material characterization would be completed, as necessary.

5.2.14.2.2 Tailings Basin

Tailings from the beneficiation process would be disposed of in a Tailings Basin, constructed on top of Cell 1E and Cell 2E of the existing LTVSMC Tailings Basin. Figure 5.2.14-4 depicts the Tailings Basin at its proposed final elevation (year 20).

The data inputs, modeling methodology, results, and design and operating requirements for the Tailings Basin were reported in Geotechnical Data Package Volume 1 (PolyMet 2015l) and Flotation Tailings Management Plan (PolyMet 2015n), which were reviewed by the Co-lead Agencies. The information provided in the data package informs the permitting process and is summarized below.

Design Criteria

In Minnesota, dams must be constructed in accordance with applicable requirements of *Minnesota Rules* 6115.0300 through 6115.0520. In addition, under the NorthMet Geotechnical Modeling Work Plan (PolyMet 2015l, Attachment A), the Co-lead Agencies require that the critical cross section of the Tailings Basin is demonstrated to meet or exceed the following minimum Factors of Safety as required for various loading scenarios:

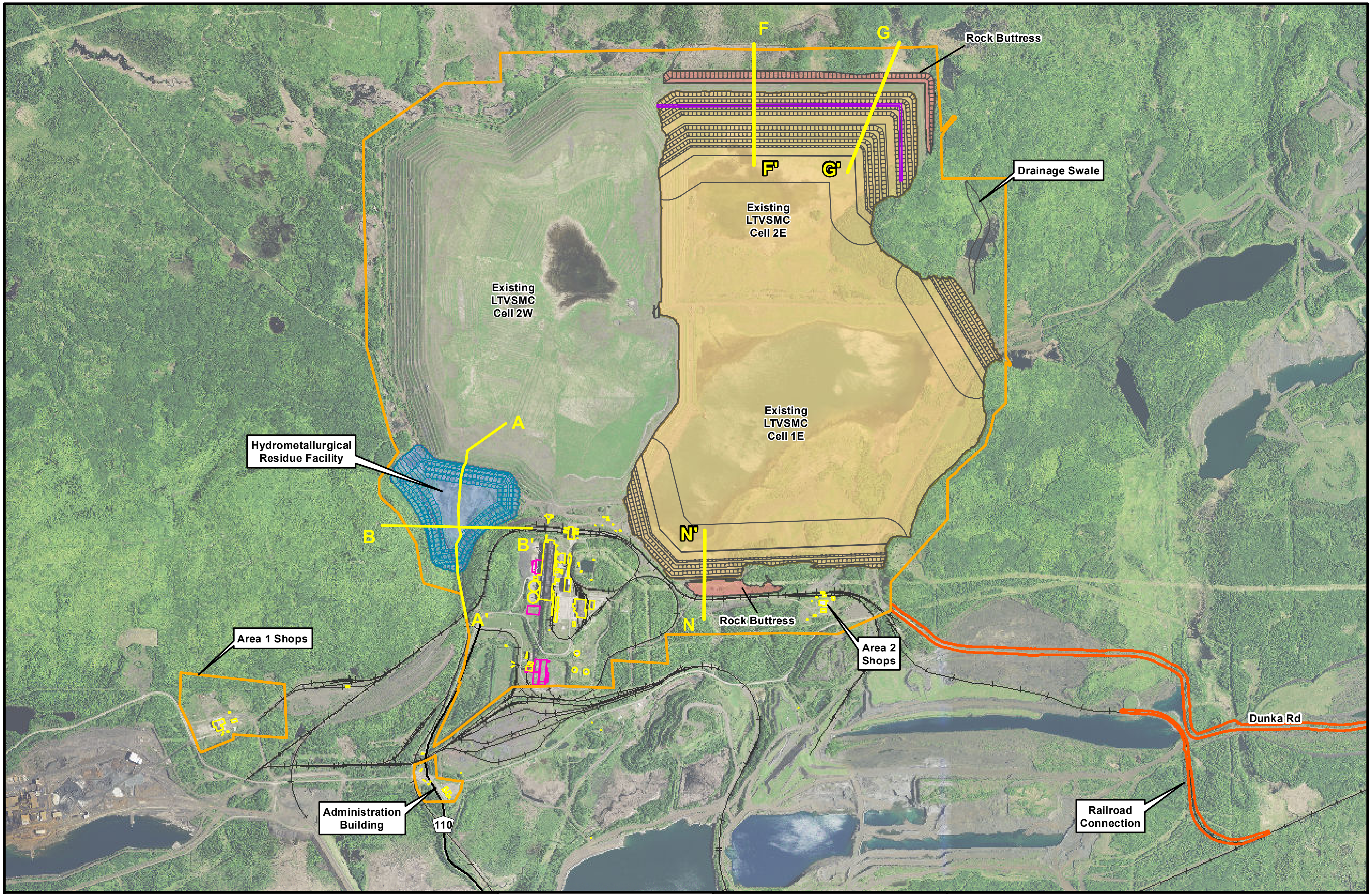
- Factor of Safety greater than or equal to 1.5 for effective stress conditions using parameters that reflect long-term, drained strength conditions.
- Factor of Safety greater than or equal to 1.3 for short-term, undrained strength conditions for soils that are not prone to static liquefaction using undrained strength conditions.
- Liquefaction analysis of potentially liquefiable materials in undrained strength conditions including:
  - Liquefaction triggering analysis Factor of Safety greater than or equal to 1.1;

- Seismic liquefaction triggering analysis (i.e., induced by design earthquake event) Factor of Safety greater than or equal to 1.2 (or, the Co-lead Agencies may accept a Factor of Safety between 1.2 and 1.0 if the results of deformation modeling are also deemed acceptable by the Co-lead Agencies); and
- Liquefied scenario (assumes all saturated contractive materials have liquefied) Factor of Safety greater than or equal to 1.10.

These minimum Factors of Safety were selected with consideration for:

- The proposed construction of the Tailings Basin on top of the existing LTVSMC Tailings Basin and the known geotechnical conditions and material characteristics of the existing facility;
- The expected characteristics of the NorthMet Project tailings and construction materials and methods, including long-term wet closure; and
- Similar industry standards and other large tailings dams in Minnesota.

298 -Page Intentionally Left Blank-



Plant Site
Tailings Basin
Proposed Buildings
Existing Building
Hydrometallurgical Residue Facility
Rock Buttress
Transportation and Utility Corridor
Cross-Section
Proposed Cement Deep Soil Mix
Existing Railroad

US Army Corps of Engineers
St. Paul District

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N W E S

0 1,000 2,000 4,000 Feet

Figure 5.2.14-4
Proposed Plant Site Layout
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

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Methodology

In order to demonstrate that the design of the Tailings Basin would meet the respective geotechnical requirements, PolyMet, in accordance with the NorthMet Geotechnical Modeling Work Plan (PolyMet 2015l, Attachment A) took the following steps:

1. Gathered existing conditions data (i.e., existing basin topography, stratigraphy, soil and tailings strength and hydraulic characteristics [see Section 4.2.14], characteristics of NorthMet tailings based on material produced during the pilot-plant processing, and other data as needed to support geotechnical modeling and Tailings Basin design).
2. Developed Tailings Basin cross sections (i.e., geometry and stratigraphy for existing and planned conditions) for the Tailings Basin for seepage and stability modeling.
3. Developed seepage and stability models using Geo-Slope International, Inc. modeling software (i.e., SLOPE/W, SEEP/W and SIGMA/W as necessary) for various construction and loading scenarios (such as various dam crest and pond surface elevations during construction and closure).
4. Established the geotechnical design data for model input including identification of hydraulic and strength parameters and the triggering potential for static and seismic events of the various tailings material types.
5. Performed modeling and results interpretation.
6. Refined the design and operating requirements necessary until modeling showed that the required slope stability Factors of Safety are achieved for the critical slope cross section.

Design

Various design specifications have been established and used for Tailings Basin geotechnical analysis (PolyMet 2015l). The following is a summary of the design characteristics applied and considered in modeling.

Preconstruction Design Considerations for Stability and Water Management

Before placement of NorthMet tailings, coarse tailings sourced from the existing LTVSMC Tailings Basin would be used to construct a drainage layer to maintain a lowered phreatic surface within the new dam. A lower phreatic surface would help to prevent saturation of the dam embankments. Additional modeling would be conducted to ascertain if this drainage layer needs to be continuous along the length of the dam, or if narrow segments of foundation material would prove to be sufficiently effective.

Rock buttresses would be placed at the northern toe of the existing Cell 2E starter dam, and at the south end of Cell 1E near the railroad fill to provide resistance to the driving forces created by the dam raises. The location of the proposed rock buttress is shown in Figure 5.2.14-4. Peat would be removed from below the rock buttress footprint before placement, so that the rock can be founded on the firmer till and bedrock. Buttress material would likely consist of waste rock sourced from the LTVSMC Area 5 Stockpile (assumed to have the same geochemical properties as Category 1 waste rock for water impact modeling purposes).

Installation of CDSM columns would also be used along the northern and northeastern sides of Cell 2E to enhance the shear strength of the existing LTVSMC fine tailings, slimes, and peat layers by mixing in situ soil with cement or other suitable stabilizing agent. The location of one proposed CDSM option is shown in plan view on Figure 5.2.14-5. A potential arrangement of CDSM that may be applied at the Tailings Basin is shown in Figure 5.2.14-5.

As described in Section 3.2.2.3.10, the Tailings Basin design includes a containment system and a storm water management system that would encompass the northern, western and eastern sides of the Tailings Basin. Storm water runoff is not expected to cause significant erosion to the dams. However, if erosion were to occur, more robust erosion control measures would be implemented. A drainage swale would be added to redirect runoff storm waters falling outside of the dams. These design features would not affect the stability of the dams (PolyMet 2015l). Precipitation that falls within the Tailings Basin would be contained by a freeboard that has been designed based on the predicted bounce from a PMP event (PolyMet 2015n). Overflow would be prevented by pumping excess pond water to the WWTP. In the rare event that freeboard within the Tailings Basin, and pumping of excess water to the WWTP, is not sufficient to contain all storm water, water would be directed to an emergency overflow spillway.

A seismic hazard assessment and subsequent liquefaction analysis was undertaken for the Tailings Basin. Results indicated that a significant earthquake is unlikely in Minnesota, and a seismic design event with a peak ground acceleration of 0.024g (2,475 year return period) is not likely to trigger liquefaction in the Tailings Basin materials. Seismic deformation was also considered and the effect of settlement resulting from a design earthquake event would not affect the stability or pond containment of the Tailings Basin.

NorthMet Tailings Basin Design and Construction

The Tailings Basin would be constructed using the upstream method, whereby NorthMet dam embankments would be constructed using preferentially borrowed LTVSMC tailings on top of the existing LTVSMC tailings embankment and on the spigotted tailings adjacent to the perimeter embankment. NorthMet bulk tailings would be discharged into the new basin by perimeter spigots and a pond barge pump. New dam embankments (using LTVSMC Bulk tailings) would be raised in stages on top of the existing LTVSMC tailings impoundment, and the new tailings are deposited upstream of the dam into the basin from spigots at the dam's edge. Tailings would also be discharged subaqueously in the basin via a barge.

The Tailings Basin incorporates construction of new dam embankments over the existing LTVSMC Tailings Basin Cells 1E and 2E. The design process is an iterative approach whereby various combinations of stabilization factors including slope angle, lift heights, intermediate slope bench width, drainage layers beneath the proposed NorthMet tailings, CDSM, and supporting rock buttresses were modeled to identify a design that would achieve the following:

- Provide safe permanent storage of tailings generated over the proposed 20-year operating life of the NorthMet Project Proposed Action and maintain stability post-closure;
- Efficiently and effectively recover process water from the surface of the Tailings Basin during operation, and contain groundwater and surface water seepage during operation and over the long term (refer to Section 5.2.2 for more information on water management);
- Accommodate the planned wet cover system at closure; and
- Meet project regulatory requirements (including Factors of Safety).

As shown in Figure 5.2.14-6, Figure 5.2.14-7, and Figure 5.2.14-8 the proposed design consists of eight lifts with a proposed final crest elevation (selected on the basis of tailings storage capacity requirements) modeled as 1,732 ft amsl. This would be an additional 150 ft on top of the existing LTVSMC Tailings Basin Cell 2E. This proposed elevation is similar to the elevation of the existing north dam of Cell 2W, which is at a designed final elevation of 1,735 ft amsl. A schematic cross section of the Tailings Basin is shown in Section 3.2.2.3.5.

The proposed dams would be constructed from mechanically placed and compacted "bulk tailings" taken from the existing LTVSMC Tailings Basin as needed to produce the desired dam lift height and geometry. LTVSMC "bulk tailings" are currently defined as a mixture of tailings from the existing LTVSMC Tailings Basin. The exterior face of the dams would be augmented with a bentonite layer to limit oxygen and rain water infiltration into the Tailings Basin.

The individual lifts would have a slope of 4.5H:1V, which, including setbacks, would provide for an overall slope of approximately 8.6H:1V. Each lift would be 20 ft high, with the exception of the final lift, Lift 8, which would be 10 ft in height. There is a 60-ft bench on top of each lift, with an additional 200-ft setback on top of Lift 4, and a 625-ft beach extending from the interior crest of dam to the edge of the Tailings Basin pond.

Closure of the Tailings Basin

As dams are constructed, exterior slopes would be covered with bentonite and vegetated. Upon reaching the final proposed dam elevation (after 20 years of operation), the Tailings Basin would be closed in accordance with *Minnesota Rules* 6132.3200 and would also include the following:

- Bentonite augmentation of the pond area bottom to reduce infiltration to a sufficient degree to maintain desired pond water elevations at closure;
- Slight slope grading of the interior portions for effective storm water routing into the pond area;
- Bentonite augmentation of the exposed embankments and beach areas; and
- Mulching and planting/seeding of native vegetation of upland areas (plants would be selected and monitored to limit root growth from penetrating bentonite).

Monitoring and maintenance measures that would be applied post closure are further addressed below and additional details on closure are provided in Section 3.2.2.3.12.

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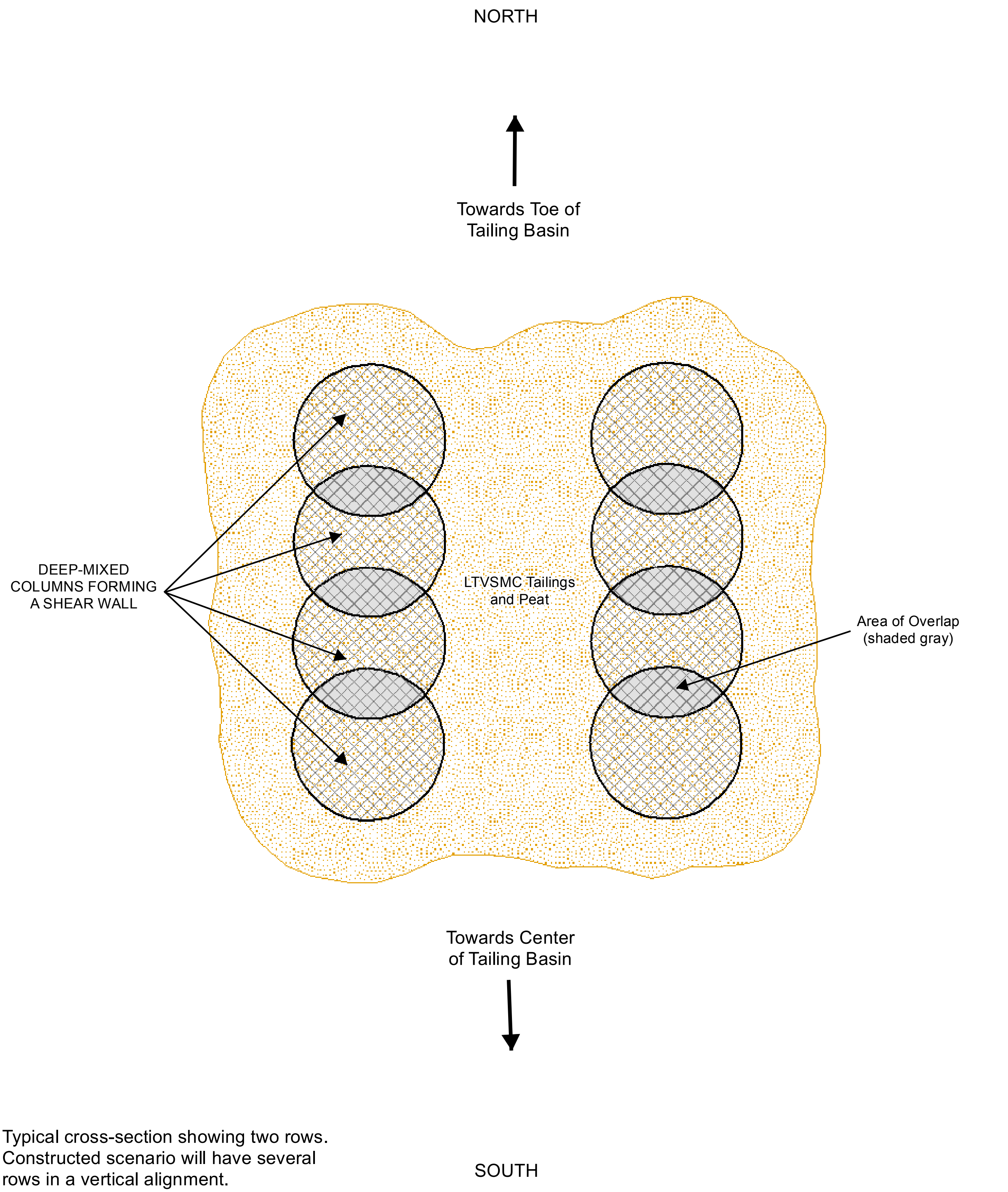

Typical cross-section showing two rows.
Constructed scenario will have several
rows in a vertical alignment.

NOT TO SCALE

Figure 5.2.14-5
Potential Cross-section of Cement Deep Soil Mixed Columns Forming a Shear Wall
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Minnesota

June 2015

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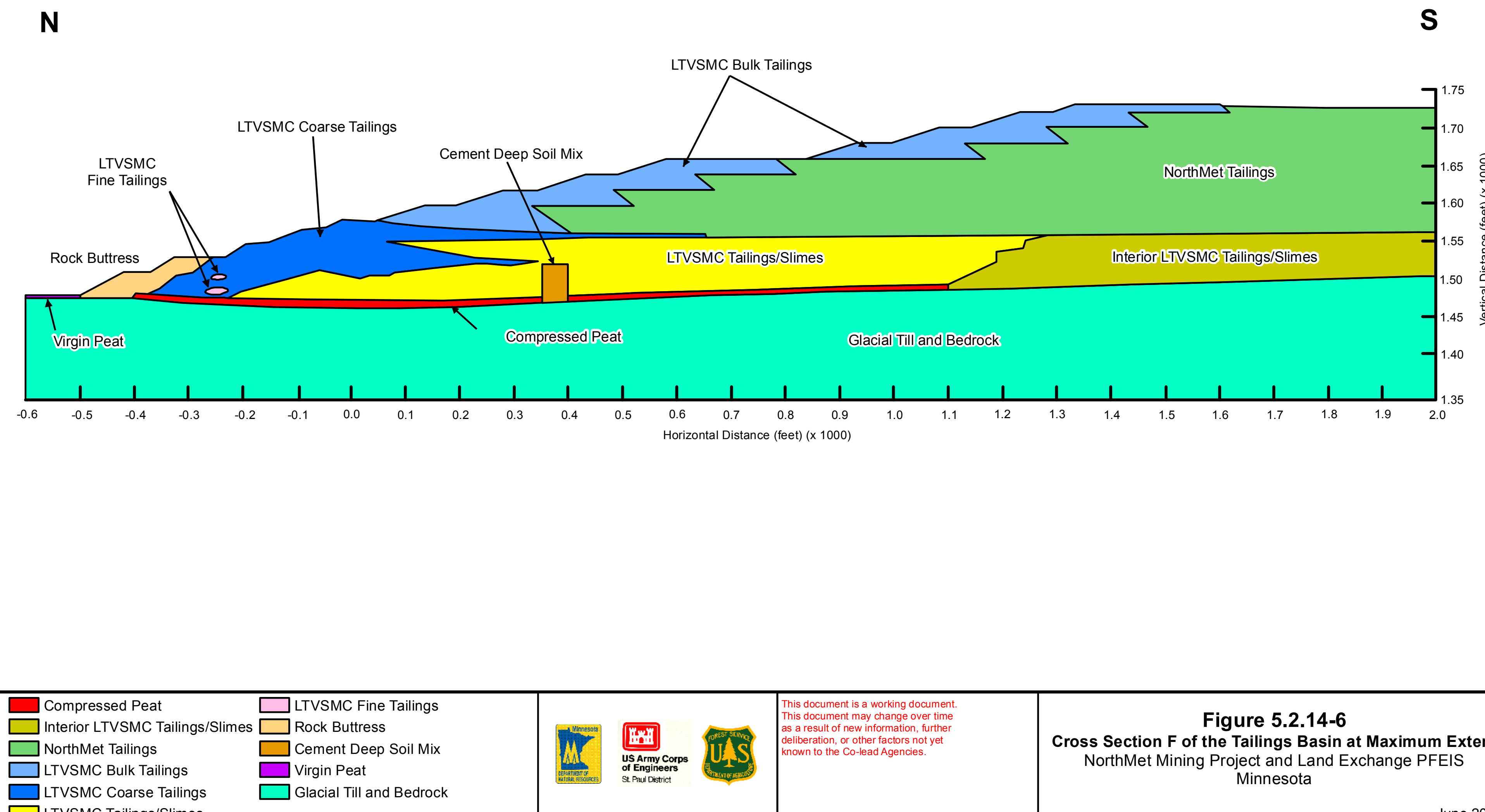

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Figure 5.2.14-6
Cross Section F of the Tailings Basin at Maximum Extent
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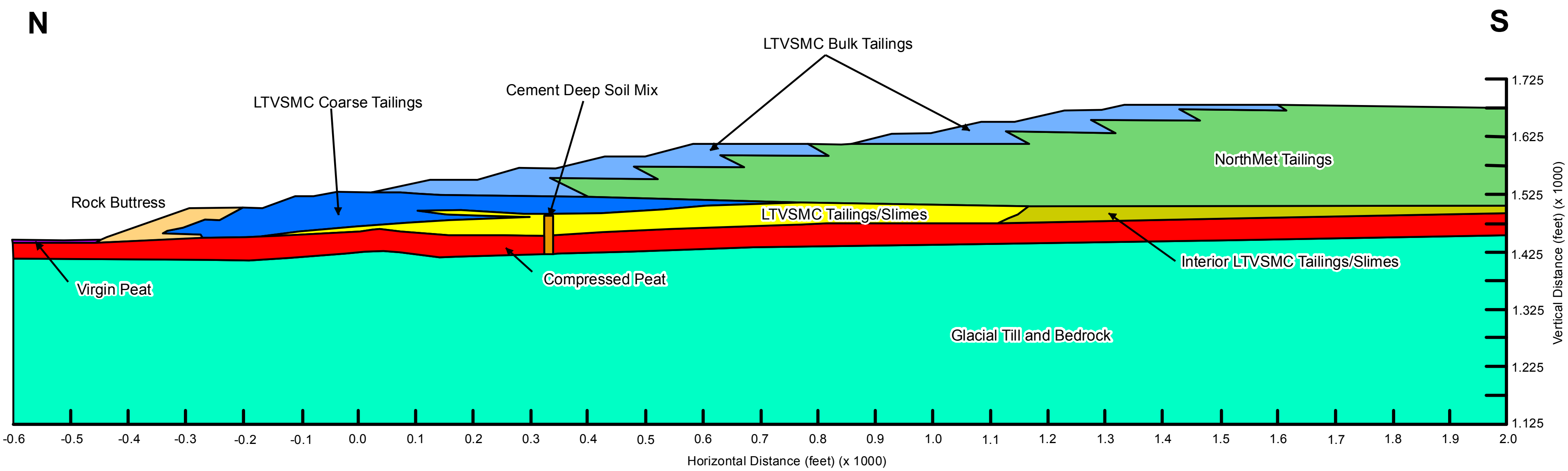
June 2015

418 -Page Intentionally Left Blank-



Compressed Peat
Interior LTVSMC Tailings/Slimes
NorthMet Tailings
LTVSMC Bulk Tailings
LTVSMC Coarse Tailings
LTVSMC Tailings/Slimes
Rock Buttress
Cement Deep Soil Mix
Virgin Peat
Glacial Till and Bedrock

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Figure 5.2.14-7
Cross Section G of the Tailings Basin at Maximum Extent
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June 2015

420

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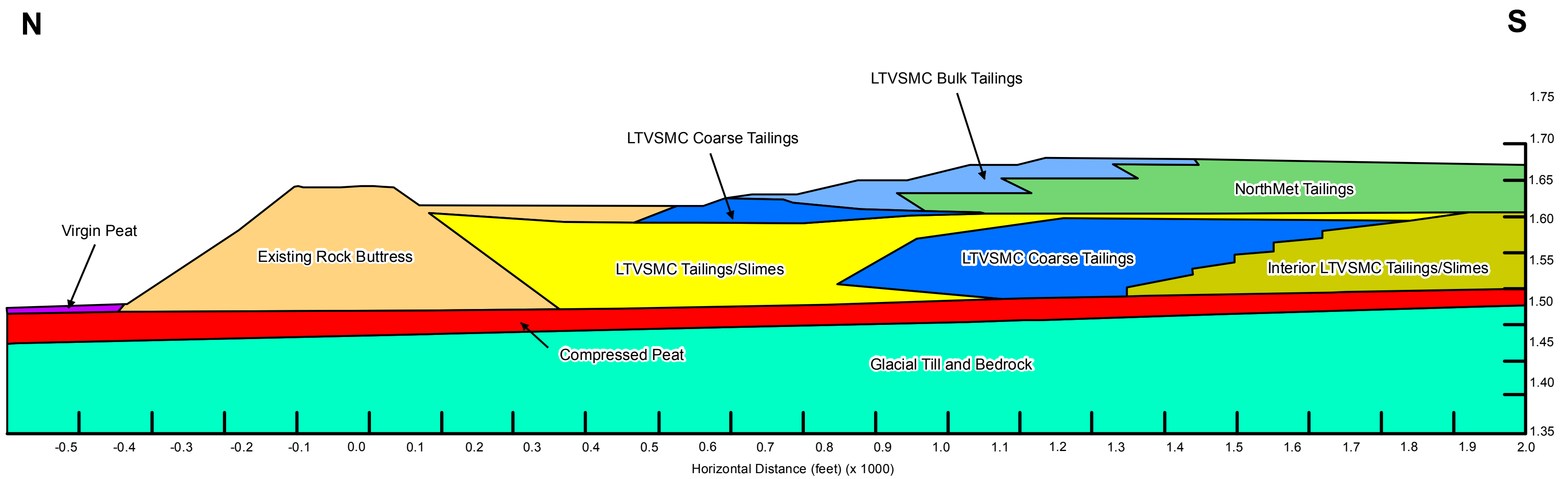

Compressed Peat	LTVSMC Tailings/Slimes
Interior LTVSMC Tailings/Slimes	Existing Rock Buttress
NorthMet Tailings	Cement Deep Soil Mix
LTVSMC Bulk Tailings	Virgin Peat
LTVSMC Coarse Tailings	Glacial Till and Bedrock

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St. Paul District

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Figure 5.2.14-8

Cross Section N of the Tailings Basin at Maximum Extent

NorthMet Mining Project and Land Exchange PFEIS

Minnesota

June 2015

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Identification of the Critical Cross Section

Geotechnical conditions along the length of existing LTVSMC Tailings Basin dams have varying layers of coarse tailings, fine tailings, and slimes. Cross Section F, which intersects the northern dam of Cell 2E, as shown in Figure 5.2.14-4, was selected to represent the critical cross section for stability analysis purposes as it is the maximum section based on height as measured from the downstream toe to the proposed final crest, some layers of the weaker fine tailings and slimes extend close to the dam, and the original starter dam lower existing tailings is underlain by peat. Material types identified from borings in the existing LTVSMC Tailings Basin along Cross Section F are shown in Figure 4.2.14-3. Figure 5.2.14-6 shows the proposed design of the NorthMet Project Proposed Action Tailings Basin along Cross Section F at its full extent.

Cross Section F was analyzed in a sequential manner consisting of the development of the dam cross section stratigraphy for analyses, application of the material strength and permeability characteristics, and modeling of seepage conditions at the dam cross section, followed by stability analyses.

Cross Section F also was evaluated with the Tailings Basin at the proposed final crest height to determine whether liquefaction would be triggered in the contractive materials, based on certain triggers prescribed in the NorthMet Geotechnical Modeling Work Plan (PolyMet 2015l, Attachment A).

In addition to Cross Section F, Cross Section G and N were selected to represent separate, non-critical sections of the Tailings Basin. These cross sections are shown in plan view on Figure 5.2.14-4. Figures 5.2.14-7 and 5.2.14-8 show the proposed design of the NorthMet Project Proposed Action Tailings Basin along Cross Sections G and N at their full extent respectively. Stability modeling was also performed for these cross sections as described below.

Modeling Results

The results reported in Geotechnical Data Package Volume 1 indicate that the proposed design of the Tailings Basin would meet all respective Factors of Safety as required (PolyMet 2015l). The modeling undertaken and results obtained are summarized below. Subsequent to Geotechnical Data Package Volume 1, PolyMet evaluated the effect that the Tailings Basin groundwater containment system would have on stability. Results indicated that the groundwater containment system would not impact the stability of the Tailings Basin or the Factor of Safety results for Cross Sections F, G, and N determined in Geotechnical Data Package Volume 1 and provided below (PolyMet 2015l). All minimum Factors of Safety correspond to Cross-Section F, confirming that it is the critical cross-section given the analyses performed.

Technical documents have been reviewed by the Co-lead Agencies and these results would be further verified before the completion of permitting.

Slope Stability

The predicted Factor of Safety values for Cross Sections F, G and N at various stages of development of the Tailings Basin are summarized in Table 5.2.14-1. The geometry and physical changes to the embankments (such as CDSM) were incorporated into the design so that all computed slope stability Factors of Safety met or exceeded the Factors of Safety required by the NorthMet Geotechnical Modeling Work Plan (PolyMet 2015l, Attachment A).

Table 5.2.14-1 Summary of Stability Modeling Results

Cross-Section Location	Cross-Section F			Cross- Section G			Cross-Section N		
Case	USSA yield	ESSA	USSA liq	USSA liq	ESSA	USSA liq	USSA yield	ESSA	USSA liq
Target Factor of Safety	1.3	1.5	1.1	1.3	1.5	1.1	1.3	1.5	1.1
Design Scenarios – Steady State Seepage									
Existing Conditions	-	1.83	-	-	2.21	-	-	3.11	-
Interim Lift 2	1.89	3.12	-	2.28	3.43	-	-	-	-
Interim Lift 4	1.74	3.18	-	2.09	3.42	-	-	-	-
Interim Lift 6	1.88	3.18	-	1.93	3.43	-	1.88	4.43	-
Interim Lift 8 – Normal Pool	1.69	3.17	-	1.86	3.44	-	2.00	4.58	-
Interim Lift 8 – PMP Event	1.77	3.18	-	1.85	3.46	-	1.91	4.34	-
Long-Term Stability – Steady State Seepage									
End of Operations	-	3.07	-	-	-	-	-	-	-
20 Years after Closure	-	3.09	-	-	-	-	-	-	-
200 Years after Closure	-	3.21	-	-	-	-	-	-	-
2,000 Years after Closure	-	3.15	-	-	-	-	-	-	-
Cross-Section F Liquefaction Triggering Analysis									
Baseline	2.06	-	-	-	-	-	-	-	-
Plugged Drain	2.06	-	-	-	-	-	-	-	-
Lift 1 Rapid Loading	-	-	1.78	-	-	-	-	-	-
Erosion	1.99	-	-	-	-	-	-	-	-
Plugged Drain	1.91	-	-	-	-	-	-	-	-
Fully Liquefied with Unknown Trigger									
Operations	-	-	1.10	-	-	1.25	-	-	1.16
20 Years after Closure	-	-	1.35	-	-	-	-	-	-
200 Years after Closure	-	-	1.45	-	-	-	-	-	-
2,000 Years after Closure	-	-	1.53	-	-	-	-	-	-

Source: PolyMet 2015l

USSA = Undrained Strength Stability Analysis
ESSA = Effective Strength Stability Analysis
Liq = Liquefied conditions
Yield = point of elastic deformation

Liquefaction

The potential for liquefaction, where a triggering event changes the stress state of the material such that it loses a significant amount of its strength, was assessed under different scenarios, including rapid loading and construction, ineffective underdrain resulting in increased saturation, and erosion events. Results shown in Table 5.2.14-1 indicate that the design under these conditions meets the minimum Factor of Safety for Cross Sections F, G, and N.

A scenario for potential liquefaction was evaluated whereby all contractive, saturated soils were modeled with their liquefied shear strengths. Table 5.2.14-1 shows that if the contractive, saturated soils were to liquefy at the end of operations, or 20, 200, or 2,000 years after operations, the design would meet the minimum Factors of Safety deemed acceptable by the Co-lead Agencies.

Potential for seismic activity was also analyzed and assessed. Results indicated that there is a very low likelihood of liquefaction as a result of seismic events.

Long-Term Closure Stability Conditions

While it is normally preferable from a stability perspective to allow tailings facilities to drain following closure, the NorthMet Project Proposed Action involves maintaining a pond on top of the Tailings Basin for water quality management purposes.

The Tailings Basin would be covered with a bentonite-amended surface on the exterior face of the NorthMet Project dam lifts (amended during construction). After the Tailings Basin has been filled to its maximum height, the dam would be prepared for reclamation by amending the 625-ft beach of tailings and the bottom of the pond with bentonite. A closure overflow channel would be constructed to drain excess water from the Tailings Basin pond in order to maintain appropriate freeboard and beach lengths.

Modeling was undertaken to predict the long-term stability of the Tailings Basin. As shown in Table 5.2.14-1, the long-term closure slope stability Factors of Safety are above the minimum value required under the Work Plan.

Proposed Monitoring

Geotechnical investigations would be performed on the Tailings Basin during construction and operations to confirm that the construction and performance of the dam meet design criteria. Results may inform adaptive design changes to ensure stability criteria would be met as construction progresses. This approach is typical for large earthen structures that are developed incrementally over long periods of time.

A Flotation Tailings Management Plan (PolyMet 2015n) has been prepared by PolyMet that includes a description of the operating plans, monitoring procedures, and adaptive management approaches for the Tailings Basin. Monitoring activities include construction material sampling, geotechnical instrumentation, geotechnical investigations, and systematic dam safety inspections.

Existing and proposed geotechnical instrumentation would measure actual tailings dam performance by monitoring stability, seepage, and deformation. Monitoring instrumentation relevant to geotechnical stability would include:

- **Piezometers** to facilitate monitoring of the pore water pressure within the Tailings Basin and perimeter dams (the phreatic surface has a significant effect on slope stability), which would be compared to modeled phreatic surface.

- **Inclinometers** to facilitate monitoring of the movement of the Tailings Basin dams.
- **Survey monitoring points** to facilitate the monitoring of horizontal and vertical deformation (including settlement) of the Tailings Basin dams.

Geotechnical investigations and systematic dam safety inspections would include:

- Staff observation of the condition of the dam and the reporting of any conditions that indicate a departure from the design specifications.
- Weekly/daily routine dam inspections by staff to observe the conditions and performance of the Tailings Basin dams and associated facilities so that any changes to dam conditions could be identified and promptly addressed. These would supplement more detailed Dam Safety Inspections (below).
- Regulator Dam Safety Inspections to evaluate, on a regular basis, the current and past performance of the Tailings Basin dams and to observe potential deficiencies in their condition, performance, and/or operation.
- Semi-annual Dam Safety Inspections undertaken by an independent Minnesota-registered consulting engineer retained specifically for dam safety expertise.
- Inspection after unusual events to monitor and report observations.
- Routine Dam Safety Reviews every 5 years by a qualified geotechnical engineer registered in the State of Minnesota. The review would ascertain that the dam has an adequate margin of safety, based on the current Dam Safety Permit, current engineering practice, and updated operations and design input data. A Dam Safety Review may also be carried out to address a specific problem.

Annual reports on the conditions of the Tailings Basin are required under the MDNR Dam Safety Permit and Permit to Mine. Monitoring and maintenance would continue post closure in accordance with permit requirements.

Proposed Maintenance and Mitigation

Typical maintenance of the facility would include repairing eroded surfaces and repair and/or replacement of damaged monitoring and operational infrastructure. The majority of the non-mechanical maintenance work at the Tailings Basin would be carried out on an as-required basis, rather than on a scheduled basis because it is driven by weather events rather than hours of operation.

Where monitoring or model updates indicate that the Factor of Safety for the Tailings Basin may no longer meet design criteria, appropriate modifications to the Tailings Basin would be considered, modeled, and, if necessary, undertaken. Modifications could include but are not limited to: modification of bench widths between lifts of the dam, modification of lift heights, and modification of slope angles. Other modifications could include increasing the size of the rock buttress, improving the performance of underdrains, and increasing mid-slope setbacks.

A Contingency Action Plan has been prepared as part of the Flotation Tailings Management Plan (PolyMet 2015n). The plan provides guidance to on-site personnel and emergency responders in the case of unplanned occurrences at the Tailings Basin. The plan defines three levels of hazardous and emergency conditions response:

1. Level 1 is defined as unusual conditions that do not warrant an emergency response but require prompt investigation and resolution.
2. Level 2 is defined as conditions that represent a potential emergency, if sustained or allowed to progress, but no emergency situation is imminent. The first action in the event of a Level 2 emergency condition is to discuss and define a response plan.
3. Level 3 is defined by either imminent failure of the Tailings Basin or a significant component thereof. The first actions in the event of any Level 3 condition are to check all persons who could potentially be affected are safe, initiate the appropriate chain of communications, and immediately undertake appropriate response actions.

Long-term maintenance tasks at the Tailings Basin would include:

- Annual inspection of vegetation on the exterior dam faces and interior beaches, with erosion repaired and vegetation reseeded in accordance with requirements of plans as needed until released from these activities by the MDNR;
- Snow removal from the dam crest to allow access during winter months;
- Reconstruction of eroded dam crest, slope or toe;
- Mulching for fugitive dust control in accordance with requirements of plans; and
- Repair and/or replacement of damaged instrumentation and monitoring.

5.2.14.2.3 Hydrometallurgical Residue Facility

As shown in Figure 5.2.14-4, hydrometallurgical residue would be disposed of in a new Hydrometallurgical Residue Facility that would be located at the site of the existing LTVSMC Emergency Basin, adjacent to the southern extent of existing LTVSMC Tailings Basin Cell 2W.

The data inputs, modeling methodology, results, and design and operating requirements for the Hydrometallurgical Residue Facility were reported in Geotechnical Data Package Volume 2 (PolyMet 2014c) and reviewed by the Co-lead Agencies. The information provided in the data package informs the permitting process and is summarized below.

Design Criteria

The design of the Hydrometallurgical Residue Facility must meet the applicable requirements of *Minnesota Rules* 6115.0300 through 6115.0520 and the requirements of the NorthMet Geotechnical Modeling Work Plan (PolyMet 2015l, Attachment A) which include the following:

- The ability of the most sensitive slope cross section to meet a global slope stability Factor of Safety of 1.5;
- The ability of the composite liner system to comply with infinite slope stability Factor of Safety of 1.5, and
- The capability of the composite liner system to withstand the longitudinal strain anticipated due to differential settlement that may occur in the facility foundation materials.

Methodology

PolyMet took the steps listed below in order to demonstrate that the design of the Hydrometallurgical Residue Facility would meet the respective geotechnical requirements and would be in accordance with the NorthMet Geotechnical Modeling Work Plan (PolyMet 2015l, Attachment A):

1. Gathered existing conditions data (i.e., facility foundation material stratigraphy and strength data, hydrogeological data, characteristics of NorthMet Project Proposed Action residues based on those produced during the pilot-plant processing, and other data as needed to support geotechnical modeling of the Hydrometallurgical Residue Facility) (see Section 4.2.14).
2. Developed residue facility layout and cross sections (i.e., geometry and stratigraphy for existing and planned conditions) for proposed residue facility stability and deformation modeling.
3. Developed seepage and stability models using Geo-Slope International, Inc. modeling software (i.e., SLOPE/W, SEEP/W and SIGMA/W as necessary) for maximum facility dam height with minimum and maximum pond elevation, and post-closure – cover effective with minimum pond elevation.
4. Established the geotechnical design data for model input including identification of strength parameters and the triggering potential for static and seismic events.
5. Ran the models to determine Factors of Safety, and the potential for slope failure and deformation of the foundation and liner.
6. Refined the design and operating requirements necessary to maintain required slope stability Factors of Safety and deformation requirements for the critical slope cross section.

Design

Various design specifications have been established and used for the Hydrometallurgical Residue Facility geotechnical analysis (PolyMet 2014c). The following is a summary of the design characteristics applied and considered in modeling.

Preconstruction Design Considerations for Stability and Water Management

The proposed Hydrometallurgical Residue Facility would be located on top of the existing LTVSMC Emergency Basin, and would include a double liner and leakage collection system. To prevent stress deformation and strain on the liner system, the emergency tailings would be consolidated by applying a preload fill material on top of the emergency tailings to achieve the required consolidated conditions prior to construction of the Hydrometallurgical Residue Facility.

To achieve this, PolyMet would perform the following tasks:

1. Install a granular drainage layer at the existing LTVSMC Emergency Basin, as needed to facilitate wick drain installation and operation;
2. Install wick drains (if required); and

3. Place, monitor, and remove a preload fill in the existing LTVSMC Emergency Basin to pre-consolidate existing material, thereby reducing future anticipated settlements to mitigate the potential future strains.

In addition to consolidation of the existing LTVSMC emergency tailings, a railroad grade would also be abandoned and removed to facilitate construction.

Seeps have been observed along the southern edge of the LTVSMC Tailings Basin Cell 2W. These seeps have diminished since the termination of the LTVSMC operations and are expected to remain minimal as Cell 2W is not proposed for use as part of the NorthMet Project Proposed Action. The design of the Hydrometallurgical Residue Facility includes a collection drain that would collect water from the seep below the proposed constructed embankment and liner systems to transmit the collected seep to the exterior of the facility. This seepage collection system would consist of a layer of free draining soil which would reduce the potential for phreatic build-up below the liner.

The double liner and collection system would be installed with the following components, listed in order from top to bottom:

1. Upper geomembrane;
2. Geocomposite (geonet) (for leakage collection and recovery);
3. Lower geomembrane; and
4. Geosynthetic clay liner.

PolyMet initiated laboratory testing to consider the chemical compatibility of the potential geosynthetic liner to be used with leakage from residue (PolyMet 2014r). Results indicated that a polymer-treated geosynthetic liner should be used that is manufactured specifically in anticipation of the chemical characteristics of the liquid and the pore water that would be contained within the facility. The hydraulic conductivity of the leakage collection system is not expected to degrade over time. Typical liner performance assumes a 500 year service life of the geomembrane, therefore, hydraulic conductivity of the liner is not expected to degrade over that time. Specific attributes would be determined during the geosynthetic clay layer development to achieve the desired performance before final installation.

As noted in Section 4.2.14.3.4, the Minnesota Geological Survey has inferred but not confirmed the presence of a north-south trending fault that would underlie the proposed Hydrometallurgical Residue Facility. The potential presence of faults within the footprint of the Hydrometallurgical Residue Facility is not anticipated to have a negative impact on the storage of residue within the double lined facility. A probabilistic seismic hazard analysis was done for the Hydrometallurgical Residue Facility. Results indicated that a severe earthquake is highly unlikely in Minnesota, and any seismically induced forces would not likely affect the stability of the Hydrometallurgical Residue Facility.

Hydrometallurgical Residue Facility Design and Construction

The Hydrometallurgical Residue Facility has been designed as a single cell structure with a design capacity of 6,400,000 cubic yards. The perimeter would have an irregular shape consisting of the north dam (a portion of the existing southern LTVSMC Tailings Basin Cell 2W dam), natural high ground, and new dams (see Figure 5.2.14-4). New dams would be located beyond the extent of the LTVSMC Emergency Basin and founded on existing silty sand, gravel glacial till, and Giants Range granite.

The maximum height of the proposed dams is approximately 85 ft, with a crest elevation of 1,650 ft amsl and an additional 3-ft minimum freeboard (14-ft maximum freeboard at a residue surface slope of 0.5 percent). The exterior, downstream face of the dam would be constructed at a slope of 4H:1V) The interior of the Hydrometallurgical Residue Facility would be sloped at 4H:1V and 30-ft horizontal benches would be placed at elevations of 1,600 and 1,630 ft amsl.

The dams would be constructed using downstream construction methods that involve constructing a smaller starter dam first and then raising the dam upward and outward over the downstream shell of the dam as additional capacity is needed. Construction material would be sourced from natural soil and quarried bedrock between the high ground and south dam. Some LTVSMC coarse tailings may also be utilized for dam construction. While the material is placed, it would be compacted to the design density.

Materials placed in thin, well-compacted lifts, such as those proposed for the Hydrometallurgical Residue Facility embankment fill, are understood to be sufficiently dense so that liquefaction is not anticipated under the various loading conditions, including the design earthquake event with a peak ground acceleration of 0.024g (2,475 year return period). Although liquefaction of the hydrometallurgical residue (within the basin) may occur, the embankment dam is sufficiently designed so that containment would not be lost. Therefore, the integrity of the facility would not be impacted by the loss of strength associated with potential residue liquefaction.

Closure of the Hydrometallurgical Residue Facility

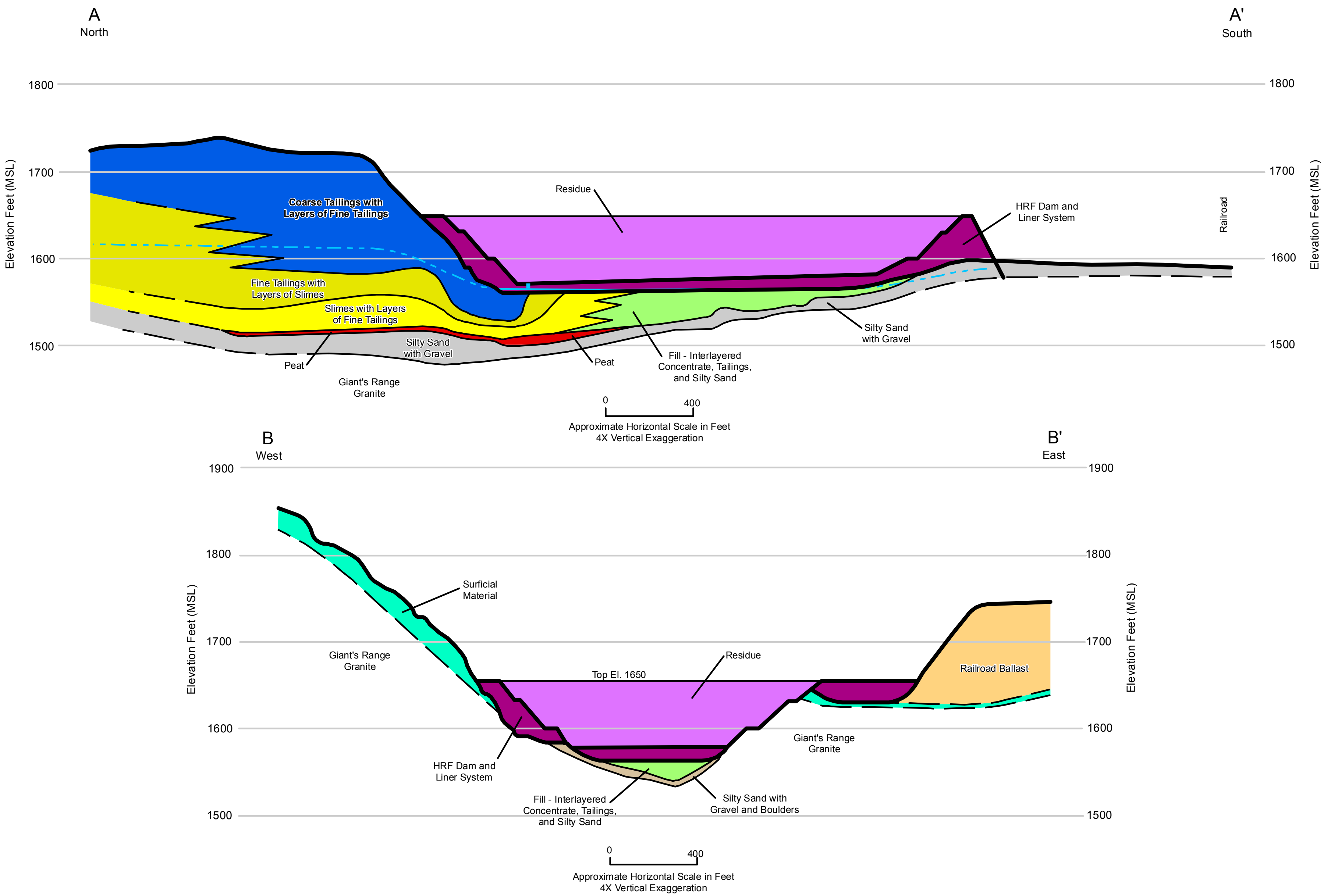
Reclamation of the Hydrometallurgical Residue Facility would include removal of ponded water, removal of pore water from the residue, construction of the cover system, and establishment of vegetation and surface water runoff controls.

Turf and final cover would be inspected and maintained by mowing once per year or as needed, fertilizing when visual inspection indicates poor vegetation growth, and implementing repairs. Additional information relating to closure of the Hydrometallurgical Residue Facility is provided in Section 3.2.2.3.12.

Identification of the Design Cross Section

Cross Section A, depicted in Figure 5.2.14-4, has been identified as the design cross section. It approximates the base of a former ravine, beginning south of the future south dam and terminating near the crest of the Hydrometallurgical Residue Facility north dam. It is considered as the design cross section, as it incorporates the thickest sections of LTVSMC slimes. Fine tailings and slimes in the Emergency Basin are the thickest at approximately 50 ft located 280 ft away from the toe of the south dam of Cell 2W. A cross section of the Hydrometallurgical Residue Facility at its maximum extent along cross sections A and B is shown in Figure 5.2.14-9.

The global slope stability discussed below was assessed along Cross Section A.



Coarse Tailings with Layers of Fine Tailings
Fill - Interlayered Concentrate, Tailings, and Silty Sand
Fine Tailings with Layers of Slimes
Slimes with Layers of Fine Tailings
Peat
Railroad Ballast
Residue
Silty Sand with Gravel
Silty Sand with Gravel and Boulders
HRF Dam and Liner System
Surficial Material

Minnesota Department of Natural Resources

US Army Corps of Engineers
St. Paul District

Forest Service U.S. Department of Agriculture

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Figure 5.2.14-9
Cross Sections A and B of the Hydrometallurgical Residue Facility at Year 20
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

709

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Modeling Results

The results reported in Geotechnical Data Package Volume 2 indicate that the proposed design of the Hydrometallurgical Residue Facility would meet all respective Factors of Safety as required (PolyMet 2014c). The modeling undertaken and results are summarized below.

Stress Deformation and Strain in the Liner System

A preload would be placed on the existing LTVSMC Emergency Basin to consolidate the foundation materials before construction of the Hydrometallurgical Residue Facility. Wick drains may be used to help accelerate the consolidation time by increasing the effective hydraulic conductivity of the tailings due to decrease in flow path length. Some portion of this load would be removed before construction, and the remaining material would be graded to provide sufficient drainage slope and provide a suitable foundation material for the facility. The material would rebound a small amount after the preload is removed. The aggregate settlement at a representative location within the Emergency Basin, considering the maximum anticipated tailings thickness in the foundation, is computed to be 3.9 ft. The material at this location is modeled to consolidate an additional 1.4 ft by the end of operations of the Hydrometallurgical Residue Facility.

Residue consolidation within the basin is modeled as beginning after the cessation of residue discharge to the Hydrometallurgical Residue Facility. Over time, the rate of consolidation would decrease with the greatest amount of consolidation occurring before pore-water pressure reaches hydrostatic equilibrium (approximately 10 years following closure). Total settlement in areas with the greatest depth of residue is estimated to be on the order of 9.6 ft. As the depth of residue decreases near the edge of the Hydrometallurgical Residue Facility, less settlement would occur. The resulting deformed surface of the Hydrometallurgical Residue Facility would be concave with the greatest deformation in areas of greatest residue thickness.

Strain in the Hydrometallurgical Residue Facility liner system would result from differential settlement in the facility foundation between points along the liner. The maximum strain in the liner system is estimated to be 0.20 percent. This value is well within acceptable limits of most geosynthetics, which range from 1 to 19 percent.

Global Slope Stability

Analysis of the new dams (i.e., those not supported by the existing LTVSMC Tailings Basin or natural topography) at their greatest height (at year 20) resulted in a computed Factor of Safety for the ESSA of 2.32, which is greater than the required minimum of 1.5. Because the friction angle for the dam fill material (approximately 30 degrees) is greater than the proposed dam downstream slope angle (18 degrees), significant surficial slope failures are not expected.

Liquefaction analysis was not applicable and not performed because the material proposed in the constructed dams would be well-compacted and the Hydrometallurgical Residue Facility liner system would limit leakage through the dams. Therefore, the embankment is not anticipated to be saturated during and after operations.

Infinite Slope Stability

The components of the double liner system are designed to act as hydraulic barriers to leakage; not as structural members of the dam system. Therefore, the liner layers must not be allowed to slide relative to one another. Evaluation of this potential for sliding was performed using infinite slope stability analyses. The minimum infinite slope stability Factor of Safety for all Hydrometallurgical Residue Facility liner system components is 1.5.

The interior slope angle for the Hydrometallurgical Residue Facility and the geosynthetic materials of the liner that would directly contact the underlying soils used for dam construction must be selected to produce a stable liner system—a system that would not slide down-slope during operations. In addition, each successive layer of the liner system must have an adequate interface-friction angle with the adjacent layer to prevent down-slope movement of any layer of the liner system. Infinite slope stability for the liner system layer interface configurations currently expected is shown in Table 5.2.14-2. Computed Factors of Safety shown in Table 5.2.14-2 are based on commonly reported interface friction angles between the materials anticipated to be used for the Hydrometallurgical Residue Facility liner. Any variation from the anticipated material types warrants project-specific interface shear testing to confirm that the friction angles are equal to or greater than those used in this analysis.

Shear failure in the geosynthetic clay/geomembrane liner systems would occur at the interface with the lowest peak shear strength. On the basis of the interface friction angles used in the analysis, the design proposed for the Hydrometallurgical Residue Facility achieves a computed Factor of Safety of 2.94.

Table 5.2.14-2 Infinite Slope Stability Analysis Results for the Hydrometallurgical Residue Facility

Interface Number	Material Types	Slope Angle, (deg)	Predicted friction Angle, (deg)	Minimum required Factor of Safety	Predicted Factor of Safety
4	Textured Geomembrane above Geocomposite Drainage Net	15.95	28	1.5	1.86
3	Geocomposite Drainage Net above Textured Geomembrane	15.95	28	1.5	1.86
2	Textured Geomembrane above Geosynthetic Clay Liner	15.95	28	1.5	1.86
1	Geosynthetic Clay Liner above Granular Soil	15.95	24	1.5	1.56

<u>Proposed Monitoring, Maintenance, and Mitigation</u>

A Hydrometallurgical Residue Management Plan (PolyMet 2014r) prepared by PolyMet includes a description of the operating plans, monitoring procedures, and adaptive management approaches for the Hydrometallurgical Residue Facility.

Monitoring and maintenance for the Hydrometallurgical Residue Facility would be similar to that discussed for the Tailings Basin at the end of Section 5.2.14.2.2 above.

Construction quality control and assurance would occur throughout construction of the Hydrometallurgical Residue Facility, beginning with regulatory agency review and approval of the construction quality control and assurance plan. A Construction Quality Assurance Manual template for the installation of the soil and geosynthetic components of liner and cover systems has been drafted to addresses QA/QC procedures for earthwork, geomembrane and geosynthetic clay liner installation, and piping components of the HRF double liner and leakage collection system, drainage collection system, and cover system (PolyMet 2014r). Upon completion of construction, a construction documentation report would be prepared to document that construction of the Hydrometallurgical Residue Facility was completed in conformance with regulatory agency permit requirements.

A Contingency Action Plan has been prepared as part of the Residue Management Plan (PolyMet 2014r). The plan provides guidance to on-site personnel and emergency responders in the case of unplanned occurrences at the Hydrometallurgical Residue Facility.

5.2.14.3 NorthMet Project No Action Alternative

Under the No Action Alternative, no waste rock stockpiles, or expanded Tailings Basin, or Hydrometallurgical Residue Facility would be created. The existing geotechnical conditions are discussed in Section 4.2.14. The existing LTVSMC Tailings Basin as discussed in Section 4.2.14 would remain at the site and monitoring and inspection would continue under the LTVSMC site closure plan and the MDNR Dam Safety regulations.

798 -Page Intentionally Left Blank-

5.3 LAND EXCHANGE

5.3.1 Land Use

The Land Exchange Proposed Action represents a transfer of surface rights of 6,495.4 acres from the Superior National Forest to PolyMet to eliminate the conflict between federal surface and private mineral estate. This action would remove those acres from Superior National Forest management and public use. The Land Exchange Proposed Action would remove these acres, which are part of the 1854 Ceded Territory, from lands available to the Bands to exercise reserved 1854 Treaty rights. Given the existing lack of overland public access and the current and historic use of the federal lands for mineral exploration (see Section 4.2.9), the Land Exchange Proposed Action represents little to no change in the actual level of recent or current use of the federal lands. At the same time, the Land Exchange Proposed Action brings as many as 7,075.0 acres of private land into the public domain, making it available for the Bands to exercise 1854 Treaty rights (see Section 4.3.9).

When compared with the Land Exchange No Action Alternative, the Land Exchange Proposed Action and the Land Exchange Alternative B would provide a slight improvement in key indicators described in Section 5.3.1.1. The Land Exchange Proposed Action provides for more of an improvement in overall indicators than under the Land Exchange Alternative B. The Land Exchange Proposed Action and the Land Exchange Alternative B are both compatible with adjacent zoning and management area designations.

There is no current legacy contamination on the non-federal parcels. Past legacy contamination concerns are discussed in Section 4.3.1.

5.3.1.1 Methodology and Evaluation Criteria

The area of analysis for land use effects from the Land Exchange Proposed Action included the federal and non-federal tracts, as well as properties abutting the tracts, which provide the basis for determining compatibility of land uses on the federal and non-federal parcels. The temporal analysis is based on the time of change in ownership. Management areas and subsequent land uses would be established at the time of the ownership change.

The analysis of the land use resources affected by the Land Exchange Proposed Action was guided by evaluation criteria that were developed by the USFS and the other Co-lead Agencies. The following impact indicators identify anticipated outcomes of the Land Exchange Proposed Action alternatives being considered for the NorthMet Project Proposed Action:

- Net change in the number of acres controlled by the USFS on the Superior National Forest;
- Net change in the length of the boundary around USFS-controlled land in the Superior National Forest (including internal boundaries around private in-holdings) to be managed under each of the proposed alternatives;
- Net change in the level of land fragmentation, expressed as a ratio of linear boundary-to-area (linear miles per acre) of the USFS-controlled portions of the Superior National Forest under each of the proposed alternatives;

- The degree of access to lands owned by the USFS in the Superior National Forest, as determined through the identification of public access points via road or trail;
- Degree of compatibility between USFS management areas and zoning or land use designations (in the absence of zoning) of adjacent areas;
- Potential for mineral development within the parcels, assessed by the USFS based on mineral ownership, the type of mineral, and the precedent/history for exploitation of this mineral within Minnesota; and
- Quality of title within each of the parcels being considered. Quality was evaluated by the USFS according to outstanding encumbrances on the parcels considered for each of the Land Exchange Proposed Action alternatives, including mineral ownership and development potential.

Quantitative criteria, such as boundary length and land area, were calculated using GIS. Evaluations of mineral development potential were conducted by third party professional geologists (Barr 2011c). The risk of conflict between mineral interests and USFS surface management and quality of title were assessed by a USFS Forest Realty Specialist.

5.3.1.2 Land Exchange Proposed Action

5.3.1.2.1 Forest Available for Public Access and Use

Through the Land Exchange Proposed Action, 6,495.4 acres of federal lands in the Superior National Forest would be transferred to PolyMet in exchange for up to approximately 7,075.0 acres of non-federal lands presently in private ownership. This would result in a net increase of up to 579.6 acres for the Superior National Forest.

All of the non-federal lands are within the 1854 Ceded Territory and would thus be subject to Treaty rights reserved by the Bands as a result of the Land Exchange Proposed Action. This would result in a net increase of up to 579.6 acres of publicly owned land in the 1854 Ceded Territory. Table 5.3.1-1 shows the Management Area designations that the USFS would apply to the non-federal lands under the Land Exchange.

Table 5.3.1-1 Management Area Allocations under the Land Exchange Proposed Action

	Acreage by Management Area[1]				
Tract	**General Forest**	**General Forest-Longer Rotation**	**Riparian Emphasis Areas**	**cRNA[5]**	**Total[6]**
Federal Lands[2]	355.3	6,140.1	0.0	0.0	6,495.4
Non-federal Lands[3]					
Tract 1	4,619.3	0.0	0.0	306.9	4,926.2
Tract 2	0.0	161.0	220.9	0.0	381.9
Tract 3	1,450.0	125.8	0.0	0.0	1,575.8
Tract 4	0.0	160.2	0.0	0.0	160.2
Tract 5	0.0	30.8	0.0	0.0	30.8
Subtotal, Non-federal Lands	6,069.3	477.8	220.9	306.9	7,075.0
Net Increase/(Decrease)[4]	5,714.0	(5,662.3)	220.9	306.9	579.6

[1] See definitions of USFS Management Areas in Section 4.2.3.
[2] Source: USFS 2011a.
[3] Source: USFS 2011b.
[4] Calculated as (non-federal) minus (federal).
[5] Candidate Research Natural Area (see Section 4.2.3).
[6] Totals may not match overall NorthMet Project area acreages due to rounding.

The 6,495.4 acres of federal lands are not accessible for public use via land (see Section 4.2.11), while substantial portions of the non-federal lands do have public access via public roads or hiking trails. This distinction is a factor in evaluating land use effects, because public access defines the degree to which the lands in question can actually be used—either by the public for recreational purposes, by forestry interests for economic purposes, or for research and conservation purposes (in the case of Riparian Emphasis and cRNA management areas, defined in Section 4.3.1). Tract 1 has direct public access via existing county roads (see Figure 5.3.1-1), and Tract 4 has public access via other roads (see Figure 5.3.1-2). Tracts 2 and 3 have no direct public access (see Figure 5.3.1-1). When considered collectively, public access to, and therefore use of the Superior National Forest, would be increased under the Land Exchange Proposed Action.

Table 5.3.1-2 shows the effect of the Land Exchange Proposed Action on the total acreage within the Superior National Forest that is controlled by the USFS, the boundary of the USFS-controlled land (see Section 5.3.1.2.2), and the fragmentation ratio (see Section 5.3.1.2.3). The Land Exchange Proposed Action would increase the federal estate by adding a net of 385.1 acres to the 2,171,603.9 acres of USFS-controlled land within the Superior National Forest.

Table 5.3.1-2 Superior National Forest Boundary, Acreage, and Fragmentation under the Land Exchange Proposed Action

	Baseline / Land Exchange No Action Alternative	Land Exchange Proposed Action	
		Predicted Value	Net Increase/ (Decrease)[1]
Acreage in Superior National Forest controlled by USFS	2,171,603.9	2,171,989.0	385.1
Boundary length (linear miles)	10,054.8	10,021.6	(33.2)
Fragmentation (linear miles per acre)	0.005	0.005	0.00

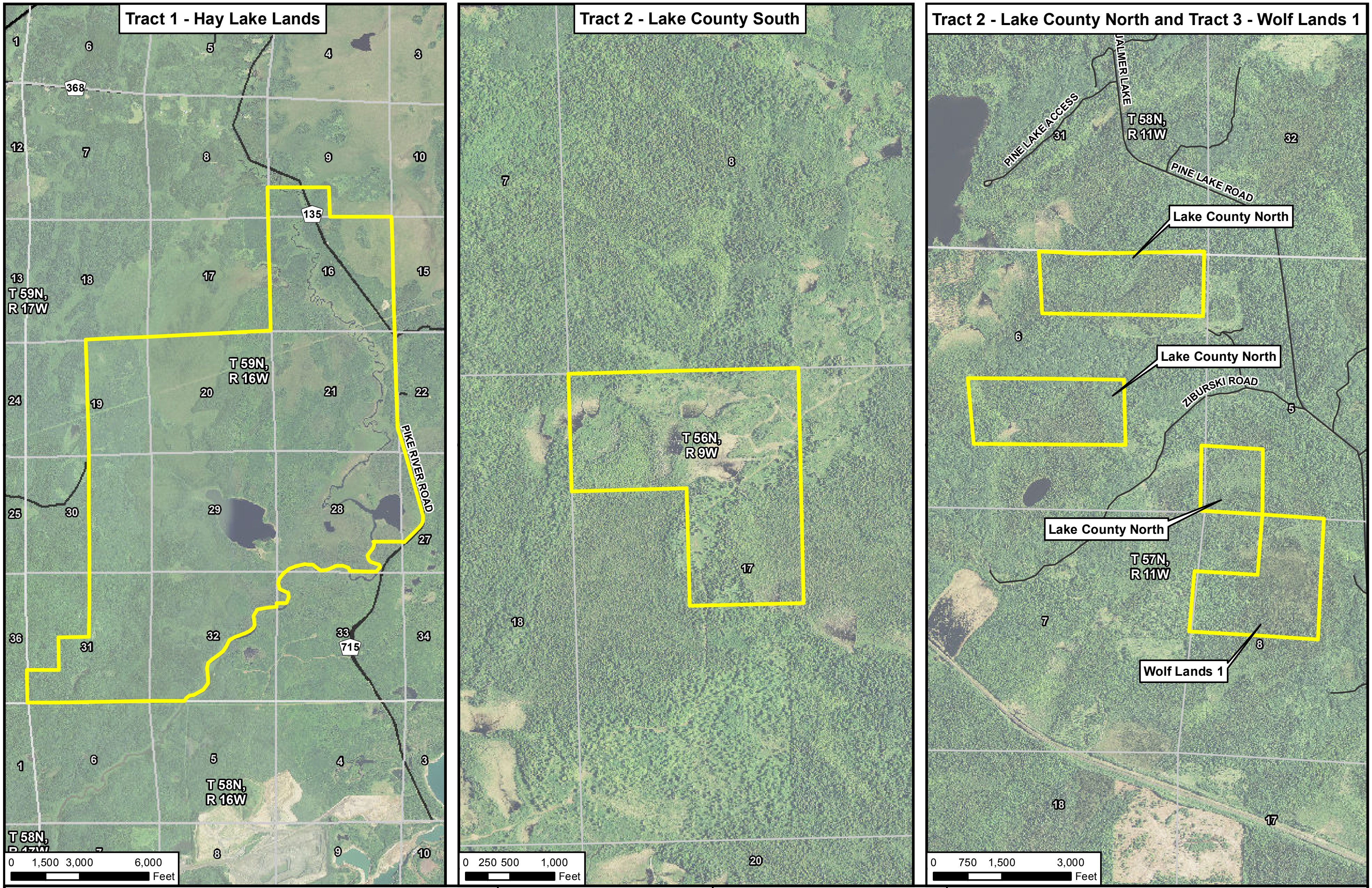
[1] Totals differ from acreage reported in Section 5.3.1.2.1 (579.6 acres) due to inconsistencies in GIS data and because Mud Lake (30.5 acres) would continue to be managed by the MDNR.

5.3.1.2.2 Boundary Managed

A reduced boundary length is more desirable for the USFS, because it reduces the difficulty of accessing and managing the forest. The Land Exchange Proposed Action would result in a 33.2-linear mile net reduction of the perimeter around the USFS-controlled portions of the Superior National Forest (see Table 5.3.1-2).

5.3.1.2.3 Forest Fragmentation

The underlying assumption regarding land fragmentation of USFS-controlled portions of the Superior National Forest is that a lower ratio of boundary to area is more desirable, because it reduces the difficulty of accessing and managing the forest in addition to increasing the forest's overall quality and function. All of the non-federal parcels are contiguous with National Forest System lands, thus decreasing the ratio of boundary to area. This reduction would be marginal in magnitude, and the Land Exchange Proposed Action would not alter the existing ratio of fragmentation in the Superior National Forest of approximately 0.005 linear mile of boundary per acre of USFS-controlled Superior National Forest land (see Table 5.3.1-2).



Non-federal Lands

Section Boundary

1 Section Label

Road

This document is a working document. This document may change over time as a result of new information, further deliberation, or other factors not yet known to the Co-lead Agencies.

N W E S

Figure 5.3.1-1

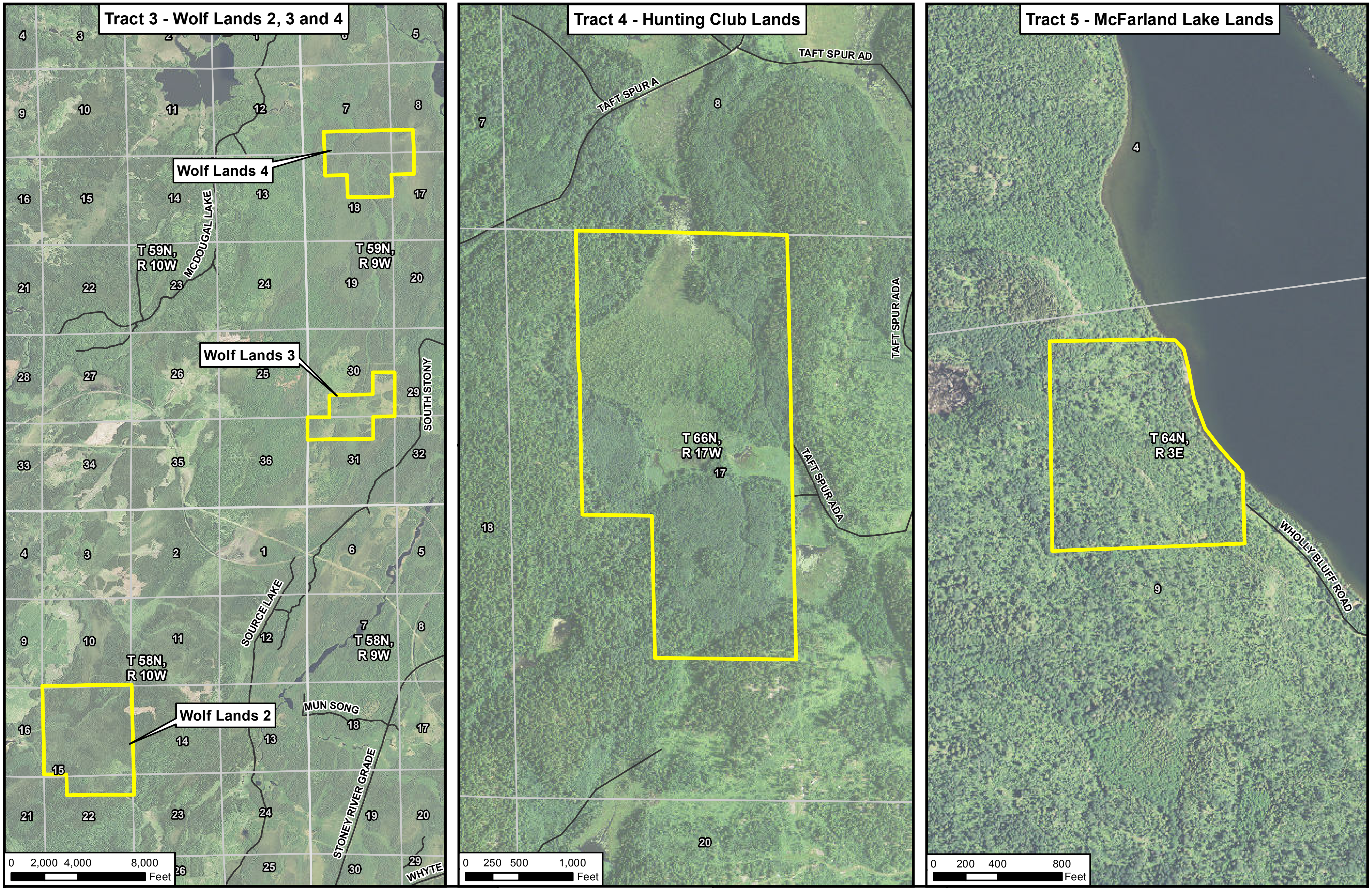
Tracts 1, 2, and 3 Roads

NorthMet Mining Project and Land Exchange PFEIS

Minnesota

June 2015

108 -Page Intentionally Left Blank-



Non-federal Lands

Section Boundary

1 Section Label

Road

US Army Corps of Engineers St. Paul District

This document is a working document. This document may change over time as a result of new information, further deliberation, or other factors not yet known to the Co-lead Agencies.

N E S W

Figure 5.3.1-2

Tracts 3, 4, and 5 Roads

NorthMet Mining Project and Land Exchange PFEIS

Minnesota

June 2015

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5.3.1.2.4 Zoning Compatibility

Management area designations establish USFS policy for public use of National Forest System lands (e.g., recreation, scenic resources, and facilities). Section 4.3.1 provides definitions of the intended uses of the management area designations that apply to the federal and non-federal tracts, as well as surrounding areas within the Superior National Forest.

Zoning in areas adjacent to the non-federal lands outside of the Superior National Forest and compatibility with the management area designations of non-federal lands are summarized below:

- Zoning on privately owned ("non-forest") lands adjacent to Tract 1 is split among multiple zoning districts that collectively provide for residential development, wild rice production, timber, and hunting (St. Louis County 2011). With the exception of residential development and timber, these uses are generally compatible with the proposed General Forest Management Area designation of Tract 1. Recreational uses such as personal-use riding and hunting would be consistent with the cRNA designation. Non-forest lands to the east and south of Tract 1 are in the Multiple-Use Non-Shoreland (MUNS-4) district (St. Louis County 2011), which is generally compatible with the General Forest and cRNA management areas.
- Non-forest lands adjacent to Tracts 2 and 3 are in the Forest-Recreation district, as defined by the Lake County Zoning Ordinance (Nelson, Pers. Comm., October 10, 2011). This is compatible with the proposed General Forest, General Forest – Longer Rotation, and Riparian Emphasis Area Management Area designations.
- Non-forest lands adjacent to Tract 4 to the west and southeast are within the St. Louis County FAM-1 zoning district, which emphasizes forestry, agricultural, and recreational uses (St. Louis County 2011). These uses are generally compatible with the proposed General Forest – Longer Rotation Management Area designation.
- Privately owned lands adjacent to Tract 5 to the north and southeast are within Cook County's Recreational Development zoning district (Cook County 2011), which is generally compatible with the proposed General Forest – Longer Rotation Management Area.

Overall, the management area designations of the non-federal lands are compatible with surrounding zoning. The Land Exchange Proposed Action would be compatible with the USFS Management Areas and zoning/land use designations of adjacent lands.

5.3.1.2.5 Mineral Development Potential and Quality of Title

The Land Exchange Proposed Action would remove from the Superior National Forest 6,495.4 acres of land with privately held, minable mineral development potential and USFS-held surface rights, in exchange for up to 7,075.0 acres of non-federal land with a low mineral development potential. As described in Section 3.3, the Land Exchange would eliminate conflict between mineral estate and surface rights on the federal lands by transferring the federal surface to the holder of the private mineral rights, fulfilling the USFS's purpose and need.

Table 5.3.1-3 summarizes the risk of conflict between mineral potential and the USFS surface management objectives on each of the non-federal parcels, as well as the overall quality of title to the land.

Table 5.3.1-3 Mineral Interests and Quality of Title for Non-Federal Lands

Tract/Parcel	Risk of Conflict Between Mineral Interests and USFS Surface Management[1]	Quality of Title[2,3]
1: Hay Lake	Moderate	Moderate
2: Lake County North	Low	Moderate
2: Lake County South	Low	Moderate
3: Wolf Lands 1	Low	Moderate
3: Wolf Lands 2	Low	Moderate
3: Wolf Lands 3	Low	Moderate
3: Wolf Lands 4	Low	Moderate
4: Hunting Club	Low	High
5: McFarland Lake	Low	Moderate

Source: USFS 2011c.

[1] Low is the best and high is the worst, as defined in USFS 2011c and Barr 2011c.
[2] Condition of title represents review as of December 21, 2011 -- may be revised per specialist investigation or advice of USDA, Office of General Counsel.
[3] High is the best and poor is the worst, as defined in USFS 2011c.

The risk of conflict determination in Table 5.3.1-3 expresses the degree to which "split estate" conditions could complicate achievement of USFS management goals and objectives. Split estate refers to situations where private ownership of mineral rights would occur on land whose surface is owned by the Superior National Forest after the Land Exchange Proposed Action. This concern notwithstanding, the USFS allows exploration, development, and production of mineral resources on National Forest System lands under conditions where the activities "are conducted in an environmentally sound manner so that they may contribute to economic growth and national defense" (USFS 2004b).

The "moderate" risk of conflict on Tract 1 reflects the presence of potential surficial aggregate resources in the far northeastern corner of the tract. There are also some potential surficial aggregate resources near Greenwood Lake in Tract 3, but development of these resources is constrained due to the presence of wetlands, which may limit or prohibit access (Barr 2011c). For all other tracts, the risk of conflict is low due to the low potential for mineral development.

The quality of title determination assesses existing uncertainties in surface ownership, title insurance, or other encumbrances that may be transferred to the USFS in the event of the Land Exchange moving forward, as well as the risk of conflict defined above. Details of the quality of title determination are presented below by tract (USFS 2011c):

- Tract 1: Moderate, due to the presence of surficial aggregate resources in the northeastern portion of the site and certain title encumbrances that may be cured by endorsements in the final title insurance policy.
- Tract 2: Moderate, due to the presence of privately held mineral exploitation rights. This potential is constrained by the low potential presence of subsurface mineral resources and the absence of surficial deposits.
- Tract 3: Moderate, due to the presence of privately held mineral exploitation rights on portions of all Tract 3 parcels and the presence of private timber rights for one parcel. Mining potential is constrained by the low potential presence of subsurface mineral resources, the absence of surficial deposits, and the presence of wetlands that may make mineral exploitation difficult.

- Tract 4: High, because the mineral estate was never severed from this parcel.
- Tract 5: Moderate, due to the potential for privately held mineral exploitation rights. This potential is constrained by the low potential presence of subsurface mineral resources and the absence of surficial deposits.

By comparison, the risk of conflict between mineral and surface rights on the federal lands is high due to the presence of privately owned mineral rights and economically developable minerals and USFS surface ownership. The Land Exchange Proposed Action would reduce this risk by exchanging the high-risk federal lands for predominantly low-risk non-federal lands. The risk of conflict on the non-federal lands may be reduced and title quality further improved through subsequent arrangements with holders of mineral rights on the non-federal lands or affirmative title insurance coverage. Thus, the overall effect of the Land Exchange Proposed Action improves the quality of title and reduces the complexity of title to the federal and non-federal lands.

5.3.1.3 Land Exchange Alternative B

5.3.1.3.1 Forest Available for Public Access and Use

Under the Land Exchange Alternative B, 4,752.6 acres of federal lands would be transferred to private ownership in exchange for up to approximately 4,926.3 acres of land (Tract 1 only), as determined by appraisals. This land is currently in private ownership, resulting in a net increase of approximately 173.6 acres for the Superior National Forest. The federal lands transferred out of the Superior National Forest in this scenario have poor public access (see Section 4.3.11). The smaller federal parcel would leave an isolated island of federal lands to the west of the Mine Site. These federal lands would be difficult to access because the railroad and road are private property. Access points managed by the USFS to the isolated area are limited. The non-federal tract has relatively good public access. Land Exchange Alternative B would result in a net increase of 173.6 acres for the Superior National Forest. All of Tract 1 is within the 1854 Ceded Territory and would thus be available for exercise of 1854 Treaty rights reserved by the Bands. Table 5.3.1-4 shows the Management Area designations that the USFS would apply to Tract 1 under Land Exchange Alternative B.

Table 5.3.1-4 Management Area Allocations under Land Exchange Alternative B

	Acreage by Management Area[1]				
Tract	**General Forest**	**General Forest-Longer Rotation**	**Riparian Emphasis Areas**	**cRNA[5]**	**Total[6]**
Federal lands[2]	355.3	4,397.3	0.0	0.0	4,752.6
Non-federal lands[3]					
Tract 1	4,619.3	0.0	0.0	306.9	4,926.2
Net Increase/(Decrease)[4]	4,264.0	(4,397.3)	0.0	306.9	173.6

[1] See definitions of USFS Management Areas in Section 4.2.3.
[2] Source: USFS 2011a.
[3] Source: USFS 2011b.
[4] Calculated as (non-federal) minus (federal).
[5] Candidate Research Natural Area (see Section 4.2.3).
[6] Totals may not match overall project area acreages due to rounding.

Table 5.3.1-5 shows the effect of the Land Exchange Alternative B on the total acreage within the Superior National Forest that is controlled by the USFS, the boundary of the USFS-controlled land (see Section 5.3.1.4.2), and the fragmentation ratio (see Section 5.3.1.4.3). The Land Exchange Alternative B would increase the federal estate by a net of 38.7 acres to the 2,171,603.9 acres of USFS-controlled land within the Superior National Forest.

Table 5.3.1-5 Superior National Forest Boundary, Acreage, and Fragmentation for Land Exchange Alternative B

	Baseline/ Land Exchange No Action Alternative	**Land Exchange Alternative B**	
		Predicted Value	**Net Increase/(Decrease)[1]**
Acreage in Superior National Forest controlled by USFS	2,171,603.9	2,171,642.6	38.7
Boundary length (linear miles)	10,054.8	10,046.2	(8.6)
Fragmentation (linear miles per acre)	0.005	0.005	0.00

[1] Totals differ from acreage reported in Table 5.3.1-4 (173.6 acres) due to inconsistencies in GIS data and because Mud Lake (30.5 acres) would continue to be managed by the MDNR.

5.3.1.3.2 Boundary Managed

The Land Exchange Alternative B would result in an 8.6-mile net reduction of the perimeter around the USFS-controlled portions of the Superior National Forest (see Table 5.3.1-5).

5.3.1.3.3 Forest Fragmentation

The Land Exchange Alternative B would not change the fragmentation ratio in USFS-controlled portions of the Superior National Forest (see Table 5.3.1-5).

5.3.1.3.4 Zoning Compatibility

Under the Land Exchange Alternative B, the forest lands that would become isolated under this alternative to the west of the smaller federal parcel would remain within the Superior National Forest, and would retain their General Forest – Longer Rotation Management Area designation.

This management area is compatible with nearby mining activity. There is no existing public access to this portion of the Superior National Forest, and it is reasonable to expect that permission of the private landowner to access the land would be restricted, for health and safety reasons, for the anticipated life of the mine.

The proposed management area designation for Tract 1 under the Land Exchange Alternative B would be the same as in the Land Exchange Proposed Action (see Section 5.3.1.2.4). The Land Exchange Alternative B would be compatible with the USFS management areas and zoning/land use designations of adjacent lands.

5.3.1.3.5 Mineral Development Potential and Quality of Title

The Land Exchange Alternative B would remove 4,752.6 acres of forest lands with proven mineral development potential from the Superior National Forest, in return for up to 4,926.3 acres with moderate mineral development potential, except for potential surficial aggregate resources in the far northeastern corner of Tract 1 (Barr 2011c). The risk of conflict and quality of title for the Land Exchange Alternative B is the same as for Tract 1 in the Land Exchange Proposed Action (see Table 5.3.1-3).

As with the Land Exchange Proposed Action, the Land Exchange Alternative B would result in a reduced risk of conflict and improved quality of title. The Land Exchange Alternative B would result in relinquishing the federal parcel with severed, private mineral rights and known, economically developable minerals and acquiring parcels with low to moderate risk of conflict and moderate to high title quality. The risk of conflict and title quality may be further improved through subsequent arrangements with holders of mineral rights on the non-federal lands or affirmative title insurance coverage. Thus, the Land Exchange Alternative B would also benefit efforts to manage the Superior National Forest, although to a lesser degree than the Land Exchange Proposed Action.

Mineral rights to the Mine Site are held by PolyMet, while surface rights are held by USFS, creating a conflict between surface and mineral rights. As described in Section 3.3, the USFS's Purpose and Need is to resolve the conflict between surface and mineral rights (see Section 5.3.1).

The Land Exchange Alternative B would be consistent with this Purpose and Need, as well as existing land use designations surrounding the Mine Site. Therefore, the Land Exchange Alternative B would have no adverse effect on land use at the Mine Site. Effects on recreational and natural resource use at the Mine Site are addressed in other sections of this chapter.

5.3.1.4 Land Exchange No Action Alternative

The Land Exchange No Action Alternative represents no change to current land use on the federal and non-federal lands. There would be no change in the amount of forest boundary managed, level of forest fragmentation, or acres available for public access and use.

Under the Land Exchange No Action Alternative, interest in development of mineral potential on the federal lands could continue, and would be compatible with relevant local zoning ordinances and planning designations. The Land Exchange No Action Alternative is also compatible with the General Forest and General Forest – Longer Rotation Management Area classifications. However, the mineral rights would remain severed from federal ownership. The potential conflict between mineral interests and USFS surface management of the federal parcel would remain.

The presence of a privately owned road (Dunka Road) and rail on the southern border of the federal lands would continue to limit public access to and use of the federal lands, as envisioned by the management area designations.

5.3.2 Water Resources

This section describes the potential effects and compares the resource value of the Land Exchange Proposed Action on water resources of the federal and non-federal lands to be exchanged, as well as for Land Exchange Alternative B and the Land Exchange No Action Alternative. The effects on the federal and non-federal lands are discussed together to facilitate comparison between the water resources of the lands exchanged. The total yield and quality of surface and groundwater currently leaving the non-federal tracts and flowing into the federal estate would not be altered by any of the Land Exchange alternatives. Under the Land Exchange Proposed Action and alternatives, the Superior National Forest would retain its ongoing responsibility for managing water resources on USFS lands in accordance with the Forest Plan. Table 5.3.2-1 shows the effects of the Land Exchange Proposed Action and Land Exchange alternatives on acreage of surface water and wild rice beds.

Under the Land Exchange Proposed Action, a net increase of 95.2 acres of MDNR-designated public water lakes (2.1 miles of shoreline) and 4.6 miles of public water streams would be added to the federal estate. By comparison, under Land Exchange Alternative B, a net increase of 116.8 acres of public water lakes (2.6 miles of shoreline) and 3.6 miles of public water streams would be added to the federal estate. One difference is that, under the Land Exchange Proposed Action, all of Mud Lake (30.5 acres) would be exchanged for the private lands, while under Land Exchange Alternative B only about 8.9 acres of Mud Lake would be included in the land exchange.

Both the Land Exchange Proposed Action and Land Exchange Alternative B would result in a net increase of wild rice beds to the federal estate. The federal lands do not contain any known wild rice beds, but Hay Lake Lands (Tract 1) contain known wild rice beds (approximately 126 acres). No wild rice beds would be affected as a result of the Land Exchange Proposed Action or Land Exchange Alternative B as no activities are proposed on the non-federal lands and the proposed mining activities would not affect these lands. Furthermore, though the Land Exchange Proposed Action would result in an increase in wild rice stands within the federal estate boundaries, there would be no change to the wild rice harvest opportunities for the public due to the Land Exchange Proposed Action or the Land Exchange Alternative B.

Table 5.3.2-1 Net Change in Surface Water and Wild Rice Beds to the Federal Estate under the Land Exchange Proposed Action and Alternatives

	Net Increase/(Decrease) of Water Resources			
Alternative	**Public Water Lakes (acres)**	**Public Water Lakes (miles of shoreline)**	**Public Water Streams (miles)**	**Wild Rice Beds (acres)[1]**
Land Exchange Proposed Action	95.2	2.1	4.6	>125.7[(2)]
Land Exchange Alternative B	116.8	2.6	3.6	>125.7[(2)]
Land Exchange No Action Alternative	0	0	0	0

[1] Wild rice beds within the Land Exchange Proposed Action and the Land Exchange Alternative B boundaries are currently, and would continue to be, located in MDNR-designated public waters.
[2] Excludes area of wild rice beds in Pike River. Presence of wild rice in the Pike River, which runs through Rice Lake, was noted in Barr's surveys (2011a; 2012a; 2013l), but the area of rice was not calculated.

There is limited groundwater or surface water quality data available for the non-federal tracts, with the exception of sulfate data for the Hay Lake Lands. There are, however, no known reasons to suspect surface water or groundwater contamination of any of the tracts from human activities. In general, water quality is expected to reflect natural conditions as similar to that found from MPCA regional studies (see Section 4.3.2.2.3).

5.3.2.1 Methodology and Evaluation Criteria

The area of analysis for water resource effects of the Land Exchange alternatives included the federal and non-federal tracts proposed for the exchange.

Since the Land Exchange Proposed Action would not actually result in any direct effects, as there are no construction or other activities proposed that would affect water resources, this assessment focuses on a comparison of the net change in the quantity and quality of water resources between the federal and non-federal tracts involved in the exchange.

5.3.2.1.1 Groundwater Evaluation Criteria

Groundwater resource evaluation criteria for the Land Exchange Proposed Action include a qualitative assessment of potential for groundwater contamination of the non-federal properties using MDNR and MPCA groundwater quality data.

5.3.2.1.2 Surface Water and Wild Rice Evaluation Criteria

Surface water evaluation criteria for the Land Exchange Proposed Action include a comparison of the length of public water streams/rivers, public water lake acreage, and shoreline length between the federal and non-federal lands. This was used to determine the net change in quantity of waterbodies. In addition, a qualitative assessment of surface water quality was conducted taking into consideration available water quality data, aerial photographs, and GIS information.

Wild rice evaluation criteria include a comparison in the amount of known or potential wild rice beds between federal and non-federal lands. This was used to determine the potential change in acres of wild rice on the federal estate. Information that was used in the analysis of wild rice beds included available field data, aerial photographs, and GIS layers.

5.3.2.2 Land Exchange Proposed Action

The Land Exchange Proposed Action would involve the transfer of 6,495.4 acres of federal lands from public to private ownership, and up to 7,075.0 acres of private land to public ownership (see Figure 3.3-1).

5.3.2.2.1 Groundwater

The Land Exchange Proposed Action would not directly result in a change in groundwater quantity or quality presently at the non-federal tracts. Evaluation of existing hydrogeologic data did not suggest the potential for groundwater contamination from human activity from any of the tracts. Therefore, there does not appear to be any substantive difference in the quality of groundwater resources between the federal and non-federal tracts.

5.3.2.2.2 Surface Water and Wild Rice

The Land Exchange Proposed Action would not directly result in a change in surface water quantity or quality at the non-federal tracts. There would be a net increase to the federal estate of 4.6 miles of public water streams and 95.2 acres of public water lakes (including 2.1 miles of additional shoreline).

No wild rice stands are known to occur on the federal lands, and suitable habitat is limited. The non-federal lands that contain wild rice beds would not be affected as a result of the Land Exchange Proposed Action or Land Exchange Alternative B, because no activities are proposed on these lands and the proposed mining activities would not affect these lands. As noted in the FEIS, the Land Exchange Proposed Action would result in a net increase of 125.7 acres of wild rice beds to the federal estate. FEIS Sections 5.3.2 and 5.3.4 clarify that, although the Land Exchange would result in an increase in wild rice stands within the federal estate boundaries, there would be no change to the existing public access to Tract 1 wild rice stands via the Pike River. Consequently, there would be no increase in wild rice harvest opportunities for the public.

Table 5.3.2-2 summarizes the federal and non-federal surface water resources and shows the net changes in these resources to the federal estate that would result from the Land Exchange Proposed Action. The Hay Lake lands (Tract 1) account for the majority of the net gain in surface water and wild rice beds to the federal estate from all the non-federal lands.

Table 5.3.2-2 Net Change in Surface Water and Wild Rice Beds to the Federal Estate under the Land Exchange Proposed Action

	Surface Water Resource			
	Public Water Lakes (acres)	Public Water Lakes (miles of shoreline)	Public Water Streams (miles)	Wild Rice Beds (acres)[1]
		Lands Conveyed		
Federal Lands	30.5	0.9	4.5	0.0
		Lands Acquired		
Tract 1 – Hay Lake	125.7	2.8	8.1	>125.7[(2)]
Tract 2 – Lake County	0.0	0.0	0.0	0.0
Tract 3 – Wolf Lands	0.0	0.0	1.0	0.0
Tract 4 – Hunting Club	0.0	0.0	0.0	0.0
Tract 5 – McFarland Lake	0.0	0.2	0.0	0.0
Subtotal: Non-federal Lands	125.7	3.0	9.1	>125.7[(2)]
Net Increase/(Decrease)	**95.2**	**2.1**	**4.6**	**>125.7[(2)]**

[1] Wild rice beds within the Land Exchange Proposed Action boundaries are currently, and would continue to be, in MDNR-designated public waters.
[2] Excludes area of wild rice beds in Pike River.

5.3.2.3 Land Exchange Alternative B

Under the Land Exchange Alternative B, 4,752.6 acres of federal lands would be transferred from public to private ownership, and 4,926.3 acres of land from private to public ownership, for a net increase in 173.7 acres in the federal estate (see Figure 3.3-2).

5.3.2.3.1 Groundwater

The Land Exchange Alternative B would not directly result in a change in groundwater quantity or quality at the non-federal tracts. Evaluation of existing hydrogeologic data did not suggest the potential for groundwater contamination from human activity from any of the tracts. Therefore, there does not appear to be any substantive difference in the quality of groundwater resources between the federal and non-federal tracts.

5.3.2.3.2 Surface Water and Wild Rice

The Land Exchange Alternative B would not directly result in a change in surface water quantity or quality at the non-federal tracts. There would be a net increase to the federal estate of about 3.6 miles of public water streams, under Land Exchange Alternative B. There would also be a net increase of about 116.8 acres of public water lake area (including 2.6 miles of shoreline) and at least 125.7 acres of wild rice beds contained within the federal estate under the Land Exchange Alternative B.

No wild rice stands are known to occur on the smaller federal parcel, and suitable habitat is limited. The non-federal lands that contain wild rice beds would not be affected as a result of the Land Exchange Proposed Action or Land Exchange Alternative B, because no activities are proposed on these lands and the proposed mining activities would not affect these lands. As noted in the FEIS, the Land Exchange Alternative B would result in a net increase of 125.7 acres of wild rice beds to the federal estate. FEIS Sections 5.3.2 and 5.3.4 clarify that, although the Land Exchange would result in an increase in wild rice stands within the federal estate boundaries, there would be no change to the existing public access to Tract 1 wild rice stands via the Pike River. Consequently, there would be no increase in wild rice harvest opportunities for the public.

Table 5.3.2-3 summarizes the federal and non-federal surface water resources and shows the net changes in these resources to the federal estate that would result from the Land Exchange Alternative B.

Table 5.3.2-3 Net Change in Surface Water and Wild Rice Beds to the Federal Estate under Land Exchange Alternative B

	Surface Water Resource			
	Public Water Lakes (acres)	**Public Water Lakes (miles of shoreline)**	**Public Water Streams (miles)**	**Wild Rice Beds (acres)[1]**
	Lands Conveyed			
Federal Lands	8.9	0.2	4.5	0.0
	Lands Acquired			
Tract 1	125.7	2.8	8.1	>125.7[(2)]
Net Increase/(Decrease)	**116.8**	**2.6**	**3.6**	**>125.7[(2)]**

[1] Wild rice beds within the Land Exchange Alternative B boundaries are currently, and would continue to be, in MDNR-designated public waters.
[2] Excludes area of wild rice beds in Pike River.

5.3.2.4 Land Exchange No Action Alternative

Under the Land Exchange No Action Alternative, the Land Exchange Proposed Action would not take place and would result in no changes in existing water resources under federal ownership. The Superior National Forest would have an ongoing responsibility for managing water resources on the federal lands in accordance with the Forest Plan. The Land Exchange No Action Alternative would not change the USFS responsibility for managing water resources.

136 -Page Intentionally Left Blank-

5.3.3 Wetlands

This section describes the potential environmental consequences of the Land Exchange Proposed Action on wetland resources that occur on the federal and non-federal lands. In this section, effects on the federal and non-federal lands are discussed together, to facilitate calculation of net changes to wetland resources. Under the Land Exchange Proposed Action and alternatives, the Superior National Forest would retain its ongoing responsibility for managing wetland resources on Forest Service lands in accordance with the Forest Plan.

Overall, the Land Exchange Proposed Action would result in an increase to the federal estate of wetland acreage by up to 505.5 acres through the acquisition of up to 7,075.0 acres of non-federal lands in exchange for 6,495.4 acres of federal land, and thus would be in conformity with EO 11990 (see Table 5.3.3-1). The Land Exchange Proposed Action would result in a net increase to the federal estate of 376.2 acres of mapped floodplain area, but would result in a decrease of 1,602.2 acres of unmapped floodplain area, for a net decrease of 1,226.0 acres of overall floodplain area (see Table 5.3.3-1). There would be no decrease in the amount of mapped floodplain or increase in the flood damage potential associated with the Land Exchange Proposed Action. The effects on the ecological function of the floodplain wetlands would be mitigated through the Section 404 Permit and the proposed mitigation described in Section 5.2.3. The Land Exchange Proposed Action would also increase the wetlands within the federal estate. The Land Exchange Proposed Action would be in conformance with EO 11988 (USFS 2004d [FSH 5409.13 § 33.43c]). The Land Exchange Proposed Action would result in an increase of coniferous swamp, hardwood swamp, open water, shallow marsh, and shrub swamp wetland resources to the federal estate, but would result in a decrease of coniferous bog, open bog, and sedge/wet meadows wetland resources to the federal estate (see Table 5.3.3-2). In addition, the Land Exchange Proposed Action would result in an increase in waterway acreage and frontage to the federal estate (see Table 5.3.3-3).

Due to the reduced land area involved, Land Exchange Alternative B would result in a lesser degree of wetlands, floodplains, and other water resources exchanged to the federal estate as the proposed Land Exchange Proposed Action. Overall, Land Exchange Alternative B would increase wetland areas to the federal estate by 69.9 acres (see Table 5.3.3-1) through the acquisition of up to 4,926.3 acres of the non-federal lands in exchange for 4,752.6 acres of federal land, and would thus be in conformity with EO 11990. The Land Exchange Alternative B would result in a net increase to the federal estate of 376.2 acres of mapped floodplain area, but would result in a decrease of 1,237.9 acres of unmapped floodplain area, for a net decrease of 861.7 acres of overall floodplain area (see Table 5.3.3-1). There would be no decrease in the amount of mapped floodplain or increase in the flood damage potential associated with the Land Exchange Alternative B. The effects on the ecological function of the floodplain wetlands would be mitigated through the Section 404 Permit and the proposed mitigation described in Section 4.2.3. The Land Exchange Alternative B would also increase the wetlands within the federal estate. The Land Exchange Alternative B would be in conformance with EO 11988 (USFS 2004d [FSH 5409.13 § 33.43c]). Land Exchange Alternative B would result in an increase of coniferous swamp, open water, shallow marsh, and shrub swamp wetland resources to the federal estate but would result in a decrease to coniferous bog, hardwood swamp, open bog, and sedge/wet meadows wetland resources to the federal estate (see Table 5.3.3-2). In addition, Land

Exchange Alternative B would result in an increase of waterway acreage and frontage to the federal estate (see Table 5.3.3-3).

Table 5.3.3-1 Net Increase or Decrease of Wetland and Floodplain Acres on the Federal Estate from the Land Exchange Proposed Action and Alternatives

	Increase (or Decrease) of Wetland and Floodplain Acres	
Alternative	**Wetlands (Acres)**	**Floodplains[1,2] (Acres)**
Land Exchange Proposed Action	505.5	(1,226.0)
Land Exchange Alternative B	69.9	(861.7)

[1] The federal floodplain area is a 500-year (0.2%) probability floodplain.
[2] Includes an increase of 376.2 acres of mapped floodplains to the federal estate.

Table 5.3.3-2 Net Increase or Decrease of Wetland Resource Types on the Federal Estate from the Land Exchange Proposed Action and Alternatives

	Increase (or Decrease) of Wetland Resource Types (Acres)								
Alternative	**Coniferous Bog**	**Coniferous Swamp[1]**	**Deep Marsh**	**Hardwood Swamp[2]**	**Open Bog**	**Open Water (includes shallow, open water, and lakes)**	**Sedge/Wet Meadow**	**Shallow Marsh[3]**	**Shrub Swamp (includes alder thicket and shrub-carr)**
Land Exchange Proposed Action	(1,961.4)	1,954.6	0.0	36.9	(202.4)	151.7	(35.7)	20.5	541.3
Land Exchange Alternative B	(1,677.0)	1,477.8	0.0	(5.7)	(172.9)	168.0	(34.9)	3.2	311.4

[1] Coniferous bogs on the non-federal lands were grouped with coniferous swamps during field data collection.
[2] Hardwood swamps on the non-federal lands may contain coniferous tree species.
[3] Shallow marsh areas on the non-federal lands may contain deep marshes.

Table 5.3.3-3 Net Increase or Decrease of Frontage of Waterways on the Federal Estate from the Land Exchange Proposed Action and Alternatives

	Increase (or Decrease) of Frontage of Waterways					
	Lake			River/Stream/Creek		
Alternative	**Acres**	**Frontage (ft)**	**Length of Lake Frontage/Acre**	**Miles**	**Frontage (linear ft)**	**Length of River Frontage/Acre**
Land Exchange Proposed Action	99.1	12,864.0	34.9	3.8	27,456.0	34.0
Land Exchange Alternative B	120.7	15,224.0	3.2	2.8	16,896.0	3.5

Source: Data from Section 4.3.3.

Based on a qualitative assessment, the Land Exchange Proposed Action and Land Exchange Alternative B would appear to result in an increase to the federal estate of wetlands rated as high for vegetation diversity/integrity, wetland water quality, fish habitat, and amphibian habitat. Land Exchange Alternative B would also appear to result in an increase to the federal estate of wetlands rated as high for hydrology and wildlife habitat. The Land Exchange Proposed Action would result in an increase to the federal estate of moderate and low rated wetlands for amphibian habitat, as where Land Exchange Alternative B would also result in an increase to the federal estate of wetlands rated low for amphibian habitat. The Land Exchange Proposed Action would have similarly rated hydrology, flood attenuation, downstream water quality, wildlife habitat, and aesthetics/education/cultural functions. Land Exchange Alternative B would result in a decrease to the federal estate of wetlands rated high and moderate for flood attenuation and downstream water quality and would not result in a change to aesthetics/education/cultural functions.

5.3.3.1 Methodology and Evaluation Criteria

The potential effect that the Land Exchange Proposed Action and alternatives would have on wetland resources was evaluated using two types of criteria: 1) criteria assessing conformity to EOs 11990 and 11988, which requires a wetland acre-for-acre analysis and a floodplain acre-for-acre analysis of the federal estate, and 2) criteria used in an analysis of wetlands and floodplain habitat, as well as other water resource indicators.

As previously discussed, to satisfy the requirements of EOs 11990 and 11988, the USFS policy is to use the following three conditions (USFS 2004d [FSH 5409.13 § 33.43c]): 1) the value of the wetlands or floodplains for properties received and conveyed is equal (balancing test) and the land exchange is in the public interest; 2) reservations or restrictions are retained on the unbalanced portion of the wetlands and floodplains on the federal lands when the land exchange is in the public interest but does not meet the balancing test; and 3) the federal property is removed from the exchange proposal when the conditions described in the preceding paragraphs 1 or 2 cannot be met.

In addition to evaluating wetlands in accordance with the two EOs, analysis of the Land Exchange included information on wetland community types as well as ecological floodplains.

To evaluate conformity to the EOs, the following evaluation criteria were used:

- Comparative difference in acres of wetland between the federal and non-federal parcels; and
- Comparative difference in acres of floodplain between the federal and non-federal parcels.

Other wetland resources indicators that were used are the following:

- Comparative difference in acres of wetland types between the federal and non-federal parcels;
- A MnRAM assessment of wetland function and value;
- Change in flood damage potential on the parcels and to the surrounding parcels;
- A MnRAM assessment of floodplain assets; and
- Comparative difference of length of streams, rivers, and lake frontage between the federal and non-federal parcels.

The spatial area of analysis for wetland resource effects from the Land Exchange Proposed Action and alternatives included the federal and non-federal tracts proposed for the exchange, while the temporal area of analysis assessed was the point in time at which the change in ownership would occur.

The analysis of the wetland resources affected by the Land Exchange Proposed Action and alternatives was guided by evaluation criteria that were developed by the USFS and other Co-lead Agencies, which included a comparison of wetland resource acreages, wetland resources types, wetland function and values, floodplain acreages, and other water resources acreages. GIS data and field observations were used and then compared over an area of analysis that included the federal and non-federal lands.

5.3.3.1.1 Wetlands

The federal lands contain 4,164.4 acres of wetlands (see Table 5.3.3-4). By comparison, the five non-federal land tracts contain 4,669.9 acres of wetlands. The Land Exchange Proposed Action would result in a net increase of up to 505.5 acres of wetlands to the federal estate if all five tracts are exchanged (see Table 5.3.3-4). The Land Exchange Proposed Action would increase wetland acreage to the federal estate by up to 505.5 acres through the acquisition of up to 7,075.0 acres of non-federal lands in exchange for 6,495.4 acres of federal land, and thus would be in conformity with EO 11990.

Table 5.3.3-4 Wetland and Floodplain Acres for the Land Exchange Proposed Action

Parcel		Acres of Wetlands	Acres of Floodplains
Lands Conveyed			
Federal Lands		4,164.4	1,889.4[(1)]
Lands Acquired			
Tract 1		2,930.8	551.2
Tract 2	Lake County North	209.3	0.0
	Lake County South	73.6	0.0
Tract 3	Wolf Lands 1	90.4	0.0
	Wolf Lands 2	706.2	0.0
	Wolf Lands 3	233.2	32.8
	Wolf Lands 4	362.8	79.4
Tract 4		63.6	0.0
Tract 5		0.0	0.0
Subtotal: Non-federal lands		4,669.9	633.4
Net Change			
Net Increase/(Decrease)		505.5	(1,226.0)[(2)]

1 The federal floodplain area is a 500-year (0.2%) probability floodplain.
2 Includes an increase of 376.2 acres of mapped floodplains to the federal estate.

As part of the increase in total wetland acreage, the Land Exchange Proposed Action would result in a net increase to the federal estate of the following wetland resource types (see Table 5.3.3-5): coniferous swamp (1,954.6 acres), hardwood swamp (36.9 acres), open water (151.7 acres), shallow marsh (20.5 acres), and shrub swamp (541.3 acres). However, the Land Exchange Proposed Action would result in a net decrease to the federal estate of the following wetland resource types: coniferous bog (1,961.4 acres), open bog (202.4 acres), and sedge/wet meadow (35.7 acres).

Table 5.3.3-5 Wetland Resource Types for the Land Exchange Proposed Action

Parcel		Coniferous Bog	Coniferous Swamp[1]	Deep Marsh	Hardwood Swamp[2]	Open Bog	Open Water (includes shallow, open water, and lakes)	Sedge/Wet Meadow	Shallow Marsh[3]	Shrub Swamp (includes alder thicket and shrub-carr)
		Acres of Wetland Resource Types								
Lands Conveyed										
Federal Lands		1,961.4	1,287.8	0.0	21.1	209.5	30.8	35.7	97.0	521.1
Lands Acquired										
Tract 1		0.0	1,953.9	0.0	8.0	2.1	176.6	0.0	84.1	706.1
Tract 2	Lake County North	0.0	135.0	0.0	34.7	1.8	0.2	0.0	2.5	35.1
	Lake County South	0.0	32.4	0.0	9.9	0.0	2.5	0.0	12.3	16.5
Tract 3	Wolf Lands 1	0.0	75.4	0.0	0.0	3.0	0.0	0.0	0.0	12.0
	Wolf Lands 2	0.0	627.4	0.0	5.0	0.0	0.4	0.0	0.4	73.0
	Wolf Lands 3	0.0	82.6	0.0	0.0	0.0	0.0	0.0	5.2	145.4
	Wolf Lands 4	0.0	320.3	0.0	0.0	0.2	0.0	0.0	0.0	42.3
Tract 4		0.0	15.4	0.0	0.4	0.0	2.8	0.0	13.0	32.0
Tract 5		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Subtotal: Non-federal lands		0.0	3,242.4	0.0	58.0	7.1	182.5	0.0	117.5	1,062.4
Net Change										
Net Increase/(Decrease)		(1,961.4)	1,954.6	0.0	36.9	(202.4)	151.7	(35.7)	20.5	541.3

[1] Coniferous bogs on the non-federal lands were grouped with coniferous swamps during field data collection.
[2] Hardwood swamps on the non-federal lands may contain coniferous tree species.
[3] Shallow marsh areas on the non-federal lands may contain deep marshes.

5.3.3.1.2 Wetland Functional Assessment

Based on a qualitative assessment, the Land Exchange Proposed Action would appear to result in an increase to the federal estate of the following high rated wetland functions: vegetation diversity/integrity, wetland water quality, fish habitat, and amphibian habitat. The Land Exchange Proposed Action would result in an increase to the federal estate of moderate- and low-rated wetlands for amphibian habitat. The Land Exchange Proposed Action would have similarly rated hydrology, flood attenuation, downstream water quality, wildlife habitat, and aesthetics/education/cultural functions.

5.3.3.1.3 Floodplains

There are no mapped floodplains within the federal lands as described in Section 4.3.3. The Land Exchange Proposed Action would result in a net increase to the federal estate of 376.2 acres of mapped floodplain area, but would result in a decrease of 1,602.2 acres of unmapped floodplain area, for a net decrease of 1,226.0 acres of overall floodplain area (see Table 5.3.3-4). There would be no decrease in the amount of mapped floodplain or increase in the flood damage potential associated with the Land Exchange Proposed Action. The effects on the ecological function of the floodplain wetlands would be mitigated through the Section 404 Permit and the proposed mitigation described in Section 4.2.3. The Land Exchange Proposed Action would also increase the wetlands within the federal estate. The Land Exchange Proposed Action would be in conformance with EO 11988 (USFS 2004d [FSH 5409.13 § 33.43c]).

5.3.3.1.4 Frontage of Waterways

The Land Exchange Proposed Action would result in a net increase of other water resources to the federal estate (see Table 5.3.3-6). A net increase of 99.1 acres of lake and 3.8 miles of rivers would be added to the federal estate from the Land Exchange Proposed Action. These increases would result in additional frontage of lakes and rivers to the federal estate.

Table 5.3.3-6 Frontage of Waterways for the Land Exchange Proposed Action

		Lake			Rivers/Creeks/Streams		
Parcel		**Acres**	**Frontage (ft)**	**Length of Lake Frontage/ Acre**	**Miles**	**Frontage (linear ft)**	**Length of River Frontage/ Acre**
Lands Conveyed							
Federal Lands		30.5	4,550.0	0.7	5.3	55,968.0	8.6
Lands Acquired							
Tract 1		129.6	16,424.0	3.5	8.1	72,864.0	15.3
Tract 2		0.0	0.0	0.0	0.0	0.0	0.0
Tract 3	Wolf Lands 1	0.0	0.0	0.0	0.0	0.0	0.0
	Wolf Lands 2	0.0	0.0	0.0	0.0	0.0	0.0
	Wolf Lands 3	0.0	0.0	0.0	0.1	1,056.0	3.8
	Wolf Lands 4	0.0	0.0	0.0	0.9	9,504.0	23.5
Tract 4		0.0	0.0	0.0	0.0	0.0	0.0
Tract 5		0.0	990.0	32.1	0.0	0.0	0.0
Subtotal: Non-federal lands		129.6	17,414.0	35.6	9.1	83,424.0	42.6
Net Change							
Net Increase/(Decrease)		99.1	12,864.0	34.9	3.8	27,456.0	34.0

Source: Data from Section 4.3.3.

5.3.3.2 Land Exchange Alternative B

5.3.3.2.1 Wetlands

The smaller federal parcel contains 2,860.9 acres of wetlands (see Table 5.3.3-7). By comparison, the non-federal lands contain 2,930.8 acres of wetlands. The Land Exchange Alternative B would result in a net increase of 69.9 acres of wetlands to the federal estate. The Land Exchange Alternative B would increase wetland areas to the federal estate by 69.9 acres through the acquisition of up to 4,926.3 acres of the non-federal lands in exchange for 4,752.6 acres of federal land, and would thus be in conformity with EO 11990.

Table 5.3.3-7 Wetland and Floodplain Acres for Land Exchange Alternative B

	Acres of Wetlands	**Acres of Floodplains**
Lands Conveyed		
Smaller Federal Parcel	2,860.9	1,412.9[1]
Lands Acquired		
Tract 1	2,930.8	551.2
Net Change		
Net Increase/(Decrease)	69.9	(861.7)[2]

[1] The federal floodplain area is a 500-year (0.2%) probability floodplain.
[2] Includes an increase of 376.2 acres of mapped floodplains to the federal estate.

As part of the increase in wetland acreage, Land Exchange Alternative B would result in a net increase to the federal estate of the following wetland resource types (see Table 5.3.3-8): coniferous swamp (1,477.8 acres), open water (168.0 acres), shallow marsh (3.2), and shrub swamp (311.4 acres). However, the Land Exchange Alternative B would result in a net decrease to the federal estate of the following wetland resource types: coniferous bog (1,677.0 acres), hardwood swamp (5.7 acres), open bog (172.9 acres), and sedge/wet meadow (34.9 acres).

Table 5.3.3-8 Wetland Resource Types for Land Exchange Alternative B

	Acres of Wetland Resource Types								
Parcel	**Coniferous Bog**	**Coniferous Swamp[1]**	**Deep Marsh**	**Hardwood Swamp[2]**	**Open Bog**	**Open Water (includes shallow, open water, and lakes)**	**Sedge/Wet Meadow**	**Shallow Marsh[3]**	**Shrub Swamp (includes alder thicket and shrub-carr)**
Lands Conveyed									
Smaller Federal Parcel	1,677.0	476.1	0.0	13.7	175.0	8.6	34.9	80.9	394.7
Lands Acquired									
Tract 1	0.0	1,953.9	0.0	8.0	2.1	176.6	0.0	84.1	706.1
Net Change									
Net Increase/(Decrease)	(1,677.0)	1,477.8	0.0	(5.7)	(172.9)	168.0	(34.9)	3.2	311.4

[1] Coniferous bogs on the non-federal lands were grouped with coniferous swamps during field data collection.
[2] Hardwood swamps on the non-federal lands may contain coniferous tree species.
[3] Shallow marsh areas on the non-federal lands may contain deep marshes.

5.3.3.2.2 Wetland Functional Assessment

The Land Exchange Alternative B would result in an increase to the federal estate of wetlands rated as high for vegetation diversity/integrity, hydrology, wetland water quality, wildlife habitat, fish habitat, and amphibian habitat. There would be a decrease to the federal estate of wetlands rated high and moderate for flood attenuation and downstream water quality. The Land Exchange Alternative B would also result in an increase to the federal estate of wetlands rated low for amphibian habitat. The Land Exchange Alternative B would not result in a change to aesthetics/education/cultural functions to the federal estate.

5.3.3.2.3 Floodplains

There are no mapped floodplains within the federal lands as described in Section 4.3.3. The Land Exchange Alternative B would result in a net increase to the federal estate of 376.2 acres of mapped floodplain area and 1,237.9 acres of unmapped floodplain area, for a net decrease of 861.7 acres of overall floodplain area (see Table 5.3.3-7). There would be no decrease in the amount of mapped floodplain or increase in the flood damage potential associated with the Land Exchange Alternative B. The effects on the ecological function of the floodplain wetlands would be mitigated through the Section 404 Permit and the proposed mitigation described in Section 4.2.3. The Land Exchange Alternative B would also increase the wetlands within the federal estate. The Land Exchange Alternative B would be in conformance with EO 11988 (USFS 2004d [FSH 5409.13 § 33.43c]).

5.3.3.2.4 Frontage of Waterways

The Land Exchange Alternative B would result in a net increase of other water resources to the federal estate (see Table 5.3.3-9). A net increase of 120.7 acres of lake and 2.8 miles of rivers would be added to the federal estate from the Land Exchange Alternative B. These increases would result in additional frontage of lakes and rivers to the federal estate.

Table 5.3.3-9 Frontage of Waterways for Land Exchange Alternative B

	Lake			Rivers/Creeks/Streams		
Parcel	**Acres**	**Frontage (ft)**	**Length of Lake Frontage/Acre**	**Miles**	**Frontage (linear ft)**	**Length of River Frontage/Acre**
Lands Conveyed						
Smaller Federal Parcel	8.9	1,200.0	0.3	5.3	55,968.0	11.8
Lands Acquired						
Tract 1	129.6	16,424.0	3.5	8.1	72,864.0	15.3
Net Change						
Net Increase/(Decrease)	120.7	15,224.0	3.2	2.8	16,896.0	3.5

Source: Data from Section 4.3.3.

5.3.3.3 Land Exchange No Action Alternative

Under the Land Exchange No Action Alternative, the Superior National Forest would have an ongoing responsibility for managing wetland resources, floodplains, and surface waters on the federal lands in accordance with the Forest Plan. The Land Exchange No Action Alternative would not change USFS's responsibility for managing wetland resources, floodplains, and surface waters and would result in no further effects on these resources.

5.3.4 Vegetation

This section provides an evaluation of the effects of the Land Exchange Proposed Action on vegetation, including comparisons of MDNR GAP land cover types, native plant community types, MBS Sites of Biodiversity Significance, MIH types, age classes, threatened and endangered plant species, and biodiversity between the federal and non-federal lands. Table 5.3.4-1 provides a summary of these data on a net increase or decrease basis to the federal estate.

When comparing the total acres of the federal and non-federal lands, the federal estate would have an increase of 579.6 acres of MDNR GAP land cover types (see Table 5.3.4-1) as a result of the Land Exchange Proposed Action. The shrublands (1,199.4 acres) would increase the most and the upland conifer forests (919.5 acres) would decrease the most (see Table 5.3.4-2). There would be an acreage increase of upland forest (MIH 1) with lesser amounts of lowland black spruce-tamarack forest (MIH 9) and aquatic habitat (MIH 14), but a decrease of upland conifer forest (MIH 5) to the federal estate (see Table 5.3.4-1). There would be an increase to the federal estate of immature forest stands with lesser amounts of young stands, but a decrease in mature forest stands.

There would be a decrease to the federal estate of up to approximately 6,025.8 acres of MBS Sites of High Biodiversity Significance and an increase of up to 767.9 acres of MBS Sites of Moderate Biodiversity Significance under the Land Exchange Proposed Action (see Table 5.3.4-1). There would be a decrease to the federal estate of three native plant communities that are “imperiled,” “imperiled-vulnerable,” or “vulnerable,” as well as others that are ranked as “apparently secure” or “widespread and secure,” in exchange for one native plant community that is ranked as “vulnerable” and two that are ranked as “apparently secure.” There would be a decrease to the federal estate of up to 2,016.6 acres in the Jack Pine-Black Spruce landscape ecosystem, and an increase of up to 994.7 acres in the Lowland Conifer landscape ecosystem and 558.7 acres in the Mesic Red and White Pine landscape ecosystem. Additionally, the USFS would increase representation in the Dry-Mesic Red and White Pine, Mesic Birch-Aspen-Spruce-Fir, Lowland Hardwood, and Sugar Maple landscape ecosystems. Overall, there would be an increase to the federal estate of 625.2 acres of landscape ecosystems as a result of the Land Exchange Proposed Action.

There would be a decrease to the federal estate of 12 populations of 10 state-listed ETSC plant species on the federal lands in exchange for three populations of three known state-listed ETSC plant species on the non-federal lands. Though the 10 state-listed plant species on the federal lands are not known to occur on the non-federal lands, the Land Exchange Proposed Action would result in an increase to the federal estate of most habitats important to them. Drawing from the MIH exchange, RFSS plants associated with upland forest (MIH 1), lowland black spruce-tamarack forest (MIH 9), and aquatic habitat (MIH 14) could potentially exist on or spread to the habitats on the non-federal parcels. There would also be a gain of Rove Formation cliff microhabitats to the federal estate, which are important for a variety of RFSS plants in the Superior National Forest.

Rulemaking was conducted with the intent to update the list of ETSC species (*Minnesota Rules*, parts 6134.0100 to 6134.0400), with new listings becoming effective on August 19, 2013 (MDNR 2013h). This FEIS considers any new listings, or changes in the previous listings, associated with the updated list. The FEIS also considers any federal listing changes.

A Biological Evaluation has been prepared that contains further information about RFSS. The Biological Evaluation is included in Appendix D and is posted on the USFS website (http://www.fs.usda.gov/goto/superior/northmet). The organization of the methodologies and discussion in the Biological Evaluation may be different from the FEIS. The document also contains determinations of effect for the species discussed.

Table 5.3.4-1 Vegetation and Cover Type Increase or Decrease to the Federal Estate Due to Land Exchange Proposed Action and Alternatives

Category		Net Increase/(Decrease)		
		Land Exchange Proposed Action	**Land Exchange Alternative B**	**Land Exchange No Action Alternative**
Habitat Types (acres)	MDNR GAP Land Cover Types	579.6	173.6	0.0
	MIH 1 (Upland Forest)	1,364.5	1,411.8	0.0
	MIH 5 (Upland Conifer Forest)	(1,172.5)	(1,084.6)	0.0
	MIH 9 (Lowland Black Spruce-tamarack Forest)	248.3	(261.1)	0.0
	MIH 14 (Aquatic Habitat)	226.7	206.2	0.0
	Lowland Shrub	(160.1)	(272.1)	0.0
	Lowland Emergent	200.2	249.6	0.0
	Upland Grass	43.3	0.0	0.0
	Young Forest Stands	507.1	262.7	0.0
	Immature Forest Stands	2,000.5	1,933.9	0.0
	Mature Forest Stands	(2,029.6)	(2,114.5)	0.0
MBS Sites (acres)	High Biodiversity Sites	(6,025.8)	(4,573.1)	0.0
	Moderate Biodiversity Sites	767.9	(0.3)	0.0
Native Plant Communities	Imperiled (S2)	(1.0)	0.0	0.0
	Imperiled/Vulnerable (S2-3)	(1.0)	(1.0)	0.0
	Vulnerable (S3)	(1) and +1 other	(1.0)	0.0
	Apparently Secure (S4)	(6) and +2 others	(2.0)	0.0
	Widespread and Secure (S5)	(6.0)	(4.0)	0.0
Landscape Ecosystems (acres)	Dry-Mesic Red and White Pine	683.0	589.2	0.0
	Jack Pine-black Spruce	(2,016.6)	(1,411.6)	0.0
	Lowland Conifer	994.7	486.2	0.0
	Lowland Hardwood	66.5	0.0	0.0
	Mesic Birch-aspen-spruce-fir	302.2	0.9	0.0
	Mesic Red and White Pine	558.7	528.0	0.0
	Sugar Maple	36.7	0.0	0.0
ETSC Species (number of species)	State-listed Plant Species	(10) species +3 different species	(10) species +1 different species	0.0
Management Area (acres)	General Forest	5,714.1	4,264.0	0.0
	General Forest – Longer Rotation	(5,658.0)	(4,397.3)	0.0
	cRNA	306.9	306.9	0.0
	Riparian Emphasis Area	220.9	0.0	0.0

5.3.4.1 Methodology and Evaluation Criteria

The vegetation assessment area for the Land Exchange Proposed Action would involve 6,495.4 acres of federal lands transferred from public to private ownership, and up to 7,075.0 acres of land transferred from private to public ownership. The spatial and temporal area of analysis for vegetation as part of the Land Exchange Proposed Action included direct and indirect effects resulting from the change in ownership of the federal and non-federal lands, including the extent of landscape ecosystems as defined in the Forest Plan or the extent of similar landscape ecosystems on the abutting forest lands.

An evaluation was conducted to determine the potential effect that the Land Exchange Proposed Action would have on the following vegetation resources:

- The quality and quantity of forest resources/lands (change in forest types and age classes);
- Change in state-listed ETSC plant species and RFSS plants (individuals, habitat, and/or populations);
- Change in biodiversity or overall vegetation and habitat; and
- The introduction and spread of invasive non-native species.

The analysis of the vegetation resources affected by the Land Exchange Proposed Action was guided by evaluation criteria that were developed by the USFS and other Co-lead Agencies, which included a comparison of the MDNR GAP land cover types, native plant communities, MBS Sites of Biodiversity Significance, MIH types (MIH 1, 5, 9, and 14, as well as lowland shrublands, lowland emergent wetlands, and upland grass), age classes (young, immature, and mature), large mature forest patches, landscape ecosystems, management areas, threatened and endangered plant species, RFSS plants, and invasive non-native plant species. GIS data for these categories were gathered to the extent possible, and then compared over an area of analysis that included the federal and non-federal lands, and also the surrounding landscape ecosystems of the Superior National Forest or ecological subsections. MIH types and age classes have also been compared within the context of landscape ecosystems to reveal how many acres of each MIH and age class would be increased or decreased on the federal estate by the Land Exchange Proposed Action within each landscape ecosystem. MIH type and age class data for the non-federal lands were interpreted from field survey maps, aerial maps, surrounding federal MIH data, topographic maps, and USFS review. These were then compared to the federal lands MIH data to determine MIH type and age class increases or decreases of acreage to the federal estate. Additionally, all of the data types mentioned have been compared to summarize the vegetative biodiversity of the federal and non-federal lands.

5.3.4.2 Land Exchange Proposed Action

5.3.4.2.1 Cover Types

Cover types consist of several categories of classification, including MDNR GAP land cover types, USFS management areas, USFS ELTs, and USFS MIH types.

Habitat Types

The Land Exchange Proposed Action would result in an increase to the federal estate of up to 579.6 acres of MDNR GAP land cover designations, with the greatest increase in shrubland acreage of 1,199.4 acres and the greatest decrease in upland conifer forest of 919.5 acres (see Table 5.3.4-2). The decrease of upland conifer forest is contrary to a goal of the 2004 Forest Plan. The Forest Plan calls for an increase in the acreage of red, white, and jack pine habitats (and a decrease in the acreage of aspen vegetation communities). In addition, the Land Exchange Proposed Action would support other Forest Plan goals to maintain acreage of lowland deciduous habitats and non-forested wetlands. The Land Exchange Proposed Action would result in a small increase to the federal estate of lowland deciduous forests, an increase in aquatic habitats, and a large increase of shrublands.

Table 5.3.4-2 Net Increase or Decrease to the Federal Estate of MDNR GAP Land Cover Types under the Land Exchange Proposed Action

Cover Types	Federal Land Acres	Non-federal Land Acres	Net Increase/ (Decrease) Acres
Shrubland	645.6	1,845.0	1,199.4
Aquatic environments	60.1	266.6	206.5
Upland deciduous forest	1,091.8	1,232.9	141.1
Upland conifer-deciduous mixed forest	20.9	50.4	29.5
Cropland/grassland	6.2	31.7	25.5
Lowland deciduous forest	9.5	28.6	19.1
Lowland coniferous forest	2,978.6	2,920.5	(58.1)
Disturbed	63.8	0.0	(63.8)
Upland coniferous forest	1,618.9	699.4	(919.5)
Total[1]	6,495.4	7,075.0	579.6

Source: MDNR 2006b.

[1] Total acres may be more or less than presented due to rounding.

Culturally Important Plants

The Land Exchange Proposed Action would result in additional wild rice beds on the federal estate by the acquisition of Tract 1. Tract 1 contains Little Rice Lake, which supports a continuous population of wild rice. Wild rice also grows along the Pike River south of Little Rice Lake and in isolated populations on Hay Lake. Section 4.3.4.2.5 provides further discussion of wild rice on Tract 1. Wild rice does not currently grow within the proposed federal land boundaries. Though the Land Exchange would result in an increase in wild rice beds within the federal estate boundaries, there is existing public access to Tract 1 wild rice beds via the Pike River. Consequently, there would be no change in wild rice harvest opportunities for the public. A carry-down boat launching access point is located on Tract 1, which may provide private access for wild rice harvesting on the Tract 1 lands.

Natural resources culturally important to the Bands are discussed in Section 4.2.9.3.3.

Minnesota Biological Survey

The Land Exchange Proposed Action would result in a decrease to the federal estate of 6,142.7 acres of MBS Sites of High Biodiversity Significance in the Laurentian Uplands subsection, and an increase of 116.9 acres of MBS Sites of High Biodiversity Significance in the North Shore Highlands subsection. Furthermore, the Land Exchange Proposed Action would result in an increase to the federal estate of 767.6 acres of MBS Sites of Moderate Biodiversity Significance in the Laurentian Uplands subsection.

Native plant community rankings are largely unavailable for the non-federal lands, with the exception of Lake County South, which has one site ranked as “vulnerable” and others ranked as “apparently secure.” Section 4.3.4.2.6 provides further discussion of native plant community types on the Lake County South parcel. The Land Exchange Proposed Action would result in a decrease to the federal estate of three native plant communities on the federal lands that are ranked as “imperiled” to “vulnerable” in the state. A native plant community increase or decrease comparison cannot be accurately made since rankings are unavailable for much of the non-federal lands.

Management Areas

In conjunction with landscape ecosystem objectives, the USFS has developed desired future conditions and objectives, based on management areas, which describe what is desired socially and economically (USFS 2004b). The majority of the non-federal lands (86 percent) would be allocated to the General Forest Management Area upon completion of the Land Exchange Proposed Action. This management area provides a wide variety of goods, uses, and services, including wood products, scenic quality, recreation opportunities, and habitat types (USFS 2004b). The remaining non-federal lands would be allocated to the General Forest – Longer Rotation Management Area (7 percent), Potential/cRNA (4 percent), and Riparian Areas Management Area (3 percent). Section 5.3.1 provides a discussion of management area allocations on the non-federal lands for the Land Exchange Proposed Action.

Through the acquisition of Tract 1, the Land Exchange Proposed Action would result in a gain of a large contiguous block of land and lakeshore/river frontage. The majority of this tract (94 percent) would be allocated to the General Forest Management Area, with the balance allocated as a cRNA (6 percent). Two cRNA lands abut Tract 1 (USFS 2011b) and, upon completion of the Land Exchange Proposed Action, these two cRNA lands would be extended onto the parcel. The Pike Mountain cRNA is located at the southwestern corner of Tract 1. Approximately 135 acres of Tract 1 are proposed to be added to the Pike Mountain cRNA because it is an extension of the northern hardwood uplands with a high sugar maple component. The Loka Lake cRNA is located at the northeastern corner of Tract 1. Approximately 172 acres of the parcel are proposed to be added to the Loka Lake cRNA because it is an extension of the high-quality lowland black spruce and tamarack swamp.

The Land Exchange Proposed Action would result in Tract 2 being allocated as Riparian Areas (83 percent) and General Forest – Longer Rotation Management Area (17 percent) (USFS 2011b). The Riparian Emphasis Area Management Area provides protection to diverse age classes, but generally for older-growth forest stands along sensitive riparian areas.

The majority of Tract 3 would be allocated to the General Forest Management Area (92 percent), with the remaining 8 percent allocated to the General Forest – Longer Rotation Management Area (USFS 2011b).

All of Tracts 4 and 5 would be allocated to the General Forest – Longer Rotation Management Area (USFS 2011b). Obtaining Tract 5 would result in a gain of lakeshore property.

Overall, there would be a large increase to the federal estate in the General Forest Management Area (5,714.1 acres) and smaller increases in the cRNA (306.9 acres) and Riparian Areas (220.9 acres) Management Areas as a result of the Land Exchange Proposed Action (see Table 5.3.4-3). There would be a decrease to the federal estate of 5,662.3 acres of the General Forest – Longer Rotation Management Area. The lands to be acquired as part of the Land Exchange Proposed Action would be managed in accordance with Forest Plan standards and guidelines. Section 5.3.1 describes the management areas in detail.

Table 5.3.4-3 Net Increase or Decrease to the Federal Estate of Management Areas under the Land Exchange Proposed Action

	Federal Lands		Non-federal Lands		Net Increase/ (Decrease)
Category	**Acres**	**%**	**Acres**	**%**	**Acres**
General Forest	355.3	5	6,069.4	86	5,714.1
General Forest – Longer Rotation	6,140.2	95	477.8	7	(5,662.3)
Potential/cRNAs	0.0	0	306.9	4	306.9
Riparian Areas	0.0	0	220.9	3	220.9

Source: USFS 2011j.

Ecological Land Types

The Land Exchange Proposed Action would result in an increase to the federal estate of seven ELTs, including ELT 3, 4, 10, 11, 14, 17, and 18. Five of these ELTs are upland soils and two are lowland soils. The USFS would not lose representation of any ELTs currently on the federal lands, based on available data.

Management Indicator Habitats

The Land Exchange Proposed Action would result in an increase to the federal estate of upland forest (MIH 1; 1,364.5 acres), lowland black spruce-tamarack forest (MIH 9; 248.3 acres), and aquatic habitat (MIH 14; 226.7 acres), and a decrease of upland conifer forest (MIH 5; 1,172.5 acres) (see Table 5.3.4-4). The Land Exchange Proposed Action would also result in a decrease to the federal estate of lowland shrub habitat (160.1 acres), but an increase in lowland emergent (200.2 acres) and upland grass (43.3 acres) habitat types. While not considered MIH types, these are important habitats for several wildlife species. The fact that aquatic habitat (MIH 14) is not mapped on the federal lands results in an apparent increase to the federal estate in these categories, even though this habitat type does occur on the federal lands.

The Land Exchange Proposed Action would result in an increase to the federal estate of 2,507.6 acres of young and immature forest stands. However, it would result in a decrease to the federal estate of 2,029.6 acres of mature forest types. The Land Exchange Proposed Action would not result in a change to the federal estate of large patches (stands over 300 acres) of mature upland forests (MIH 13), as none exist on the federal lands (USFS 2012c) and the patches of mature forest on the non-federal lands are not part of the USFS Patch layer.

Table 5.3.4-4 Net Increase or Decrease to the Federal Estate of MIH Types and Age Classes under the Land Exchange Proposed Action

Category	Federal Land Acres [2]	Non-federal Land Acres [1,2]	Net Increase/ (Decrease) Acres
MIH Types			
MIH 1 (Upland Forest)	1,330.0	2,694.5	1,364.5
MIH 5 (Upland Conifer Forest)	1,252.4	79.9	(1,172.5)
MIH 9 (Lowland Black Spruce-tamarack Forest)	3,060.2	3,308.5	248.3
MIH 14 (Aquatic Habitat)	0.0	226.7	226.7
Lowland Shrub	492.3	332.2	(160.1)
Lowland Emergent	185.5	385.7	200.2
Upland Grass	0.0	43.3	43.3
Age Classes			
Young	271.1	778.2	507.1
Immature	1,539.2	3,539.7	2,000.5
Mature	3,854.2	1,824.6	(2,029.6)

Source: USFS 2010b.

[1] According to non-federal lands cover type table (see Table 4.3.4-3).
[2] Total acres may be more or less than presented due to rounding.

Landscape Ecosystems

The Land Exchange Proposed Action would result in a decrease to the federal estate of 2,016.6 acres of the Jack Pine-Black Spruce landscape ecosystem (0.65 percent decrease), but there would be an increase of 994.7 acres in the Lowland Conifer landscape ecosystem (0.08 percent increase) and 558.7 acres of the Mesic Red and White Pine landscape ecosystem (0.73 percent increase). The Superior National Forest, as part of the Land Exchange Proposed Action, would have increased representation in the Dry-Mesic Red and White Pine landscape ecosystem (682.9 acres; 0.11 percent increase), Mesic Birch-Aspen-Spruce-Fir landscape ecosystem (302.2 acres; 0.04 percent increase), Lowland Hardwood landscape ecosystem (66.5 acres; 0.01 percent increase), and the Sugar Maple landscape ecosystem (36.7 acres; 0.04 percent increase), and there would be an overall increase to the federal estate of 625.1 acres.

Within the Superior National Forest, the USFS tracks acreage of MIH types and age classes within each landscape ecosystem to better manage them within the broader ecological context. As a result of the Land Exchange Proposed Action, there would be an increase to the federal estate in acreage of MIH types and age classes within some landscape ecosystems and a decrease in others (see Table 5.3.4-5). The greatest percentage increase to the federal estate in MIH acreage within a landscape ecosystem is lowland black spruce-tamarack forest (MIH 9) in the Mesic Birch-Aspen-Spruce-Fir landscape ecosystem, while the greatest decrease is upland conifer forest (MIH 5) in the Jack Pine-Black Spruce landscape ecosystem. The greatest percentage increase to the federal estate in age class acreage within a landscape ecosystem is the immature age class in the Lowland Conifer landscape ecosystem, while the greatest decrease is the immature and mature age classes in the Jack Pine-Black Spruce landscape ecosystem. Overall, the Lowland Conifer landscape ecosystem would have the highest acreage increase to the federal estate in MIH types and age classes, while the Jack Pine-Black Spruce landscape ecosystem would have the highest acreage decrease in MIH types and age classes.

Table 5.3.4-5 Net Increase or Decrease to the Federal Estate of MIH Types and Age Classes within Landscape Ecosystems in the Superior National Forest under the Land Exchange Proposed Action

Landscape Ecosystem Name			Dry-Mesic Red and White Pine	Jack Pine-Black Spruce	Lowland Conifer	Lowland Hardwood	Mesic Birch-Aspen-Spruce-Fir	Mesic Red and White Pine	Sugar Maple
Category			**Net Increase/(Decrease)**						
MIH Types	MIH 1	Acres [1]	517.0	(1,374.7)	289.0	10.1	140.8	527.1	1.1
		% [2]	2	(4)	2	2	0	1	1
	MIH 5	Acres [1]	15.5	(1,089.3)	(121.2)	3.2	7.6	11.6	0.0
		% [2]	0	(8)	(2)	2	0	0	0
	MIH 9	Acres [1]	26.2	(390.7)	928.9	17.1	134.7	13.8	7.8
		% [2]	1	(7)	2	1	4	0	0
	MIH 14	Acres [1]	115.5	2.2	97.8	9.1	0.3	0.8	0.9
		% [2,3]	NA	NA	NA	NA	NA	NA	NA
Lowland Shrub		Acres [1]	3.0	(95.0)	(113.0)	24.0	19.0	0.0	0.0
		% [2]	0	(4)	(1)	4	1	0	0
Lowland Emergent		Acres [1]	6.0	(62.3)	348.1	3.2	0.0	2.4	3.1
		% [2]	1	(7)	5	1	0	0	0
Upland Grass		Acres [1]	0.0	(0.2)	15.4	0.0	0.0	0.0	23.6
		% [2]	0	0	5	0	0	0	0
Age Classes	Young	Acres [1]	250.8	(21.5)	188.0	5.6	51.1	9.3	23.6
		% [2]	15	(1)	18	7	2	0	0
	Immature	Acres [1]	178.7	(700.3)	2,170.2	2.3	50.4	298.9	0.0
		% [2]	1	(4)	28	1	0	1	0
	Mature	Acres [1]	129.2	(1,079.0)	(1,559.6)	22.5	181.6	247.1	8.9
		% [2]	1	(4)	(2)	1	1	1	6

Source: USFS 2010b; USFS 2011g.

[1] Total acres may be more or less than presented due to rounding.
[2] Percentage of acres increased or decreased on the federal estate within the entire landscape ecosystem.
[3] MIH 14 is not tracked on the federal lands; thus, percentage is NA (not applicable).

5.3.4.2.2 Invasive Non-native Plants

The Land Exchange Proposed Action would result in a reduction of occurrences of invasive non-native species on the federal lands, but an increase to the federal estate of similar occurrences of invasive non-native species on Tracts 1, 2, and 3, including common tansy, orange hawkweed, ox-eye daisy, and thistles. Tracts 4 and 5 would not have an increase of any occurrences of invasive non-native species.

5.3.4.2.3 Threatened and Endangered Plant Species

Endangered, Threatened, and Special Concern Plant Species

There are fewer occurrences of state-listed ETSC plant species on the non-federal lands (one species on Tract 1 and two species on Tract 5) than on the federal lands (10 species), so the USFS would have fewer populations as a result of the Land Exchange Proposed Action (see Table 5.3.4-6). The three species gained in the exchange are *Carex ormostachya, Woodsia scopulina,* and *Saxifraga paniculata*. Sections 4.3.4.2.5 and 4.3.4.2.9 provide a discussion of these species. There are no federally listed plant species in St. Louis, Lake, or Cook counties (USFWS 2012). Rulemaking was conducted with the intent to update the list of ETSC species (*Minnesota Rules*, parts 6134.0100 to 6134.0400), with new listings becoming effective on August 19, 2013 (MDNR 2013h). This FEIS considers any new listings, or changes in the previous listings, associated with the updated list.

Though the 10 known state-listed ETSC plant species on the federal lands are not known to occur on the non-federal lands, the Land Exchange Proposed Action would result in an increase to the federal estate of most habitats important to them. The Land Exchange Proposed Action would result in additional grassland habitat, which *Botrychium campestre* and *Botrychium pallidum* occupy. The Land Exchange Proposed Action would also result in an increase to the federal estate of upland deciduous and mixed forest habitats, used by *Botrychium pallidum*, *Botrychium rugulosum*, and *Botrychium simplex*. There would be an increase to the federal estate of aquatic habitats (open water or wetlands) for *Caltha natans*, *Eleocharis nitida*, *Juncus stygius* var. *americanus*, and *Torreyochloa pallida*. According to the MIH analysis, the Land Exchange Proposed Action would result in an increase to the federal estate of lowland black spruce or tamarack habitats, which could mean more habitats for *Platanthera clavellata*, *Pyrola minor*, and *Ranunculus lapponicus*.

Table 5.3.4-6 Increase or Decrease to the Federal Estate of State-listed ETSC Plant Populations under the Land Exchange Proposed Action

	Federal Lands Populations		Non-federal Lands Populations		
Plant Species (State Status/ Global Status[1])	**Total Populations[2,3]**	**Total Individuals[3]**	**Total Populations[2,3]**	**Total Individuals[3]**	**Net Species Increase/ (Decrease)**
Botrychium pallidum (SC/G3)	1	2	0	NA	(1)
Botrychium rugulosum (SC/G3)	1	4	0	NA	(1)
Botrychium simplex (SC/G5)	3	905	0	NA	(1)
Caltha natans (E/G5)	1	29	0	NA	(1)
Eleocharis nitida (SC/G4)	1	~486 ft^2	0	NA	(1)
Juncus stygius var. *americanus* (SC/G5)	1	1	0	NA	(1)
Platanthera clavellata (SC/G5)	1	5	0	NA	(1)
Pyrola minor (SC/G5)	1	10	0	NA	(1)
Ranunculus lapponicus (SC/G5)	1	~919 ft^2	0	NA	(1)
Torreyochloa pallida (SC/G5)	1	~25 ft^2	0	NA	(1)
Carex ormostachya (SC/G4)	0	NA	1	>20	1
Woodsia scopulina (T/G5)	0	NA	1	2	1
Saxifraga paniculata (SC/G5)	0	NA	1	1,000	1
Total	12	NA	3	NA	(7)

Source: MDNR 2014d.

1 The state status is E – Endangered; T – Threatened; and SC – Species of Special Concern. The global ranks range from G1 to G5. A lower global ranking (e.g., G3) indicates a species at higher global risk than higher ranking (e.g., G5) (NatureServe 2014b).

2 Populations are interpreted from MDNR NHIS data using Element Occurrence; this differs from the DEIS, which used colonies as the population estimate.

3 Data included here were provided by the Division of Ecological Resources, MDNR, and were current as of August 5, 2014. These data are not based on an exhaustive inventory of the state. The lack of data for any geographic area shall not be construed to mean that no significant features are present.

Regional Foresters Sensitive Species

The USFS RFSS data layer indicates there are no RFSS plants on the federal lands. However, several state-listed ETSC plant species that occur on the federal lands are also listed as RFSS plants, including *Botrychium pallidum*, *Botrychium rugulosum*, *Botrychium simplex*, *Caltha natans*, *Eleocharis nitida*, *Juncus stygius* var. *americanus*, and *Pyrola minor*. The USFS would have a decrease to the federal estate in these RFSS plant species as a result of the Land Exchange Proposed Action. *Saxifraga paniculata* is a state-listed ETSC plant species that is also listed as a RFSS plant on the Tract 5 lands. The USFS would gain this RFSS plant species under the Land Exchange Proposed Action.

As with the NorthMet Project Proposed Action, the Land Exchange Proposed Action would not affect 20 RFSS plants on the Superior National Forest. In addition, the Land Exchange Proposed Action may affect individuals, but would not be likely to cause a trend to federal listing or loss of viability for the remaining 38 RFSS plants on the Superior National Forest. Please see the Biological Evaluation listed on the USFS website (http://www.fs.usda.gov/goto/superior/northmet) for more information about effects to RFSS plants.

There would be the greatest increase to the federal estate in acres of lowland black spruce-tamarack forest (MIH 9; see Table 5.3.4-4) as a result of the Land Exchange Proposed Action, which means there is the highest chance to gain the RFSS plants listed under that category in Table 4.2.4-5, as long as the suitable habitats exist on the non-federal lands. There would be smaller acreage increases of both upland forest (MIH 1) and aquatic habitat (MIH 14), meaning the RFSS plants in those categories could also be gained. The largest acreage decrease to the federal estate would be upland conifer forest (MIH 5). There are no RFSS plants specifically listed under upland conifer forest (MIH 5); however, it is likely that some RFSS plants that occupy upland forest (MIH 1) habitats would also occupy upland conifer forest (MIH 5) habitats and the USFS could therefore have a decrease to the federal estate in RFSS plant species that prefer coniferous upland habitats. There would also be a gain of Rove Formation cliff microhabitats, which are important for a variety of RFSS plants in the Superior National Forest.

5.3.4.2.4 Biodiversity

Biodiversity is described in the Forest Plan as the "variety of life and its ecological processes … [as well as] ecosystems, which comprise both the communities of organisms within particular habitats, and the physical conditions under which they live" (USFS 2004b). Biodiversity is important to consider for managing natural communities in a sustainable and ecological manner. Several data sources mentioned above and in Section 4.2.4 were compared on an increase or decrease basis to the federal estate to measure or estimate the biodiversity of both the federal and non-federal lands.

The federal land contains a high level of biodiversity because the majority of the parcel has been classified for inclusion in two Sites of High Biodiversity Significance. Additionally, several different native plant communities exist on it, as do 10 state-listed ETSC plant species. Because the non-federal lands have not been fully studied yet, they contain less biodiversity classification since they lack MBS Sites of High Biodiversity Significance and native plant communities. Table 5.3.4-1 provides a summary of the various data used to estimate biodiversity.

In summary, the non-federal lands contain 116.9 acres of MBS Sites of High Biodiversity Significance in the North Shore Highlands subsection and 767.9 acres of MBS Sites of Moderate Biodiversity Significance in the Laurentian Uplands subsection. The Land Exchange Proposed Action would result in a decrease to the federal estate of 6,142.7 acres of MBS Sites of High Biodiversity Significance in the Laurentian Uplands subsection, and an increase of 116.9 acres of MBS Sites of High Biodiversity Significance in the North Shore Highlands subsection. Furthermore, the Land Exchange Proposed Action would result in an increase to the federal estate of 767.6 acres of MBS Sites of Moderate Biodiversity Significance in the Laurentian Uplands subsection. Overall, there would be a decrease to the federal estate of 6,025.8 acres of MBS Sites of High Biodiversity Significance and an increase of 767.6 acres of MBS Sites of Moderate Biodiversity Significance under the Land Exchange Proposed Action. However, several of the non-federal lands have preliminary classifications of Sites as Moderate, High, or Outstanding Biodiversity Significance, which, if approved by the MDNR MBS program, would help balance the exchange.

Native plant community rankings are largely unavailable for the non-federal lands, with the exception of Lake County South, which has one site ranked as "vulnerable" and others ranked as "apparently secure." Section 4.3.4.2.6 provides further discussion of native plant community types on the Lake County South parcel. The Land Exchange Proposed Action would result in a decrease to the federal estate of three native plant communities on the federal lands that are ranked as "imperiled" to "vulnerable" in the state. A native plant community increase or decrease comparison cannot be accurately made since rankings are unavailable for much of the non-federal lands.

Endangered, Threatened, and Special Concern Plant Species

As previously stated, the federal lands support 10 known state-listed ETSC plant species, while the non-federal lands currently support three known state-listed ETSC plant species. This would be a decrease to the federal estate in known state-listed species as a result of the Land Exchange Proposed Action.

5.3.4.3 Land Exchange Alternative B

5.3.4.3.1 Cover Types

The effects of Land Exchange Alternative B would be comparable to those from the Land Exchange Proposed Action, although to a lesser extent. A smaller portion of the federal lands (approximately 4,752.6 acres) would be transferred into private ownership for the non-federal Tract 1 lands (approximately 4,926.3 acres), which would be conveyed into USFS ownership. Under this alternative, the USFS would retain a smaller federal parcel located on the northwestern and western sides of the current federal lands, which would create additional linear boundaries for the USFS to maintain (see Section 5.3.1).

Habitat Types

This alternative would result in an overall increase to the federal estate of 173.6 acres of MDNR GAP land cover types. As under the Land Exchange Proposed Action, the greatest increase to the federal estate would be shrubland acreage (1,227.7 acres), and upland conifer forest would have the greatest acreage decrease (928.8 acres), as shown in Table 5.3.4-7 below.

Table 5.3.4-7 Net Increase or Decrease to the Federal Estate of MDNR GAP Land Cover Types under Land Exchange Alternative B

Cover Types	Alternative B: Smaller Federal Parcel Acres	Tract 1 Acres [1]	Net Increase/ (Decrease) Acres
Shrubland	436.9	1,664.6	1,227.7
Aquatic environments	26.3	251.1	224.8
Upland deciduous forest	804.7	999.9	195.2
Cropland/grassland	2.2	31.7	29.5
Lowland deciduous forest	4.7	17.4	12.7
Upland conifer-deciduous mixed forest	17.8	0.0	(17.8)
Disturbed	29.1	0.0	(29.1)
Lowland coniferous forest	2,064.8	1,524.2	(540.6)
Upland coniferous forest	1,366.1	437.3	(928.8)
Total [2]	4,752.6	4,926.2	173.6

Source: MDNR 2006b.

[1] According to Tract 1 land cover type table (see Table 4.3.4-11).
[2] Total acres may be more or less than presented due to rounding.

Culturally Important Plants

As with the Land Exchange Proposed Action, Land Exchange Alternative B would result in additional wild rice beds on the federal estate from the acquisition of Tract 1, but would not result in a change in harvesting opportunities for the public. Section 5.3.4.2 provides additional information on wild rice.

As with the Land Exchange Proposed Action, see Section 4.2.9.3.3 for a discussion of natural resources culturally important to the Bands.

Minnesota Biological Survey

Land Exchange Alternative B would result in a decrease to the federal estate of 4,573.1 acres of MBS Sites of High Biodiversity Significance and a decrease of 0.3 acre of MBS Sites of Moderate Biodiversity Significance within the Laurentian Uplands subsection (see Table 5.3.4-1). Portions of the west end of One Hundred Mile Swamp would remain in federal ownership. Furthermore, Land Exchange Alternative B would result in removal from the Superior National Forest of three native plant communities that are ranked as “imperiled” to “vulnerable” in the state. As previously discussed, Tract 1 does not contain any MBS Sites of Biodiversity Significance or native plant communities, so, unlike the Land Exchange Proposed Action, the federal estate would not have an increase of either MBS sites or native plant communities under this alternative.

Management Areas

Lands included as part of Land Exchange Alternative B are currently managed under the General Forest – Longer Rotation Management Area (93 percent) and the General Forest Management Area (7 percent) (see Table 5.3.4-8). The majority of Tract 1 (94 percent) would be allocated to the General Forest Management Area upon completion of Land Exchange Alternative B, and the remaining area would be managed under the cRNA Management Area (6 percent). Land Exchange Alternative B would be comparable to the Land Exchange Proposed Action in that cRNA lands would be increased on the federal estate, but Riparian Areas would not be. Section 5.3.1 describes the management areas in detail.

Table 5.3.4-8 Net Increase or Decrease to the Federal Estate of Management Areas under Land Exchange Alternative B

Category	Alternative B: Smaller Federal Parcel Acres	Alternative B: Smaller Federal Parcel %	Tract 1 Acres	Tract 1 %	Net Increase/ (Decrease) Acres
General Forest	355.3	7	4,619.3	94	4,264.0
General Forest - Longer Rotation	4,397.3	93	0.0	0	(4,397.3)
Potential/candidate Research Natural Areas	0.0	0	306.9	6	306.9
Riparian Areas	0.0	0	0.0	0	0

Source: USFS 2011j.

Ecological Land Types

Land Exchange Alternative B would result in a decrease to the federal estate of five ELTs, including ELT 1, 2, 6, 13, and 16, which are currently located on the proposed smaller federal parcel. The ELTs are unavailable for Tract 1, and so a comparison cannot be made.

Management Indicator Habitats

Land Exchange Alternative B would result in an increase to the federal estate in upland forest (MIH 1; 1,411.8 acres) and aquatic habitat (MIH 14; 206.2 acres); however, there would be a decrease of upland conifer forest (MIH 5; 1,084.6 acres) and lowland black spruce-tamarack forest (MIH 9; 261.1 acres) (see Table 5.3.4-9). Though not considered MIH types, there would be a decrease to the federal estate of lowland shrubland habitat (272.1 acres) and an increase of lowland emergent wetlands (249.6 acres). Similar to the Land Exchange Proposed Action, the aquatic habitat (MIH 14) type is not fully mapped on lands that are part of Land Exchange Alternative B, resulting in an apparent increase to the federal estate in this category; however, this habitat type does occur on these lands.

There would be a large increase to the federal estate of immature forest stands (1,933.9 acres) with lesser amounts of young stands (262.7 acres), corresponding to a decrease of mature forest stands (2,114.5 acres). Land Exchange Alternative B would not result in a change to the federal estate of large patches (stands over 300 acres) of mature upland forest, as none exist on the Alternative B: Smaller Federal Parcel lands (USFS 2012c) and patch data does not exist for the Tract 1 lands.

Table 5.3.4-9 Net Increase or Decrease to the Federal Estate of MIH Types and Age Classes under Land Exchange Alternative B

Category	Alternative B: Smaller Federal Parcel Acres[2]	Tract 1 Acres[1,2]	Net Increase/ (Decrease) Acres
MIH Types			
MIH 1 (Upland Forest)	954.2	2,366.0	1,411.8
MIH 5 (Upland Conifer Forest)	1,138.8	54.2	(1,084.6)
MIH 9 (Lowland Black Spruce-tamarack Forest)	2,078.7	1,817.6	(261.1)
MIH 14 (Aquatic Habitats)	0.0	206.2	206.2
Lowland Shrubland	385.4	113.3	(272.1)
Lowland Emergent	115.4	365.0	249.6
Upland Grass	0.0	0.0	0.0
Age Classes			
Young	271.1	533.8	262.7
Immature	1,325.9	3,259.8	1,933.9
Mature	2,574.7	460.2	(2,114.5)

Source: USFS 2010b.

[1] According to Tract 1 lands MIH table (see Table 4.3.4-3).
[2] Total acres may be more or less than presented due to rounding.

Landscape Ecosystems

Land Exchange Alternative B would result in a decrease to the federal estate of 1,411.6 acres of the Jack Pine-Black Spruce landscape ecosystem (0.46 percent decrease), but result in an increase of 486.2 acres of the Lowland Conifer landscape ecosystem (0.04 percent increase). Furthermore, there would be an increase in representation in the Dry-Mesic Red and White Pine landscape ecosystem (589.2 acres; 0.10 percent increase), Mesic Red and White Pine landscape ecosystem (528.0 acres; 0.69 percent increase), and the Mesic Birch-Aspen-Spruce-Fir landscape ecosystem (0.9 acres; less than 0.01 percent increase), and an overall increase to the federal estate of 192.7 acres.

Similar to the Land Exchange Proposed Action, Land Exchange Alternative B would result in an increase to the federal estate in acreage of MIH types and age classes within various landscape ecosystems, and a decrease in acreage in others (see Table 5.3.4-10). The greatest percentage increase to the federal estate in MIH acreage within a landscape ecosystem is upland forest (MIH 1) in the Lowland Conifer and Dry-Mesic Red and White Pine landscape ecosystems, while the greatest decrease is upland conifer forest (MIH 5) in the Jack Pine-Black Spruce landscape ecosystem. The largest percentage increase to the federal estate in age class acreage within a landscape ecosystem is the immature age class in the Lowland Conifer landscape ecosystem, while the largest decrease is in the immature age class in the Jack Pine-Black Spruce landscape ecosystem and the mature age classes within the Jack Pine-Black Spruce and Lowland Conifer landscape ecosystems. Overall, the Dry-Mesic Red and White Pine landscape ecosystem would have the highest acreage increase to the federal estate of MIH types and age classes and the Jack Pine-Black Spruce landscape ecosystem would have the highest acreage decrease of MIH types and age classes.

Table 5.3.4-10 Net Increase or Decrease to the Federal Estate of MIH Types and Age Classes within Landscape Ecosystems in the Superior National Forest under Land Exchange Alternative B

Landscape Ecosystem Name			Dry-Mesic Red and White Pine	Jack Pine-Black Spruce	Lowland Conifer	Lowland Hardwood	Mesic Birch-Aspen-Spruce-Fir	Mesic Red and White Pine	Sugar Maple
Category			**Net Increase/(Decrease)**						
MIH Types	MIH 1	Acres [1]	437.8	(1,007.1)	340.3	0.0	0.9	501.1	0.0
		% [2]	2	(3)	2	0	0	1	0
	MIH 5	Acres [1]	6.0	(998.2)	(100.1)	0.0	0.0	7.7	0.0
		% [2]	0	(7)	(2)	0	0	0	0
	MIH 9	Acres [1]	26.2	(290.9)	(10.5)	0.0	0.0	13.9	0.0
		% [2]	1	(6)	0	0	0	0	0
	MIH 14	Acres [1]	114.2	2.2	89.6	0.0	0.0	0.2	0.0
		% [2,3]	NA	NA	NA	NA	NA	NA	NA
Lowland Shrub		Acres [1]	0.0	(66.4)	(207.3)	0.0	0.0	0.1	0.0
		% [2]	0	(3)	(1)	0	0	0	0
Lowland Emergent		Acres [1]	5.0	(23.5)	265.7	0.0	0.0	2.4	0.0
		% [2]	1	(3)	4	0	0	0	0
Upland Grass		Acres [1]	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		% [2]	0	0	0	0	0	0	0
Age Classes	Young	Acres [1]	229.4	(21.5)	45.5	0.0	0.0	9.3	0.0
		% [2]	14	(1)	4	0	0	0	0
	Immature	Acres [1]	148.5	(528.7)	2,014.3	0.0	0.9	298.9	0.0
		% [2]	1	(3)	26	0	0	1	0
	Mature	Acres [1]	92.1	(726.1)	(1,709.8)	0.0	0.0	217.1	0.0
		% [2]	1	(3)	(3)	0	0	1	0

Source: USFS 2010b; USFS 2011g.

[1] Total acres may be more or less than presented due to rounding.
[2] Percentage of acres increased or decreased on the federal estate within the entire landscape ecosystem.
[3] MIH 14 is not tracked on the federal lands; thus, percentage is NA.

5.3.4.3.2 Invasive Non-native Plants

Land Exchange Alternative B would result in a reduction of occurrences of invasive non-native species on the smaller federal parcel, but in an increase to the federal estate of similar occurrences of invasive non-native species on Tract 1, including common tansy, orange hawkweed, and ox-eye daisy.

5.3.4.3.3 Threatened and Endangered Plant Species

<u>Endangered, Threatened, and Special Concern Plant Species</u>

Under Land Exchange Alternative B, a smaller portion of the federal lands would be exchanged for Tract 1. The same 10 ETSC plant species would be exchanged as for the Land Exchange Proposed Action, but fewer colonies would be exchanged. There is one known state-listed ETSC plant species located on Tract 1 (*Carex ormostachya*). Overall, 12 populations of 10 different species on the smaller federal parcel would be exchanged for one population of one species on Tract 1 (see Table 5.3.4-11). Rulemaking was conducted with the intent to update the list of ETSC species (*Minnesota Rules*, parts 6134.0100 to 6134.0400), with new listings becoming effective on August 19, 2013 (MDNR 2013h). This FEIS considers any new listings, or changes in the previous listings, associated with the updated list.

Table 5.3.4-11 Increase or Decrease to the Federal Estate of State-listed ETSC Plant Populations under Land Exchange Alternative B

	Alternative B: Smaller Federal Parcel Populations		Tract 1 Populations		
Plant Species (State Status/ Global Status[1])	**Total Populations[2,3]**	**Total Individuals[3, 4]**	**Total Populations[2,3]**	**Total Individuals[3]**	**Net Species Increase/ (Decrease)**
Botrychium pallidum (SC/G3)	1	2	0	NA	(1)
Botrychium rugulosum (SC/G3)	1	4	0	NA	(1)
Botrychium simplex (SC/G5)	3	905	0	NA	(1)
Caltha natans (E/G5)	1	29	0	NA	(1)
Eleocharis nitida (SC/G4)	1	~486 ft^2	0	NA	(1)
Juncus stygius var. *americanus* (SC/G5)	1	1	0	NA	(1)
Platanthera clavellata (SC/G5)	1	3	0	NA	(1)
Pyrola minor (SC/G5)	1	10	0	NA	(1)
Ranunculus lapponicus (SC/G5)	1	~919 ft^2	0	NA	(1)
Torreyochloa pallida (SC/G5)	1	~25 ft^2	0	NA	(1)
Carex ormostachya (SC/G4)	0	NA	1	>20	1
Total	12	NA	1	NA	(9)

Source: MDNR 2014d.

[1] The state status is E – Endangered; T – Threatened; and SC – Species of Special Concern. The global ranks range from G1 to G5. A lower global ranking (e.g., G3) indicates a species at higher global risk than higher ranking (e.g., G5) (NatureServe 2014b).

[2] Populations are interpreted from MDNR NHIS data using Element Occurrence; this differs from the DEIS, which used colonies as the population estimate.

[3] Data included here were provided by the Division of Ecological Resources, MDNR, and were current as of August 5, 2014. . These data are not based on an exhaustive inventory of the state. The lack of data for any geographic area shall not be construed to mean that no significant features are present. NA = Not Applicable.

[4] Where the number of individuals could not be determined without damaging the population, then patch size was used as a representative abundance measure.

Regional Foresters Sensitive Species

The USFS RFSS data layer indicates there are no RFSS plants on the federal lands, which includes the smaller federal parcel. However, several state-listed ETSC plant species occur on the smaller federal parcel that are also RFSS plants, including *Botrychium pallidum*, *Botrychium rugulosum*, *Botrychium simplex*, *Caltha natans*, *Eleocharis nitida*, *Juncus stygius* var. *americanus*, and *Pyrola minor*.

As with the Land Exchange Proposed Action, the Land Exchange Alternative B would not affect 20 RFSS plants on the Superior National Forest. In addition, the Land Exchange Alternative B may affect individuals, but would not be likely to cause a trend to federal listing or loss of viability for the remaining 38 RFSS plants on the Superior National Forest. Please see the

Biological Evaluation listed on the USFS website (http://www.fs.usda.gov/goto/superior/northmet) for more information about effects to RFSS plants.

There would be an increase to the federal estate in acres of upland forest (MIH 1) and aquatic habitat (MIH 14) as a result of Land Exchange Alternative B (see Table 5.3.4-9), which means there would be the greatest opportunity to gain the RFSS plants listed under those categories in Table 4.2.4-5. There would be a decrease to the federal estate in acreage of upland conifer forest (MIH 5) and lowland black spruce-tamarack forest (MIH 9), which means the RFSS plant species that prefer these habitat types and have suitable microhabitats may also be decreased on National Forest System lands.

5.3.4.3.4 Biodiversity

The smaller federal parcel contains a high level of biodiversity because the majority of the parcel has been classified for inclusion in two MBS Sites of High Biodiversity Significance. Additionally, several different native plant communities exist on it, as well as 10 state-listed ETSC plant species. Because Tract 1 has not been fully studied, it is assumed to contain less biodiversity because it lacks MBS Sites of High Biodiversity Significance and native plant communities. However, inclusion of the preliminary Site of Outstanding Biodiversity Significance on Tract 1 would balance the exchange, if not make it more biodiverse than the smaller federal parcel. Table 5.3.4-1 provides a summary of the various data used to estimate biodiversity.

Land Exchange Alternative B would result in a decrease to the federal estate of 4,573.1 acres of MBS Sites of High Biodiversity Significance and a decrease of 0.3 acres of MBS Sites of Moderate Biodiversity Significance within the Laurentian Uplands subsection (see Table 5.3.4-1). Portions of the west end of One Hundred Mile Swamp would remain in federal ownership.

Furthermore, Land Exchange Alternative B would result in removal from the Superior National Forest of three native plant community sites that are ranked as “imperiled” to “vulnerable” in the state. As previously discussed, Tract 1 does not contain any MBS Sites of Biodiversity Significance or native plant communities, so, unlike the Land Exchange Proposed Action, the federal estate would not have an increase of either MBS Sites or native plant communities under this alternative.

5.3.4.4 Land Exchange No Action Alternative

Under the Land Exchange No Action Alternative, the Superior National Forest would have an ongoing responsibility for managing vegetation resources on the federal lands in accordance with the Forest Plan. The Land Exchange No Action Alternative would not change the USFS’s responsibility for managing vegetation resources and would result in no further effects on existing vegetation.

5.3.4.4.1 Cover Types

Under the Land Exchange No Action Alternative, the current federal lands would remain in federal ownership and the lands would continue to be managed under the General Forest – Longer Rotation Management Area and the General Forest Management Area. Direct and indirect effects of the Land Exchange No Action Alternative on cover types would be unchanged, as the management of these forests has occurred on site in the past. None of the federal lands currently have any vegetation management actions planned in the near future, regardless of whether the Land Exchange Proposed Action were to occur.

5.3.4.4.2 Invasive Non-native Plants

Non-native species may still invade the federal lands as a result of logging, mineral exploration, vehicle traffic, and natural disturbances, but are likely to do so much more slowly than they would under the Land Exchange Proposed Action. The proximity of the federal lands to the already-disturbed Plant Site may put the federal lands at risk of eventual colonization by invasive non-native species.

5.3.4.4.3 Threatened and Endangered Plant Species

Under the Land Exchange No Action Alternative, timber harvests are expected to continue to occur on the federal lands, though there are not any planned in the near future. Effects on ETSC plant species and RFSS plants, for different management techniques, are addressed in the Forest Plan (USFS 2004b). As discussed in the Biological Evaluation, the Land Exchange No Action Alternative would not have effects on RFSS species.

5.3.4.4.4 Biodiversity

The Land Exchange No Action Alternative would not result in any change to biodiversity on the federal lands.

5.3.5 Wildlife

This section describes the environmental consequences of the Land Exchange to wildlife on the federal and non-federal lands. Effects from the change in federal ownership could be either beneficial or adverse, based on the change in species occurrences, habitat, and habitat connectivity on land that is under direct federal control. Effects due to the NorthMet Project Proposed Action are discussed in Section 5.2.5.

Rulemaking was conducted with the intent to update the list of ETSC species (*Minnesota Rules*, parts 6134.0100 to 6134.0400), with new listings becoming effective on August 19, 2013 (MDNR 2013h). This FEIS considers any new listings, or changes in the previous listings, associated with the updated list.

A Biological Assessment that provides further information on federally listed species, and a Biological Evaluation that contains further information about RFSS have been prepared. The Biological Assessment and Biological Evaluation are included in Appendix D and are posted on the USFS website (http://www.fs.usda.gov/goto/superior/northmet). The Biological Assessment analyzes impacts to the Canada lynx, gray wolf, and northern long-eared bat. Land Exchange alternatives were analyzed in the Biological Assessment for the NorthMet Mining Project and Land Exchange. The organization of the methodologies and discussion in the Biological Assessment and Biological Evaluation may be different from the FEIS. Both documents also contain determinations of effect for the species discussed.

The Land Exchange Proposed Action would have mixed effects for the Canada lynx. It would result in an increase in suitable habitat for lynx and for snowshoe hare (prey species) on the federal estate (although the amount of unsuitable lynx habitat would also increase). It would also result in a decrease of denning habitat and a decrease to the federal estate within designated LAUs. Critical lynx habitat would not change regardless of ownership.

The Land Exchange Proposed Action would result in an increase in the number of occurrences and forage habitat availability for the gray wolf within the federal estate, but would result in a decrease in cover habitat. The Land Exchange Proposed Action would result in a net decrease of potential northern long-eared bat roosting habitat but an increase in foraging habitat within the federal estate.

Overall, the Land Exchange Proposed Action would result in an increase (to the federal estate) of the number of occurrences and habitat availability for two state-listed species of special concern, which include the Laurentian tiger beetle and the trumpeter swan (see Table 5.3.5-1). The Land Exchange Proposed Action is not expected to result in changes to the three additional state-listed and special concern species, which include the wood turtle, the eastern heather vole, and the yellow rail.

Under the Land Exchange Proposed Action, one additional state-listed species and 22 additional SGCN would be affected due to their presence on the federally held lands. The Land Exchange Proposed Action would result in an increase of up to 579.6 acres of habitat within the federal state in the Superior National Forest. While forested habitat would be decreased, shrubland/grassland and aquatic habitats would be increased as part of the Land Exchange Proposed Action. Under the Land Exchange Proposed Action, lands to be acquired would be managed by the USFS in accordance with the current Forest Plan. No activities are planned on these lands.

Under the Land Exchange Alternative B, one additional state-listed species but one less SGCN would be affected because they occur within the federal estate. Forest habitat under federal ownership would also decrease, though by a smaller amount than under the Land Exchange Proposed Action. Similarly, the Land Exchange Alternative B would result in an increase of 173.6 acres of habitat to the federal estate, with a distribution of habitat similar to the Land Exchange Proposed Action. As with the Land Exchange Proposed Action, lands acquired under the Land Exchange Alternative B would be managed by the USFS in accordance with the current Forest Plan. There are no activities planned on these lands.

As discussed in the Biological Evaluation, the USFS determined that the Land Exchange Proposed Action and Land Exchange Alternative B may affect individuals but are not likely to cause a trend to federal listing or loss of viability for 18 RFSS terrestrial wildlife species on the Superior National Forest.

Under the Land Exchange No Action Alternative, no action would be taken. No lands would be exchanged and no changes in wildlife species on the federal estate would be anticipated. As discussed in the Biological Evaluation, the Land Exchange No Action Alternative would have no effect on RFSS species.

Table 5.3.5-1 Increase or Decrease of Special Status Wildlife Species on the Federal Estate Resulting from the Land Exchange Proposed Action and Alternatives

	Increase or (Decrease) of Special Status Wildlife Species			
Alternative	**Federally Listed Species**	**State-listed Species**	**Regional Forester Sensitive Species**	**Species of Greatest Conservation Need**
Land Exchange Proposed Action	0	2	0	22
Land Exchange Alternative B	0	2	0	(1)
Land Exchange No Action Alternative	0	0	0	0

Table 5.3.5-2 Increase or Decrease of Key Habitat Types on the Federal Estate Resulting from the Land Exchange Proposed Action and Alternatives

	Increase or (Decrease) of Acres[1] of Key Habitat Types				
Alternative	**Mature Upland Forest, Continuous Upland/Lowland Forest (MIH1-13)**	**Open Ground, Bare Soils (no MIH)**	**Grassland and Brushland, Early Successional Forest (no MIH)**	**Aquatic Environments (MIH 14)**	**Total Net Increase or (Decrease)**
Land Exchange Proposed Action	(787.9)	(63.8)	1,224.9	206.5	579.6
Land Exchange Alternative B	(1,279.3)	(29.1)	1,257.2	224.8	173.6
Land Exchange No Action Alternative	0	0	0	0	0

Source: Tables 5.3.4-2 and 5.3.4-7.

[1] Total acres may be more or less than presented due to rounding.

5.3.5.1 Methodology and Evaluation Criteria

Evaluation was conducted to determine the potential effect that the Land Exchange Proposed Action would have on wildlife on the federal estate species from the following:

- a change in federal and state-listed ETSC, SGCN, RFSS, and other wildlife species; and
- a change in habitat availability, prey species habitat availability, habitat connectivity, and adjacent land use.

Analysis of wildlife species affected by the Land Exchange Proposed Action was guided by evaluation criteria that were developed by the USFS and other Co-lead Agencies, which included a comparison of the vegetation land cover and habitat types, forest age classes (young, immature, and mature), large mature forest patches, road and trail densities, federal and state-listed ETSC, SGCN, RFSS, and other wildlife species. GIS data and field observations for these categories were gathered to the extent possible and then compared over an area of analysis that included the federal and non-federal lands and LAU.

5.3.5.2 Land Exchange Proposed Action

5.3.5.2.1 Federally Listed Species

Canada Lynx

The federal lands of the Land Exchange Proposed Action include lynx habitat and habitat for lynx prey species. Lynx habitat includes a wide variety of upland and lowland habitats and forest types/ages, shrubland, and grasslands, but excludes aquatic environments and disturbed areas. Preferred denning habitat is typically found in mature forest and is generally more dependent on forest age classes, with trees older than saplings and with a dbh greater than 5 inches (immature and mature age classes; see Table 4.3.4-3). Snowshoe hare are the primary prey species for the Canada lynx, and hare habitat includes all types and age classes of forest and shrubland, but not aquatic environments, disturbed areas, or grassland/croplands (see Table 5.3.5-3).

Table 5.3.5-3 Increase or Decrease in Suitable Habitat Types for Canada Lynx and Prey Species on the Federal Estate Resulting from the Land Exchange Proposed Action and Alternatives

Parcel	General Suitable Lynx Habitat (Acres[1])	Suitable Denning Habitat (Acres[1])	Suitable Snowshoe Hare Forage Habitat (Acres[1])	Unsuitable Lynx Habitat (Acres[1])
Land Exchange Proposed Action				
Federal Lands	6,371.5	5,393.4	6,365.3	123.9
Non-Federal Lands Total	6,808.4	5,364.3	6,776.7	250.8
Tract 1 – Hay Lake	4,675.1	3,720.0	4,643.4	251.1
Tract 2 – Lake County North	263.3	219.5	263.3	1.8
Tract 2 – Lake County South	112.8	48.4	112.8	4.0
Tract 3 – Wolf Lands 1	125.9	113.9	125.9	0.0
Tract 3 – Wolf Lands 2	767.9	683.8	767.9	0.0
Tract 3 – Wolf Lands 3	277.4	96.7	277.4	0.0
Tract 3 – Wolf Lands 4	404.7	359.7	404.7	0.0
Tract 4 – Hunting Club	150.7	92.2	150.7	9.6
Tract 5 – McFarland Lake	30.6	30.1	30.6	0.2
Net Increase/(Decrease)	436.9	(29.1)	411.4	126.9
Land Exchange Alternative B				
Smaller Federal Parcel	4,697.2	3,912.9	4,695.0	55.4
Tract 1 – Hay Lake	4,675.1	3,720.0	4,643.4	251.1
Net Increase/(Decrease)	(22.1)	(192.9)	(51.6)	195.7

Source: Tables 5.2.5-5, 4.3.4-3, and 4.3.4-8.

[1] Total acres may be more or less than presented due to rounding.

As shown in Table 5.3.5-3, the federal lands of the Land Exchange Proposed Action include 6,371.5 acres of suitable general habitat for lynx. The non-federal lands include a total of 6,808.4 acres of potentially suitable habitat, which is an increase of 436.9 acres. Aquatic environments and disturbed areas are considered unsuitable habitat, along with lowlands with dead trees (though this habitat was not specifically called out in habitat/cover data). The Land Exchange Proposed Action would also result in an increase to the federal estate of 411.4 acres of hare habitat. However, the Land Exchange Proposed Action would result in a decrease to the federal estate of 29.1 acres of denning habitat and an increase of 126.9 acres of unsuitable lynx habitat.

Lynx may utilize snow packed trails and roads as travel corridors as they are energetically easier to navigate, but they do not rely strictly on them. The federal lands do not contain any established snow packed trails (such as snowmobile trails) but are crossed by 6.9 miles of road surface. The non-federal lands are crossed by 0.03 mile of snow packed trail (snowmobile trail) and 2.2 miles of roads. The Land Exchange Proposed Action would result in a decrease to the federal estate of 4.7 miles of road and an increase to the federal estate of 0.03 mile of snow packed trails available for lynx use (see Table 5.3.5-4).

Table 5.3.5-4 Increase or Decrease of Lynx Travel Corridors on the Federal Estate Resulting from the Land Exchange Proposed Action and Alternatives

Travel Corridor Type	Established Snow Pack Trails (Miles)	Established Roads (Miles)
Land Exchange Proposed Action		
Federal Lands	0.0	6.9
Non-Federal Lands Total	0.03	2.2
Tract 1 – Hay Lake	0.0	2.2
Tract 2 – Lake County North	0.0	0.0
Tract 2 – Lake County South	0.0	0.0
Tract 3 – Wolf Lands 1	0.0	0.0
Tract 3 – Wolf Lands 2	0.0	0.0
Tract 3 – Wolf Lands 3	0.03	0.0
Tract 3 – Wolf Lands 4	0.0	0.0
Tract 4 – Hunting Club	0.0	0.0
Tract 5 – McFarland Lake	0.0	0.0
Net Increase/(Decrease)	0.03	(4.7)
Land Exchange Alternative B		
Smaller Federal Parcel	0.0	6.9
Tract 1 – Hay Lake	0.0	2.2
Net Increase/(Decrease)	0.0	(4.7)

Source: USFS 2011e.

Land ownership immediately adjacent to the federal lands is a mix of private, state, and federal. The proximity of private lands and disturbance to the north and west may limit lynx passage and utilization of habitat on the federal lands.

Overall, the land ownership patterns surrounding the non-federal lands are mixed. Federal land proximity and, thus potential habitat connectivity, is marginal on Tract 1. Connectivity on the other tracts is generally more favorable. Located in less developed areas of the Superior National Forest, these tracts are generally bordered by federal, state, or county lands and are intended to reduce fragmentation. As such, the Land Exchange Proposed Action is likely to result in generally improved habitat connectivity overall.

Because all federal and non-federal lands are located within lynx critical habitat and would remain so regardless of ownership, the Land Exchange Proposed Action would not result in a change to lynx critical habitat to the federal estate. As previously discussed, LAU were identified for purposes of analysis and development of conservation measures for lynx (USFS 2004b). The federal lands are located within LAU 12 and the non-federal lands are located in LAU 4, 16, 21, 22, and 42. Tract 1 is not located within an LAU. The USFS indicated that no development or activities are planned on the non-federal lands, which means that there would be no increase in unsuitable habitat due to the Land Exchange Proposed Action (see Table 5.3.5-5). As such, the percentage of currently unsuitable habitat in the overall LAU is not expected to change, nor would it affect the Forest Plan condition that unsuitable habitat not exceed 30 percent of the LAU (USFS 2013).

Table 5.3.5-5 Increase or Decrease in Lynx Analysis Units on the Federal Estate Resulting from the Land Exchange Proposed Action and Alternatives

Parcel	Lynx Analysis Unit	Total Acres[1] of Proposed Land Exchange Federal/Non-Federal Land Within LAU	Overall Lynx Analysis Unit Acreage[1]	Current Percentage (%) of LAU Unsuitable (Determined by USFS)
Land Exchange Proposed Action				
Federal Parcel	12	6,495.4	70,980.5	4.0
Non-Federal Lands Subtotal		2,149.7		
Tract 1 – Hay Lake	No LAU	NA	NA	NA
Tract 2 – Lake County North	16	265.2	76,108.3	4.4
Tract 2 – Lake County South	22	116.9	58,154.2	1.6
Tract 3 – Wolf Lands 1	16	126.0	76,108.3	4.4
Tract 3 – Wolf Lands 2	21	768.0	73,265.8	4.2
Tract 3 – Wolf Lands 3	21	277.5	73,265.8	4.2
Tract 3 – Wolf Lands 4	21	404.8	73,265.8	4.2
Tract 4 – Hunting Club	4	160.4	55,071.4	4.9
Tract 5 – McFarland Lake	42	30.9	32,305.4	1.9
Net Increase/(Decrease)		(4,345.7)		
Land Exchange Alternative B				
Smaller Federal Parcel	12	4,752.7		
Tract 1 – Hay Lake	No LAU	NA	NA	NA
Net Increase/(Decrease)		(4,752.7)		

Source: Superior National Forest Monitoring and Evaluation Report (USFS 2009a)

[1] Total acres may be more or less than presented due to rounding.

The Land Exchange Proposed Action would have mixed effects for the Canada lynx. It would result in an increase to the federal estate of overall suitable habitat for lynx and for snowshoe hare (prey species) to the federal estate (although the amount of unsuitable lynx habitat would also increase). It would also result in a decrease to the federal estate of denning habitat and a decrease of federal lands within designated LAU. Critical lynx habitat would not change regardless of ownership. Effects on the Canada lynx and its critical habitat are described in more detail in the Biological Assessment.

Gray Wolf

The federal lands are likely part of a territory occupied by a single pack of wolves. The federal lands are dominated by trees that range in age from immature to mature, which is adequate cover habitat for wolves. Approximately 271 acres of young forest are present for forage opportunities on the federal lands and 778 acres are present on the non-federal lands (see Table 4.3.4-3). There are 5,393.4 acres of cover habitat on the federal lands and 5,364.3 acres on the non-federal lands (see Table 5.3.5-6). Gray wolves or their sign were observed on Tracts 1, 2, 3, and 5.

Table 5.3.5-6 Increase or Decrease in Gray Wolf Habitat on the Federal Estate Resulting from the Land Exchange Proposed Action and Alternatives

Parcel	Forage Habitat (Acres)	Cover Habitat (Acres[1])
Land Exchange Proposed Action		
Federal Lands	271.1	5,393.4
Non-Federal Lands Total	778.2	5,364.3
Tract 1 – Hay Lake	533.8	3,720.0
Tract 2 – Lake County North	24.4	219.5
Tract 2 – Lake County South	43.3	48.4
Tract 3 – Wolf Lands 1	2.2	113.9
Tract 3 – Wolf Lands 2	7.6	683.8
Tract 3 – Wolf Lands 3	130.4	93.7
Tract 3 – Wolf Lands 4	9.5	359.7
Tract 4 – Hunting Club	27.0	92.2
Tract 5 – McFarland Lake	0.0	30.1
Net Increase/(Decrease)	507.1	(29.1)
Land Exchange Alternative B		
Smaller Federal Parcel	271.1	3,912.9
Tract 1 – Hay Lake	533.8	3,720.0
Net Increase/(Decrease)	262.7	(192.9)

The amount of cover habitat is similar between the federal and non-federal lands, but the non-federal lands include more potential forage habitat; therefore, the Land Exchange Proposed Action would result in a very small decrease (29.1 acres) to the federal estate of cover habitat but an increase to the federal estate of forage habitat (507.1) for the gray wolf. Overall, the Land Exchange Proposed Action would result in an increase (to the federal estate) of the number of occurrences and habitat availability for the gray wolf.

<u>Northern Long-Eared Bat</u>

Potential summer roosting and foraging habitat for the northern long-eared bat is present and individuals have been observed on the federal lands, though no hibernacula have been observed. Similarly, both forage and potential summer roosting habitat is present on the non-federal lands, though no hibernacula have been observed. Bats were observed, though not identified to species, on Tract 1 during field studies in 2009. The Land Exchange Proposed Action would result in a net decrease of mature forest habitat to the federal estate, but an increase in grassland/ brushland, which constitutes a decrease in potential bat roosting habitat but increase in foraging habitat within the federal estate. Effects on the northern long-eared bat are described in more detail in the Biological Assessment and Biological Evaluation.

5.3.5.2.2 State-listed Species

<u>Moose</u>

There is habitat present on the federal lands for the moose, and individuals and their sign have been observed during surveys. Similarly, there is habitat present, and moose individuals or their sign have been observed on Tracts 1, 2, and 3. The Land Exchange Proposed Action would result in a decrease of mature mixed forest types on the federal estate, but an increase in moose preferred habitats, including early successional forests, brushland, and aquatic environments. As moose or their sign have been observed on both the federal and non-federal lands, there would be neither an increase nor decrease in occurrences to the federal estate.

Little Brown Bat

Habitat for the little brown bat is present and individuals have been observed on the federal lands, though no hibernacula have been observed. Similarly, both forage and potential summer roosting habitat may be present on the non-federal lands, though no hibernacula have been observed. Bats were observed, though not identified to species, on Tract 1 during field studies in 2009. The Land Exchange Proposed Action would result in a net decrease of mature forest habitat to the federal estate, but an increase in grassland/ brushland, which constitutes a decrease in potential bat roosting habitat but increase in foraging habitat within the federal estate.

Eastern Pipistrelle

Habitat for the eastern pipistrelle is present on the federal lands, but no hibernacula or individuals have been observed. Similarly, both forage and potential summer roosting habitat may be present on the non-federal lands, though no hibernacula have been observed. Bats were observed, though not identified to species, on Tract 1 during field studies in 2009. The Land Exchange Proposed Action would result in a net decrease of mature forest habitat to the federal estate, but an increase in grassland/ brushland, which constitutes a decrease in potential bat roosting habitat but increase in foraging habitat within the federal estate.

Northern Goshawk

The northern goshawk may be occasionally present since northern goshawk nests have been observed on the federal parcel. Northern goshawk individuals and nests have also been identified on Tract 1 since 2010, and an active northern goshawk territory (Pike Mountain 2 territory) has been identified and is being monitored by the MDNR. According to the MDNR NHIS database, there have also been northern goshawk observations within 10 miles of the non-federal lands (Tract 1, Tract 3, and Tract 4). More forested habitat for the species is present on the federal lands than the non-federal lands (see Table 5.3.5-2). As such, the Land Exchange Proposed Action would result in a decrease of forested habitat available for the northern goshawk on the federal estate.

Boreal Owl

Mature coniferous and deciduous forests are available as potential habitat for the boreal owl on the federal lands and non-federal lands. However, there would be a decrease of these forests to the federal estate under the Land Exchange Proposed Action (see Table 5.3.5-2). No boreal owls are known to occur on the non-federal lands, and one boreal owl was observed near the federal lands in 1988 to 1989. According to the MDNR NHIS database, there have been boreal owl observations within 10 miles of the non-federal lands (Tract 2, Tract 3, and Tract 5). It is unlikely boreal owls use either the federal or non-federal lands often.

Wood Turtle

The only known population of wood turtles near the federal lands is downstream from the Mine Site, along the southern border of the federal lands. Though there is no known suitable habitat for wood turtles on the federal lands and no individuals are known to occur, wood turtles may use adjacent areas to the south of the federal lands. Similarly, no wood turtles or optimal wood turtle habitat was identified on the non-federal lands. According to the MDNR NHIS database, there have been wood turtle observations within 10 miles of the non-federal lands (Tract 1, Tract 2, and Tract 3).

Given that no wood turtles or wood turtle habitat were identified on either the federal or non-federal lands, the Land Exchange Proposed Action would not result in an increase or decrease of individuals, populations, or suitable habitat.

Eastern Heather Vole

The eastern heather vole has not been observed during field surveys or within 10 miles of the federal lands. Approximately 2,292 acres of potentially suitable habitat (upland coniferous forest, upland mixed forest, shrubland, and cropland/grassland) exists on the federal lands (see Table 4.3.4-1), so the eastern heather vole could be present, but, if so, likely in very small numbers. The eastern heather vole was not identified on the non-federal lands by surveys or in the NHIS, but the non-federal lands contain 2,626.5 acres of habitat (see Table 4.3.4-10). According to the MDNR NHIS database, there have been eastern heather vole observations within 10 miles of the non-federal lands (Tract 3). As such, the Land Exchange Proposed Action would result in an increase to the federal estate of up to 334.9 acres of habitat.

Yellow Rail

The yellow rail was not found during surveys and was not reported in the NHIS database within 10 miles of the federal lands. As previously mentioned, small, scattered areas of its preferred habitat are present on the federal lands (35.7 acres), but not the minimum nesting patch size (54 acres) needed for the species (see Table 4.3.3-1). No yellow rails or yellow rail habitat were identified on the non-federal lands. The Land Exchange Proposed Action would not result in a net change to the species or habitat.

Laurentian Tiger Beetle

The lack of suitable habitat and any recorded observations for the Laurentian tiger beetle suggest that the species does not occur on the federal lands. However, the habitat for the Laurentian tiger beetle is present at Tract 1, in an area formerly used as a sand and gravel mine. No disturbance activities are currently planned on the non-federal lands, so this potential habitat would be preserved. According to the MDNR NHIS database, there have been Laurentian tiger beetles observed within 10 miles of the non-federal lands (Tract 4). As such, the Land Exchange Proposed Action would result in an increase of suitable habitat for this species.

Taiga Alpine

Lowland coniferous swamp is present on both the federal lands and non-federal lands, which is potential habitat for the taiga alpine. However, there would be a decrease to the federal estate of lowland coniferous swamp habitat under the Land Exchange Proposed Action. According to the MDNR NHIS database, there are no known occurrences of taiga alpine within 10 miles of the federal lands, and none were observed during surveys. There have been taiga alpine observations within 10 miles of the non-federal lands (Tract 2 and Tract 3). The Land Exchange Proposed

Action would result in a decrease in potential habitat for the species but unlikely result in a change in species occurrences.

Freija's Grizzled Skipper

Grassland and shrubland is present on both the federal lands and non-federal lands, which is potential habitat for the Freija's grizzled skipper. There would be an increase to the federal estate of grassland and shrubland habitats under the Land Exchange Proposed Action. According to the MDNR NHIS database, there are no known occurrences of Freija's grizzled skipper within 10 miles of the federal lands, and none were observed during surveys. There have been Freija's grizzled skipper observations within 10 miles of the non-federal lands (Tract 2 and Tract 3). The Land Exchange Proposed Action would result in an increase in potential habitat for the species but unlikely result in a change in species occurrences.

Nabokov's Blue

Upper woodland habitat is present on both the federal lands and non-federal lands for the Nabokov's blue, though the larval host plant was not observed at either. There would be a decrease to the federal estate of upland woodland habitat under the Land Exchange Proposed Action. According to the MDNR NHIS database, there are no known occurrences within 10 miles of the federal lands, and none were observed during surveys. There have been Nabokov's blue observations within 10 miles of the non-federal lands (Tract 2, Tract 3, and Tract 5). The larval host plant, dwarf bilberry, was noted to be locally moderate to common around the observation sites. The Land Exchange Proposed Action would result in a decrease in potential habitat for the species but unlikely result in a change in species occurrences.

Quebec Emerald

The Quebec emerald dragonfly can inhabit wet meadow/sedge meadow. Approximately 36 acres of this habitat type are present on the federal lands. There has only been one documented occurrence of this species in Minnesota (Lake County in 2006), and that occurrence was not on either the federal or non-federal lands. The non-federal lands do not contain any sedge/wet meadow wetlands. The Land Exchange Proposed Action would result in a decrease of potential habitat used by this species on the federal estate.

Trumpeter Swan

Trumpeter swans were observed on Tract 1 during surveys in 2009. A pair of adults with young was seen on Little Rice Lake. The species has not been observed on the federal lands. According to the MDNR NHIS database, there have been trumpeter swan observations within 10 miles of the non-federal lands (Tract 1, Tract 2, and Tract 3). Because the species has been observed on the non-federal lands and not on the federal lands, the Land Exchange Proposed Action would result in an increase of the occurrence of this listed species within the federal estate.

5.3.5.2.3 Species of Greatest Conservation Need

Sections 4.3.5.1.1 and 4.3.5.2 discuss the SGCN in the context of their habitat. The federal lands include a wide variety of habitat types, grouped into key habitat types and MIH types (see Table 5.3.5-7).

Some acreage of some key habitat types, MIH types, and cover types within the federal estate would increase through the Land Exchange Proposed Action, while others would decrease. The key habitat types that would increase or decrease under the Land Exchange Proposed Action are listed in Table 5.3.5-7. Species dependent on these habitat types are listed by ecological subsection in Tables 4.3.5-1 through 4.3.5-5.

Table 5.3.5-7 Increase or Decrease of Habitat Types on the Federal Estate Resulting from the Land Exchange Proposed Action

Key Habitat Type and Management Indicator Habitat	Federal Lands Acres	Non-Federal Lands[1,2] Tract 1 – Hay Lake Lands Acres	Tract 2 – Lake County Lands Acres	Tract 3 – Wolf Lands Acres	Tract 4 – Hunting Club Lands Acres	Tract 5 – McFarland Lake Lands Acres	Net Increase or (Decrease) Acres
Mature Upland Forest, Continuous Upland/Lowland Forest (MIH1-13)	5,719.7	2,978.8	337.2	1,479.4	105.7	30.6	(788.0)
Open Ground, Bare Soils (no MIH)	63.8	0.0	0.0	0.0	0.0	0.0	(63.8)
Grassland and Brushland, Early Successional Forest (no MIH)	651.8	1,696.3	38.9	96.5	45.0	0.0	1,224.9
Aquatic Environments (MIH 14)	60.1	251.1	5.8	0.0	9.6	0.2	206.6
Total	6,495.4	4,926.2	381.9	1,575.9	160.3	30.8	579.7

[1] According to non-federal land cover type summary tables (see Tables 4.3.4-1, 4.3.4-11, 4.3.4-13-20).
[2] Total acres may be more or less than presented due to rounding.

The Land Exchange Proposed Action would result in a decrease of 788.0 acres of forest habitat and 63.8 acres of open ground/bare soil to the federal estate. In addition, the Land Exchange Proposed Action would result in an increase of 1,224.9 acres of grassland/brushland and 206.6 acres of aquatic environment to the federal estate. Overall, the Land Exchange Proposed Action would result in an increase of up to 579.7 acres of habitat to the federal estate, though there would be a decrease of forest and open ground habitat. As such, forest-dependent species are more likely to be affected through habitat decrease by the Land Exchange Proposed Action. Grassland and brushland species (mostly bird species and one species of insect) would have more habitat available under the Land Exchange Proposed Action, as would species dependent on aquatic environments (bird species, reptile/amphibian species, and insect species). Overall, the Land Exchange Proposed Action would result in an increase of SGCN habitat to the federal estate.

5.3.5.2.4 Regional Forester Sensitive Species

A Biological Evaluation has been prepared that contains further information about RFSS. The Biological Evaluation is included in Appendix D and is posted on the USFS website (http://www.fs.usda.gov/goto/superior/northmet). Similar to the Biological Assessment, the organization of the methodologies and discussion in the Biological Evaluation may be different from the FEIS. The Biological Evaluation also contains determinations of effect for RFSS species.

The USFS determined that the Land Exchange Proposed Action and Land Exchange Alternative B may affect individuals but are not likely to cause a trend to federal listing or loss of viability for 18 RFSS terrestrial wildlife species on the Superior National Forest.

Of the 18 terrestrial RFSS on the 2011 list for the Superior National Forest, the gray wolf, eastern heather vole, northern long-eared bat, little brown bat, eastern pipistrelle, northern goshawk, boreal owl, wood turtle, taiga alpine, Freija's grizzled skipper, Nabokov's blue, and Quebec emerald dragonfly are discussed above as federally or state-listed species. Three additional RFSS (the olive-sided flycatcher, bay-breasted warbler, and Connecticut warbler) are included as SGCN and are also discussed above. The three remaining RFSS species are discussed below. Effects on the RFSS are described in more detail in the Biological Evaluation.

Bald Eagle

As discussed in Section 5.2.5.2.2, eagles may utilize the area around the federal lands. The federal lands are located between the Embarrass and Partridge rivers, which eagles may use for foraging. Mud Lake may also be used for foraging. The nearest known nesting sites are more than 2 miles (5.8 miles south-southwest of the federal lands) from the federal lands and optimal habitat for nesting is not present. Eagles may utilize Mud Lake for nesting, though they tend to utilize larger lakes for nesting. Though optimal nesting and foraging habitat are not present in the federal lands, eagles may still utilize these areas.

Eagle habitat is present on several of the non-federal lands. Though they are smaller waterbodies than are optimal for eagles, Tract 1 includes the Pike River, Hay Lake, and Rice Lake. Tracts 2 and 3 are located near large lakes such as Pine and Greenwood. Tract 5 borders McFarland Lake, which is connected to other lakes within the BWCAW. With the exception of Tract 1, these lands are also further from developed mining areas and disturbances are less likely than on the federal lands. Overall, the Land Exchange Proposed Action would result in an increase (to the federal estate) of the number of occurrences and habitat availability for the bald eagle.

Great Gray Owl

Though not observed during call surveys, the great gray owl may be occasionally present on the federal lands. Because owl calling surveys (ENSR 2005) found no great gray owls, populations in the area are likely small and/or occasional. No observations of great gray owls have been made on the non-federal lands. However, because the species utilizes forested habitat and the Land Exchange Proposed Action would result in a decrease of 788.0 acres of forested habitat, the Land Exchange Proposed Action would result in a decrease of this species' habitat on the federal estate.

Three-Toed Woodpecker

A three-toed woodpecker was identified on the federal lands during surveys in 2000 and was observed on the parcel again in 2007. Area populations are expected to be low, and these habitat specialists require standing dead or dying trees where they can forage for bark beetles. The species has not been observed on the non-federal lands. As such, the Land Exchange Proposed Action would result in a decrease of this species' occurrence. Since the Land Exchange Proposed Action would result in a decrease of approximately 788.0 acres of forest, the Land Exchange Proposed Action would also result in a habitat decrease for this species on the federal estate.

Other factors, such as lower disturbance levels and increase of contiguous habitat, would potentially increase RFSS utilization of the non-federal lands. The federal lands contain two stands of contiguous forest habitat greater than 300 acres (340.6 acres and 1,352.3 acres) while the non-federal lands include one forest stand greater than 300 acres (598.2 acres – Tract 3, Wolf Lands 2). The Land Exchange Proposed Action would result in a net decrease of 1,094.7 acres of contiguous habitat stands greater than 300 acres to the federal estate.

5.3.5.2.5 Other Wildlife Species

Other regionally common wildlife species, such as ravens, grouse, beaver, wolves, black bear, white-tailed deer, fox, marten, and snowshoe hare, have been observed on both the federal and non-federal lands. Effects on wildlife species important to the Bands are discussed in Section 5.2.9 on a connected ecosystems level. Similar to SGCN, habitat for some other species of wildlife would increase via the Land Exchange Proposed Action while habitat would decrease for others. As previously discussed, forested habitat would decrease via the Land Exchange Proposed Action, but grassland/shrubland habitat and aquatic habitat would increase. Grassland and brushland species would have more habitat available under the Land Exchange Proposed Action, as would species dependent on aquatic environments. The Land Exchange Proposed Action would result in 579.7 additional acres of wildlife habitat to the federal estate.

Game species such as white-tailed deer and black bear are of significant concern to the Bands. As mentioned above, forested habitat on the federal estate would decrease under the Land Exchange Proposed Action, but grassland and brushland and aquatic habitat would increase. The Land Exchange Proposed Action would result in increased hunting opportunities on the federal estate, as the non-federal lands would become available for use while the federal lands, which currently have limited access, would become private.

5.3.5.3 Land Exchange Alternative B

Under the Land Exchange Alternative B, a smaller federal parcel would be exchanged for only one non-federal parcel, Tract 1. The effects that would result from this alternative are similar to those of the Land Exchange Proposed Action.

5.3.5.3.1 Federally Listed Species

Canada Lynx

As shown in Table 5.3.5-3, the smaller federal parcel includes 4,697.2 acres of suitable general habitat for lynx. Tract 1 has a total of 4,675.1 acres of habitat potentially suitable for the Canada lynx, which would result in a decrease of 22.1 acres to the federal estate. The Land Exchange Alternative B would also result in a decrease of 192.9 acres of denning habitat. Snowshoe hare habitat would increase by 51.6 acres, but there would also be an increase of 195.7 acres of unsuitable lynx habitat to the federal estate under the Land Exchange Alternative B.

The smaller federal parcel does not contain any established snow packed trails (such as snowmobile trails) but is crossed by 6.9 miles of road surface. Tract 1 is crossed by 2.2 miles of roads and no established snow trails. Since lynx use snow packed trails and roads as travel corridors, the Land Exchange Alternative B would result in a decrease to the federal estate of 4.7 miles of road use for lynx.

Land ownership under the Land Exchange Alternative B would be similar to the Land Exchange Proposed Action, but the smaller federal parcel would be bordered to the west by USFS-managed federal lands. Tract 1 is bordered by federal lands to the north, west, and partially east, but the area is generally surrounded by private lands and developed areas. Habitat connectivity to Tract 1 is marginal. The Land Exchange Alternative B is likely to result in limited habitat connectivity overall. Similar to the Land Exchange Proposed Action, the smaller federal parcel and non-federal lands are located within lynx critical habitat and would remain so regardless of ownership; the Land Exchange Alternative B would not result in a change to lynx critical habitat. As shown in Table 5.3.5-5, the Land Exchange Alternative B would result in the decrease of 4,753 acres of land within an LAU because the federal parcel is within an LAU, but the Tract 1 lands are not.

The Land Exchange Alternative B would have mixed habitat effects for the Canada lynx. It would result in a decrease of overall suitable habitat for lynx and denning habitat, but would result in an increase of suitable snowshoe hare habitat. It would also result in a decrease of federal lands within designated LAUs. Critical lynx habitat would not change regardless of ownership. As such, the Land Exchange Alternative B is not likely to have either a net increase or decrease on Canada lynx on the federal estate.

Gray Wolf

Gray wolves have been observed on both the smaller federal parcel and on Tract 1. Approximately 271 acres of forage habitat is present on the smaller federal parcel (young age class, see Table 5.3.4-4) and 533.8 acres are present on Tract 1. There are 3,912.9 acres of cover habitat on the smaller federal parcel (immature and mature age classes) and 3,720.0 acres on Tract 1. This would result in an increase of 262.8 acres of forage habitat but also in a decrease of 192.9 acres of cover habitat on the federal estate under Land Exchange Alternative B.

Northern Long-Eared Bat

Potential summer roosting and foraging habitat for the northern long-eared bat is present and individuals have been observed on the smaller federal parcel, though no hibernacula have been observed. Bats were observed, though not identified to species, on Tract 1 during field studies in 2009. The Land Exchange Alternative B would result in a net decrease of mature forest habitat to the federal estate, but an increase in grassland/brushland, which constitutes a decrease in potential summer roosting habitat but increase in foraging habitat within the federal estate.

5.3.5.3.2 State-listed Species

Moose

There is habitat present on the Alternative B: Smaller Federal Parcel for the moose, and individuals and their sign have been observed during surveys. Similarly, there is habitat present and moose individuals or their sign have been observed, on Tracts 1, 2, and 3. There would not be a change in species occurrences on the federal estate. The Land Exchange Alternative B would result in a decrease of mature mixed forest types, but an increase in preferred habitat types, including early successional forests, brushland, and aquatic environments.

Little Brown Bat

Habitat for the little brown bat is present and individuals have been observed on the Alternative B: Smaller Federal Parcel, though no hibernacula have been observed. Bats were observed, though not identified to species, on Tract 1 during field studies in 2009. The Land Exchange Alternative B would result in a net decrease of mature forest habitat to the federal estate, but an increase in grassland/brushland, which constitutes a decrease in potential bat roosting habitat but an increase in foraging habitat within the federal estate.

Eastern Pipistrelle

Habitat for the eastern pipistrelle is present on the Alternative B: Smaller Federal Parcel, though no hibernacula or individuals have been observed. Bats were observed, though not identified to species, on Tract 1 during field studies in 2009. The Land Exchange Alternative B would result in a net decrease of mature forest habitat to the federal estate, but an increase in grassland/brushland, which constitutes a decrease in potential bat roosting habitat but an increase in foraging habitat within the federal estate.

Northern Goshawk

The northern goshawk may be occasionally present on the Alternative B: Smaller Federal Parcel since a northern goshawk nest has been observed. Northern goshawk individuals and nests have also been identified on Tract 1, and according to the MDNR NHIS database, there have been northern goshawk observations within 10 miles of the non-federal lands (Tract 1). More forested habitat for the species is present on the smaller federal parcel than on Tract 1 (see Table 5.3.5-8). As such, the Land Exchange Alternative B would result in a decrease of forested habitat available for the northern goshawk on the federal estate.

Boreal Owl

The boreal owl was observed in proximity to the Alternative B: Smaller Federal Parcel in 1988 to 1989, but has not been observed on the Tract 1 lands. The Land Exchange Alternative B would result in a decrease of coniferous or mixed forest habitats available for the boreal owl on the federal estate.

Wood Turtle

No wood turtles or optimal wood turtle habitat were identified on Tract 1 or the smaller federal parcel. According to the MDNR NHIS database, there have been wood turtles observed within 10 miles of the non-federal lands (Tract 1). As such, the Land Exchange Alternative B would not result in an increase or decrease of habitat for the species on the federal estate.

Eastern Heather Vole

The eastern heather vole has not been observed during field surveys within 10 miles of the federal lands. There are 1,261.6 acres of potentially suitable habitat on the smaller federal parcel (see Table 4.3.4-6). Eastern heather voles were not identified on the non-federal lands by surveys or in the NHIS, but Tract 1 contains 2,133.6 acres of habitat, which would result in an increase of 872.0 acres of habitat for the eastern heather vole on the federal estate. As such, the Land Exchange Alternative B would result in an increase of habitat for this species.

Yellow Rail

The yellow rail was not found during surveys and was not reported in the NHIS database within 10 miles of the federal lands. As previously mentioned, small, scattered areas of its preferred habitat are present on the federal lands (34.9 acres), but not the minimum nesting patch size (54 acres) needed for the species. Similar to the Land Exchange Prosed Action, the Land Exchange Alternative B would not result in a net change to the species or its habitat on the federal estate.

Laurentian Tiger Beetle

Similar to the Land Exchange Proposed Action, the lack of suitable habitat and any recorded observations for the Laurentian tiger beetle suggest that the species does not occur on the smaller federal parcel. However, habitat for the Laurentian tiger beetle is present on Tract 1, in an area formerly used as a sand and gravel mine. No disturbance activities are currently planned on Tract 1, so this potential habitat would be preserved. As such, the Land Exchange Alternative B, similar to the Land Exchange Proposed Action, would result in an increase of suitable habitat for the species on the federal estate.

Taiga Alpine

There is potential habitat present for the taiga alpine on both the Alternative B: Smaller Federal Parcel and Tract 1 lands. Under the Land Exchange Alternative B, there would be a decrease to the federal estate of lowland coniferous swamp habitat, and therefore a decrease in potential habitat for the species, but it is unlikely this would result in a change in species occurrences.

Freija's Grizzled Skipper

There is potential habitat present for the Freija's grizzled skipper on both the Alternative B: Smaller Federal Parcel and Tract 1 lands. Under the Land Exchange Alternative B, there would be an increase to the federal estate of grassland and shrubland habitats, and therefore an increase in potential habitat for the species, but it is unlikely this would result in a change in species occurrences.

Nabokov's Blue

There is potential habitat present for the Nabokov's blue on both the Alternative B: Smaller Federal Parcel and Tract 1 lands, though the larval host plant was not observed at either. Under the Land Exchange Alternative B there would be a decrease to the federal estate of upland woodland habitat and a decrease in potential habitat for the species; but it is unlikely this would result in a change in species occurrences.

Quebec Emerald

The Quebec emerald dragonfly has not been identified on the smaller federal parcel, as there has only been one documented occurrence of this species in Minnesota in Lake County in 2006 (Minnesota Odonata Survey Project 2012). Tract 1 does not contain any sedge/wet meadow wetlands, and so the Land Exchange Alternative B would result in a decrease of potential habitat used by this species on the federal estate.

Trumpeter Swan

Trumpeter swans were observed on Tract 1 during surveys in 2009. A pair of adults with young was seen on Little Rice Lake. The species has not been observed on the smaller federal parcel. Similar to the Land Exchange Proposed Action, because the species has been observed on Tract 1 but not on the smaller federal parcel, the Land Exchange Alternative B would result in an increase of the occurrence of this listed species within the federal estate.

5.3.5.3.3 Species of Greatest Conservation Need

Like the Land Exchange Proposed Action, the SGCN for the Land Exchange Alternative B are discussed in the context of their habitat. The smaller federal parcel also includes a wide variety of habitat types, grouped into key habitat types and MIH types (see Table 5.3.5-8).

Similar to the Land Exchange Proposed Action, the Land Exchange Alternative B would result in a decrease of forest habitat (1,279.3 acres) and open ground/bare soil (29.1 acres) on the federal estate. The Land Exchange Proposed Action, however, would result in an increase of grassland/brushland (1,257.2 acres) and aquatic environments (224.8 acres) on the federal estate. Overall, the Land Exchange Proposed Action would result in an increase of up to 173.6 acres of habitat to the federal estate, though there would be a decrease of forest and open ground habitat. As such, forest-dependent species are more likely to be affected through habitat decrease under the Land Exchange Alternative B. Grassland and brushland species (mostly bird species and one species of insect) would have more habitat available under the Land Exchange Alternative B, as would species dependent on aquatic environments (bird species, reptile/amphibian species, and insect species). Overall, the Land Exchange Alternative B would result in an increase of SGCN habitat to the federal estate.

Table 5.3.5-8 Increase or Decrease of Habitat Types on the Federal Estate Resulting from Land Exchange Alternative B

Key Habitat Type and Management Indicator Habitat	Smaller Federal Parcel (Acres)	Non-Federal Land Tract 1 (Acres)	Net Increase or (Decrease) (Acres)
Mature Upland Forest, Continuous Upland/Lowland Forest (MIH1-13)	4,258.1	2,978.8	(1,279.3)
Open Ground, Bare Soils (no MIH)	29.1	0.0	(29.1)
Grassland and Brushland, Early Successional Forest (no MIH)	439.1	1,696.3	1,257.2
Aquatic Environments (MIH 14)	26.3	251.1	224.8
Total[1]	4,752.6	4,926.2	173.6

[1] Total acres may be more or less than presented due to rounding.

5.3.5.3.4 Regional Forester Sensitive Species

Bald Eagle

As under the Land Exchange Proposed Action, the smaller federal parcel and surrounding areas may be utilized by bald eagles. Similar to the Land Exchange Proposed Action, the smaller federal parcel is also located between the Embarrass and Partridge rivers, which eagles may use for foraging. However, the smaller federal parcel excludes a portion of Mud Lake. The nearest known nesting sites are greater than 2 miles (5.8 miles south-southwest of the smaller federal parcel) from the federal lands and optimal habitat for nesting is not present.

Tract 1 contains waterbodies (Pike River, Hay Lake, and Rice Lake) and large trees, which eagles may use for nesting, though no nests have been observed. The nearest known eagle nest is approximately 4 miles southwest of the parcel.

Great Gray Owl

Though not observed during call surveys, the great gray owl may be occasionally present on the smaller federal parcel, as an individual was observed along Dunka Road south of the Mine Site in 2009. No observations of great gray owls have been made on Tract 1. However, because the species utilizes forested habitat and the Land Exchange Alternative B would result in a decrease of 1,279.3 acres of forested habitat, the Land Exchange Alternative B would result in a decrease of this species' habitat on the federal estate.

Three-Toed Woodpecker

Three-toed woodpeckers were observed on or near the smaller federal parcel in 2000 and again in 2007. Area populations are expected to be low, and the species has not been observed on Tract 1. As such, the Land Exchange Alternative B would result in the decrease of this species' occurrence. Since the Land Exchange Alternative B would result in a decrease of 1,279.3 acres of forest, this would result in a habitat decrease for this species on the federal estate.

Other factors, such as lower disturbance levels and increase of contiguous habitat, would potentially increase RFSS utilization of Tract 1 lands. The smaller federal parcel contains two stands of contiguous forest habitat greater than 300 acres (340.6 and 926.1 acres) while there are no stands greater than 300 acres on Tract 1.

5.3.5.3.5 Other Wildlife Species

Similar to the Land Exchange Proposed Action, forested habitat within the federal estate would decrease under the Land Exchange Alternative B, but grassland/shrubland habitat and aquatic habitat would be increased. Grassland and brushland species would have more habitat available under the Land Exchange Alternative B, as would species dependent on aquatic environments. The Land Exchange Alternative B would result in 173.6 additional acres of wildlife habitat on the federal estate.

5.3.5.4 Land Exchange No Action Alternative

Under the Land Exchange No Action Alternative, the current federal lands would remain in federal ownership and would continue to be managed under the General Forest – Longer Rotation Management Area and the General Forest Management Area. Wildlife would be directly affected by logging, mineral exploration, vehicle traffic, natural disturbances, and thinning activities, which would occur as planned by the USFS, and would be indirectly affected by changes in habitat caused by forest management. However, these activities would affect wildlife to a lesser degree than under the Land Exchange Proposed Action. Section 5.2.4.3.1 provides further discussion of the effects on management of cover types and habitat on the federal lands. Under the Land Exchange No Action Alternative, the USFS has an ongoing responsibility for managing wildlife resources on Superior National Forest lands in accordance with the Forest Plan (USFS 2004b). The Land Exchange No Action Alternative would not change the Forest Service's responsibility for managing wildlife resources and would result in no change in anticipated effects on existing wildlife.

Under the Land Exchange No Action Alternative, the non-federal lands would not go into USFS ownership, and land use would be determined by the private land owners. Effects on wildlife species are difficult to predict given the uncertainty of future potential land use. Lands may be developed, resulting in potential effects on individuals and local populations, habitat decrease, and effects on wildlife travel corridors.

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5.3.6 Aquatic Species

This section describes the environmental consequences of the Land Exchange alternatives on aquatic biota, using comparisons of the existing conditions presented in Sections 4.2.6 and 4.3.6 to conditions after the Land Exchange alternatives in terms of net increase or decrease in aquatic biological resources for the federal and non-federal lands.

The Land Exchange Proposed Action would result in a net increase to the federal estate of surface waters (MIH 14), including 99.1 acres of lakes, 3.8 miles of rivers, and 8.1 miles of third-order streams. It would also result in a decrease to the federal estate of 0.3 miles of first-order streams and 4.0 miles of second-order streams. The Land Exchange Proposed Action would result in an increase in watershed riparian connectivity and aquatic connectivity for the federal estate. Based on available data, the Land Exchange Proposed Action would potentially result in an increase of nine additional fish species to the federal estate, while the macroinvertebrate assemblage would be similar. The Land Exchange Proposed Action could result in an increase to the federal estate of six new potential SGCN species, based on ecoregion data.

Land Exchange Alternative B would result in a net increase to the federal estate of surface waters (MIH 14), including 120.7 acres of lakes, 2.8 miles of rivers, and 8.1 miles of third-order streams. Additionally, it would result in a decrease to the federal estate of 1.3 miles of first-order streams and 4.0 miles of second-order streams, and an increase to the federal estate of. Land Exchange Alternative B would result in an increase in watershed riparian connectivity and aquatic connectivity for the federal estate. Based on available data, Land Exchange Alternative B would potentially result in a decrease to the federal estate of four fish species, while the macroinvertebrate assemblage would likely be similar. Land Exchange Alternative B would result in no net change of SGCN species, based on ecoregion data.

The Land Exchange No Action Alternative would not result in any increase or decrease of aquatic habitats or SGCN species to the federal estate.

Rulemaking was conducted with the intent to update the list of ETSC species (*Minnesota Rules*, parts 6134.0100 to 6134.0400), with new listings becoming effective on August 19, 2013 (MDNR 2013h). The FEIS considers any new listings, or changes in the previous listings, associated with the updated list. The FEIS also considers any federal listing changes. A Biological Evaluation has been prepared that contains further information about RFSS species. The Biological Evaluation is included in Appendix D and is posted on the USFS website (http://www.fs.usda.gov/goto/superior/northmet).

5.3.6.1 Methodology and Evaluation Criteria

The criteria used to describe the direct and indirect effects of the Land Exchange alternatives focused on the ecological integrity of the aquatic systems present at the federal lands and non-federal lands where physical, chemical, and biological characteristics that are important to biotic quality were considered. The spatial and temporal area of analysis for aquatic resources included the federal and non-federal lands that are proposed for the exchange based on current conditions.

The methodology used for analysis of the Land Exchange alternatives included review and evaluation of available literature, aerial photography review, and GIS analysis of all surface waters and aquatic species habitat present within the Land Exchange areas. Both quantitative and qualitative analyses were used. The analysis of the aquatic resources affected by the Land Exchange alternatives was guided by evaluation criteria that were developed by the USFS and other Co-lead Agencies as follows:

- change in the amount of Superior National Forest MIHs (MIH 14 [aquatic habitat]) available for species on the federal and non-federal lands;
- changes in the length of stream segments;
- changes in the area of lake or deepwater wetland;
- qualitative determination of community habitat and ecological value;
- qualitative assessment of the aquatic connectivity (network created by streams, rivers, and lakes as they flow into one another) and the potential for barriers to fish passage; and
- net change in aquatic species.

5.3.6.2 Land Exchange Proposed Action

5.3.6.2.1 Surface Water Features (MIH 14)

Comparing the footprints of the surface water features present within the federal and non-federal lands provides a direct assessment of the increase or decrease to the federal estate in aquatic environments that support aquatic biota and associated habitats. This comparison was made by analyzing the linear shoreline frontage and frontage index of the surface water features within the federal and non-federal lands, where the frontage index indicates the linear ft of lake and shoreline frontage per acre of land.

The Land Exchange Proposed Action would result in a net increase of surface water resources to the federal estate (see Table 5.3.6-1). A net increase of 99.1 acres of lake and 3.8 miles of rivers would be added to the federal estate from the Land Exchange Proposed Action. For both lakes and streams, the frontage index would increase substantially by 34.0 shoreline/acre units as a result of the exchange.

Table 5.3.6-1 Federal and Non-federal Land Surface Water Comparisons

	Lake			Rivers/Creeks/Streams		
Parcel	**Acres**	**Frontage (ft)**	**Frontage Index (shoreline/acre)**	**Miles**	**Frontage (linear ft)[1]**	**Frontage Index (shoreline/acre)[2]**
Lands Conveyed						
Federal Lands	30.5	4,550.0	0.7	5.3	55,968.0	8.6
Lands Acquired						
Tract 1 – Hay Lake	129.6	16,424.0	3.5	8.1	72,864.0	15.3
Tract 2 – Lake County	0.0	0.0	0.0	0.0	0.0	0.0
Tract 3 – Wolf Lands						
Wolf Lands 1	0.0	0.0	0.0	0.0	0.0	0.0
Wolf Lands 2	0.0	0.0	0.0	0.0	0.0	0.0
Wolf Lands 3	0.0	0.0	0.0	0.1	1,056.0	3.9
Wolf Lands 4	0.0	0.0	0.0	0.9	9,504.0	23.5
Tract 4 – Hunting Club	0.0	0.0	0.0	0.0	0.0	0.0
Tract 5 – McFarland Lake	0.0	990.0	32.1	0.0	0.0	0.0
Total Non-federal lands	129.6	17,414.0	35.6	9.1	83,424.0	42.6
Net Change						
Net Increase/(Decrease)	99.1	12,864.0	34.9	3.8	27,456.0	34.0

Note: Surface water shoreline distance calculated by GIS analysis.

[1] Includes shoreline distance on both sides of streams.
[2] Frontage Index calculated by dividing total acres of parcel by total shoreline within parcel.

5.3.6.2.2 Differences of Strahler Stream Orders and Habitat

For the purposes of this FEIS, the Strahler Order (USEPA 2011a) is used to describe the hierarchical ordering of streams, where a first-order stream describes a headwater type stream with no branching. Where two first-order streams meet, they become larger second-order streams and where two second-order streams meet, they become larger third-order streams, etc. A quantitative comparison of the Strahler Stream Order indicates the Land Exchange Proposed Action would result in a decrease of 0.3 miles of first-order headwater streams and 4.0 miles of second-order streams, and an increase in 8.1 miles of third-order streams to the federal estate (see Table 5.3.6-2).

The net increase of third-order streams and decrease in second-order streams would likely add more habitat diversity to the Superior National Forest since, generally, stream habitat diversity increases with higher-order streams. No significant habitat changes would likely occur associated with the slight decreases in first-order, headwater streams acquired as a result of the Land Exchange Proposed Action; however, the net reduction to the Superior National Forest of 0.3 mile of first order streams may result in slightly less habitat available for headwater stream dependent species.

Table 5.3.6-2 Increase or Decrease of Stream Orders from the Land Exchange Proposed Action

Parcel (Stream)	Stream Distance (miles) 1st Order	2nd Order	3rd Order
Lands Conveyed			
Federal Lands (Yelp Creek and Partridge River)	1.3	4.0	0.0
Lands Acquired			
Tract 1 – Hay Lake (Pike River)	0.0	0.0	8.1
Tract 2 – Lake County	0.0	0.0	0.0
Tract 3 – Wolf Lands			
Wolf Lands 1	0.0	0.0	0.0
Wolf Lands 2	0.0	0.0	0.0
Wolf Lands 3 (Coyote Creek)	0.1	0.0	0.0
Wolf Lands 4 (Coyote Creek)	0.9	0.0	0.0
Tract 4 – Hunting Club	0.0	0.0	0.0
Tract 5 – McFarland Lake	0.0	0.0	0.0
Total Non-federal Lands	1.0	0.0	8.1
Net Increase/(Decrease)	**(0.3)**	**(4.0)**	**8.1**

Note: Surface water shoreline distance calculated by GIS analysis.

5.3.6.2.3 Watershed Level Riparian and Aquatic Connectivity

Riparian Connectivity

Intact riparian areas are an important factor contributing to diverse and productive aquatic ecosystems and function to maintain available water quality and physical habitat. The streams present on the federal and non-federal lands (Partridge River, Pike River, and Coyote Creek) are each part of a network of streams, creeks, and rivers that makes up a larger watershed. The connections between these surface water features are affected by the vegetated, undisturbed riparian edges bordering these water bodies. A comparison of the watersheds using the RCI is presented in Table 5.3.6-3. The index was developed from GIS analysis of vegetative cover along riparian areas where agriculture and land development have affected natural riparian vegetative cover.

The Land Exchange Proposed Action would result in a slight increase in watershed riparian connectivity, which indicates that the streams on both the federal and non-federal lands are located within watersheds with existing high-quality riparian connectivity.

Table 5.3.6-3 Watershed Riparian Connectivity Index Comparison

Surface Water	Tract	Watershed	Percent Agriculture in Riparian Zone	Percent Development in Riparian Zone	RCI Score[1]
Lands Conveyed					
Partridge River/Yelp Creek	Federal Lands	St. Louis	0	5	95
Lands Acquired					
Pike River	1 - Hay Lake	Vermillion	0	1	99
Coyote Creek	3 - Wolf Lands 3 and 4	Rainy River-Headwaters	0	0	100
Net Increase/(Decrease)[2]			0	(4)	4.5

Adopted from MDNR 2015a.

[1] RCI score calculated with MDNR formula using Percent Agriculture and Percent Development in Riparian Zone; scale is from 0 to 100 where 100 indicates excellent riparian conductivity.
[2] Non-federal lands RCI score averaged to determine net increase/decrease.

Aquatic Connectivity

Structures within streams, such as dams, bridges, and culverts reduce the longitudinal and lateral connectivity of the watershed. These structures can degrade the aquatic habitat in the watershed by slowing stream flow, increasing sedimentation, incising stream channels, changing the depth, and disconnecting portions of streams from the floodplain. The ACI was developed from GIS analysis of number of structures per stream mile for each watershed, and the watershed ACI scores were used to provide a comparison of each watershed.

The Land Exchange Proposed Action would result in the Superior National Forest acquiring streams located in watersheds with better aquatic connectivity values (see Table 5.3.6-4).

Table 5.3.6-4 Watershed Aquatic Connectivity Index Comparison

Surface Water	Tract	Watershed	Aquatic: Bridges and Culverts (miles stream/# structures)	Aquatic: Dams (miles stream/# structures)	ACI Score[1]
Lands Conveyed					
Partridge River/Yelp Creek	Federal Lands	St. Louis	15	6	11
Lands Acquired					
Pike River	1 - Hay Lake	Vermillion	41	11	26
Coyote Creek	3 - Wolf Lands 3 and 4	Rainy River-Headwaters	89	19	54
Net Increase/(Decrease)[2]			50	9	29

Adopted from MDNR 2015b.

[1] ACI score calculated by dividing total miles of streams and ditches per watershed by total number of culverts, bridges, and dams; scale is from 0 to 100 where 100 indicates free flowing streams (no structures) and 0 indicates one structure for every 20 miles of flowing water.
[2] Non-federal lands averaged to determine net increase/decrease.

5.3.6.2.4 Aquatic Species Assemblages

A complete quantitative comparison of the net increase or decrease of aquatic species cannot be made for the purposes of the Land Exchange Proposed Action due to the absence of complete baseline information. Only the federal lands had aquatic biota and habitat sampling sites within the parcel boundaries. A qualitative comparison can be made for species located at the two sites within the federal parcels and the four sites near the non-federal parcels (see Section 4.2.6). The exception to this statement includes the differences between the Coyote Creek headwater stream habitat and the Stony River sampling sites chosen to qualitatively represent Tract 3, which are summarized below.

Fish Assemblages

Two survey sites were analyzed within the vicinity of the federal lands while four survey sites were analyzed among the non-federal lands (in the vicinity of Pike River and Coyote Creek; see Figure 5.3.6-1). The federal lands and the survey sites within the vicinity of the non-federal lands had 11 species in common (see Table 5.3.6-5). The Land Exchange Proposed Action would result in a potential increase to the federal estate of 12 additional species, including two pollution-intolerant species and two pollution-tolerant species (see Tables 5.3.6-5 and 5.3.6-7). There would be a potential decrease to the federal estate of one different pollution-intolerant species and one different pollution-tolerant species. Given the fact that the survey sites used for non-federal lands may not be representative, it is possible that some species are more or less prevalent than is noted here.

The fish assemblages located at each survey site indicate that the Land Exchange Proposed Action potentially would result in minimal change to the fish assemblages for the streams the Superior National Forest would acquire. Additionally, the dominant fish species present at each site (see Table 5.3.6-6) indicate that the stream characteristics were consistent with slower moving, glide pool features with the exception of the segment on the Stony River where the MCAB_05RN024 survey site was located. Longnose dace dominate the fish community at the site, which indicate riffle-run habitats are likely present as described in Section 4.2.6. Note that Coyote Creek, within Tract 3, likely exhibits first order, headwater stream characteristics and if riffle-run habitat is present there, it would likely be smaller and support a less diverse fish community than the Stony River sampling site.

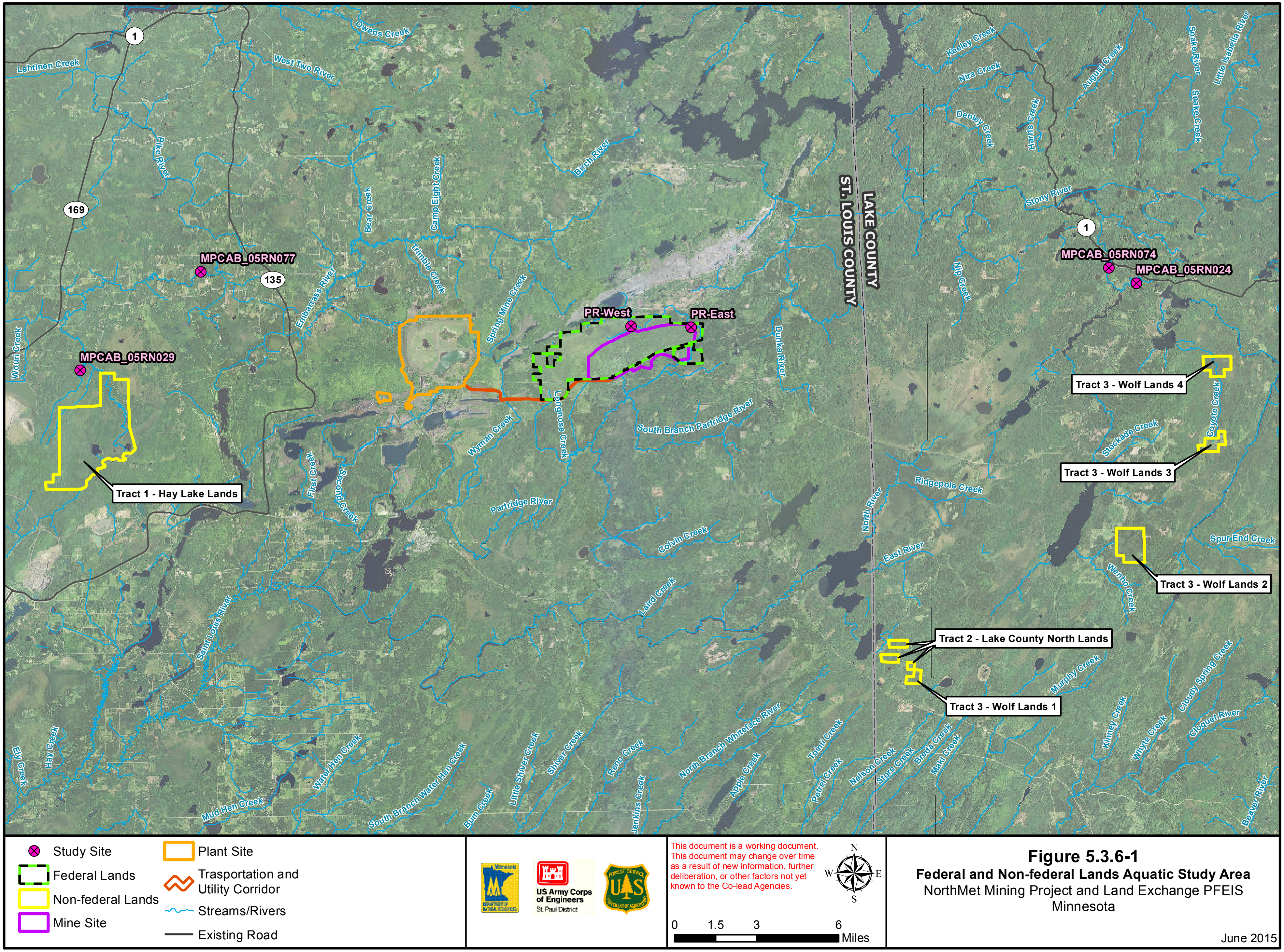

Figure 5.3.6-1
Federal and Non-federal Lands Aquatic Study Area
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

157

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Table 5.3.6-5 Potential Increase or Decrease of Stream Fish Assemblage for the Land Exchange Proposed Action

Species	**Common Name**	**Tolerance Designation[1]**	**Federal Land Parcel**	**Non-federal Land Parcels (study areas within vicinity of Tract 1 and Tract 3-Wolf Lands 3 and 4)**
Catostomus commersonii	White sucker	Tolerant	X	X
Luxilus cornutus	Common shiner	Intermediate	X	X
Notemigonus crysoleucas	Golden shiner	Tolerant		X
Notropis heterolepis	Blacknose shiner	Intolerant		X
Notropis hudsonius	Spottail shiner	Intermediate		X
Notropis volucellus	Mimic shiner	Intolerant		X
Etheostoma nigrum	Johnny darter	Intermediate	X	X
Perca flavescens	Yellow perch	Intermediate		X
Sander vitreus	Walleye	Intermediate		X
Percina caprodes	Logperch	Intermediate		X
Lota lota	Burbot	Intermediate	X	X
Ambloplites rupestris	Rock bass	Intermediate		X
Micropterus dolomieu	Smallmouth bass	Intermediate		X
Esox lucius	Northern pike	Intermediate	X	X
Phoxinus eos	Northern redbelly dace	Tolerant	X	
Culaea inconstans	Brook stickleback	Intermediate	X	X
Phoxinus neogaeus	Finescale dace	Intermediate		X
Rhinichthys atratulus	Blacknose dace	Intolerant	X	
Rhinichthys cataractae	Longnose dace	Intolerant	X	X
Semotilus margarita	Pearl dace	Intermediate	X	
Noturus gyrinus	Tadpole madtom	Intermediate	X	X
Umbra limi	Central mudminnow	Tolerant	X	X
Hybognathus hankinsoni	Brassy minnow	Intermediate	X	
Pimephales promelas	Fathead minnow	Tolerant	X	X
Cottus bairdii	Mottled sculpin	Intolerant	X	X
Semotilus atromaculatus	Creek chub	Tolerant		X
Coregonus clupeaformis	Lake whitefish	Intermediate		X
Total Species			15	23
# Intolerant Species			3	4
# Tolerant Species			4	5
Net Increase or Decrease Species			(8)	8
Net Increase or Decrease Intolerant Species			(1)	1
Net Increase or Decrease Tolerant Species			(1)	1

[1] Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates, and Fish - Second Edition EPA 841-B-99-002 (USEPA 2012b).

Table 5.3.6-6 Dominant Fish Species Present at Study Sites

Attributes	Federal Land (within parcel)		Non-federal Land (study areas within vicinity of Tract 1)		Non-federal Land (study areas within vicinity of Tract 3- Wolf Lands 3 and 4)	
Study site	PR-west	PR-east	MPCAB-05RN029	MPCAB-05RN077	MPCAB-05RN024	MPCAB-05RN074
Dominant Species	Brook stickleback	Northern redbelly dace	White sucker	White sucker	Longnose dace	Blacknose shiner

Adopted from Barr 2011b and MPCA 2011c.

Table 5.3.6-7 Increase or Decrease of Stream Fish Assemblage for the Land Exchange Proposed Action

Combined Studies Within, or Within Vicinity of, Surface Water	Tract	Total Species (#)	Pollution-Intolerant Species (#)	Pollution-Tolerant Species (#)
Lands Conveyed				
Partridge River	Federal Lands	15	3	4
Lands Acquired				
Pike River	Tract 1	11	0	4
Coyote Creek	Tract 3 - Wolf Lands 3 and 4	18	4	4
Total Non-Federal Lands		21[1]	4	5[2]
Net Increase/(Decrease)		12 species (4) other species	1	1

Adopted from Section 4.3.6.

[1] Species would overlap between Tract 1 and Tract 3; thus, 21 species are distinct number of species for combined non-federal lands.
[2] Does not equal sum of non-federal lands since some species overlap or vary between Tract 1 and Tract 3.

<u>Benthic Macroinvertebrate Assemblages</u>

Macroinvertebrate baseline surveys completed within and in the vicinity of the federal lands ranked macroinvertebrate assemblages as fair within the second-order stretches of the Partridge River, as indicated by the HBI (see Table 5.3.6-8). The first-, third-, and fourth-order segments of the streams within the vicinity of the non-federal lands indicated macroinvertebrate assemblages ranging from good to fair. A qualitative comparison using the attributes of HBI, stream order, total families (diversity), and percent pollution-tolerant organisms indicate that the macroinvertebrate assemblages likely would remain the same under the Land Exchange Proposed Action. This qualitative comparison assumes the habitat and associated macroinvertebrate assemblages are similar in the stream segments within the non-federal lands boundaries including the third-order segment of the Pike River on Tract 1 and the first-order segments of Coyote Creek within Tract 3 (see Figure 5.3.6-1).

Table 5.3.6-8 Stream Macroinvertebrate Assemblage Comparisons for the Land Exchange Proposed Action

Attributes	Federal Parcel (within parcel)		Non-federal Land (study areas within vicinity of Tract 1)		Non-federal Land (study areas within vicinity of Tract 3- Wolf Lands 3 and 4)	
Study site	PR-west	PR-east	MPCAB-05RN029	MPCAB-05RN077	MPCAB-05RN024	MPCAB-05RN074
Stream order	2	2	1	4	3	4
HBI score	6.4	6.0	5.7	5.1	5.9	5.2
HBI ranking	Fair	Fair	Fair	Good	Fair	Good
Total families	11	10	11	31	23	27
Percent pollution-tolerant	8	18	3	5	10	26

Adopted from Barr 2011b and MPCA 2011c.

5.3.6.2.5 Aquatic Species of Greatest Conservation Need

The MDNR and USFS have developed the ECS for ecological mapping and landscape classification (MDNR 2011a), which defines uniform ecological features within a mapped area. The federal and non-federal lands are located in the Northern Superior Uplands Section of the Laurentian Mixed Forest Province. These lands are further divided into several subsections. The federal lands include the Laurentian and Nashwauk Uplands subsections while the non-federal lands include these two subsections and the Border Lakes subsection.

As discussed in Section 4.2.6.1.4, SGCN aquatic species are associated with these ecological subsections based on occurrence and habitat considerations. Using the approach of comparing SGCN species by subsection association only, the Land Exchange Proposed Action could result in an increase of six new potential SGCN species (see Table 5.3.6-9). Of these, the spoonhead sculpin, lake chub, and longear sunfish have the highest potential to be found near the shoreline habitat of Tract 5 (within the Border Lakes subsection).

Regardless of the potential indicated by subsection association, no SGCN species were identified within the boundaries of the federal or non-federal lands during field surveys. While habitat is present in at least some locations within these boundaries for SGCN species, the surveys performed within the vicinity of the federal lands found no SGCN aquatic species, suggesting that SGCN species are likely not present on the federal lands. Conversely, occurrences of the creek heelsplitter, an SGCN species, have been documented within the vicinity of the non-federal lands on segments of the Pike River (downstream of Tract 1) and the Stony River (downstream of Tract 3) as discussed in Section 4.3.6.2. The predominant sand substrate documented in survey areas within the vicinity of these SGCN occurrence locations and the possibility that similar substrates exist within the boundaries of Tract 1 and Tract 3 indicate the creek heelsplitter may exist within the river segments of these non-federal lands. A qualitative review of these data indicates the Land Exchange Proposed Action may result in the added presence of the creek heelsplitter.

The USFS determined that the Land Exchange Proposed Action would not affect three RFSS aquatic species on the Superior National Forest, which include lake sturgeon, nipigon cisco, and shortjaw ciscoe. In addition, the Land Exchange Proposed Action may affect individuals, but would not be likely to cause a trend to federal listing or loss of viability for the remaining six RFSS aquatic species on the Superior National Forest. Please see the Biological Evaluation listed on the USFS website (http://www.fs.usda.gov/goto/superior/northmet) for more information about effects on RFSS aquatic species.

Table 5.3.6-9 Ecoregion SGCN Species Comparisons for the Land Exchange Proposed Action

SGCN Species	Common Name	Federal Land (Laurentian and Nashwauk Uplands)	Non-federal Lands (Laurentian Uplands, Nashwauk Uplands, Border Lakes)
Fish			
Acipenser fulvescens	Lake sturgeon		X
Coregonus nipigon	Nipigon cisco		X
Coregonus zenithicus	Shortjaw cisco		X
Cottus ricei	Spoonhead sculpin		X
Couesius plumbeus	Lake chub		X
Ichthyomyzon fossor	Brook lamprey	X	X
Lepomis megalotis	Longear sunfish		X
Mussels			
Lasmigona compressa	Creek heelsplitter	X	X
Ligumia recta	Black sandshell	X	X
Total species		3	9

Adopted from Section 4.3.6.

5.3.6.3 Land Exchange Alternative B

5.3.6.3.1 Surface Water Features (MIH 14)

Land Exchange Alternative B would result in a net increase of lake and river surface water features to the federal estate (see Table 5.3.6-10). A total of 120.7 acres of lake and 2.8 miles of rivers would be added to the Superior National Forest under this alternative. The increase in lake and river frontage would provide a net increase to the federal estate of habitat for aquatic species (MIH 14). The frontage index would increase in the federal estate for both lakes and streams as a result of Land Exchange Alternative B.

Table 5.3.6-10 Frontage of Waterways for Land Exchange Alternative B

	Lake			Rivers/Creeks/Streams		
Parcel	Acres	Frontage (ft)	Frontage Index (shoreline/acre)	Miles	Frontage (linear ft)[1]	Frontage Index (shoreline/acre)[2]
Lands Conveyed						
Land Exchange Alternative B	8.9	1,200.0	0.3	5.3	55,968.0	11.8
Lands Acquired						
Tract 1	129.6	16,424.0	3.5	8.1	72,864.0	15.3
Net Change						
Net Increase/(Decrease)	120.7	15,224.0	3.2	2.8	16,896.0	3.5

Note: Surface water shoreline distance calculated by GIS analysis.

[1] Includes shoreline distance on both sides of streams.
[2] Frontage Index calculated by dividing total acres of parcel by total shoreline within parcel.

5.3.6.3.2 Differences of Strahler Stream Orders and Habitat

A quantitative comparison of the Strahler Stream Order indicates that Land Exchange Alternative B would result in a decrease of 1.3 and 4.0 miles of first- and second-order streams, respectively, and an increase of 8.1 miles of third-order streams to the federal estate (see Table 5.3.6-11).

As with the Land Exchange Proposed Action, the net increase of third-order streams and decrease in first- and second-order streams would likely add more habitat diversity to the Superior National Forest. The net decrease to the federal estate of first-order streams would slightly reduce the amount of available spawning habitat for some aquatic species as headwater streams provide specialized spawning habitat for some species.

Table 5.3.6-11 Increase or Decrease of Stream Orders from Land Exchange Alternative B

	Stream Distance (miles)		
Parcel (Stream)	**1st Order**	**2nd Order**	**3rd Order**
Lands Conveyed			
Federal Lands (Yelp Creek and Partridge River)	1.3	4.0	0.0
Lands Acquired			
Tract 1 – Hay Lake (Pike River)	0.0	0.0	8.1
Net Increase/(Decrease)	**(1.3)**	**(4.0)**	**8.1**

Note: Surface water shoreline distance calculated by GIS analysis.

5.3.6.3.3 Watershed Level Riparian and Aquatic Connectivity

Riparian Connectivity

A comparison of the watersheds containing streams present on the federal lands (Partridge River) and Tract 1 (Pike River) using the RCI is presented in Table 5.3.6-12. The index was developed from GIS analysis of vegetative cover along riparian areas where agriculture and land development have affected natural riparian vegetative cover.

Under Land Exchange Alternative B, there would be a slight increase to the federal estate in watershed riparian connectivity. The streams on both the federal lands and Tract 1 are located within watersheds with existing high quality riparian connectivity.

Table 5.3.6-12 Watershed Riparian Connectivity Index Comparison

Surface Water	Tract	Watershed	Percent Agriculture in Riparian Zone	Percent Development in Riparian Zone	RCI Score[1]
Lands Conveyed					
Partridge River/Yelp Creek	Federal Lands	St. Louis	0	5	95
Lands Acquired					
Pike River	1 - Hay Lake	Vermillion	0	1	99
Net Increase (Decrease)			0	(4)	4.0

Adopted from MDNR 2015a.

[1] RCI score calculated with MDNR formula using *Percent Agriculture and Percent Development in Riparian Zone*; scale is from 0 to 100 where 100 indicates excellent riparian conductivity.

<u>Aquatic Connectivity</u>

A comparison of the watersheds containing streams present on the federal lands (Partridge River) and Tract 1 (Pike River) using the ACI is presented in Table 5.3.6-13. The index was developed from GIS analysis of structures (i.e., dams, bridges, and culverts) along stream systems in the watershed.

Land Exchange Alternative B would result in the Superior National Forest acquiring streams located in watersheds with significantly better aquatic connectivity values, indicating increased aquatic habitat.

Table 5.3.6-13 Watershed Aquatic Connectivity Index Comparison

Surface Water	Tract	Watershed	Aquatic: Bridges and Culverts (miles stream/# structures)	Aquatic: Dams (miles stream/# structures)	ACI Score[1]
Lands Conveyed					
Partridge River	Federal Lands	St. Louis	15	6	11
Lands Acquired					
Pike River	1 - Hay Lake	Vermillion	41	11	26
Net Increase (Decrease)			26	5	15

Adopted from MDNR 2015b.

[1] ACI score calculated by dividing total miles of streams and ditches per watershed by total number of culverts, bridges, and dams; scale is from 0 to 100 where 100 indicates free flowing streams (no structures) and 0 indicates one structure for every 20 miles of flowing water.

5.3.6.3.4 Aquatic Species

As with the Land Exchange Proposed Action, a semi-quantitative comparison of the net increase or decrease to the federal estate of aquatic species was made for species located within the vicinity of the Tract 1 parcel boundaries since representative survey sites located in the vicinity of the parcel are likely similar to the existing aquatic habitats present at the parcel (see Section 4.2.6).

Fish Assemblages

Two survey sites were analyzed within the vicinity of both the smaller federal parcel and within the vicinity of Tract 1. The smaller federal parcel and Tract 1 had six species in common. Land Exchange Alternative B would potentially result in a net decrease to the federal estate of four species, including two pollution-intolerant species (see Table 5.3.6-14). Given the fact that only representative survey sites were used for Tract 1, it is possible that some species are more or less prevalent than is noted here. The attributes of the fish assemblages located at each survey site indicate that Land Exchange Alternative B would result in minimal change to the fish habitat for the portions of the river the Superior National Forest would acquire. The dominant fish species present at each site indicate that the stream characteristics were consistent with slower-moving, glide pool features.

Table 5.3.6-14 Increase or Decrease of Stream Fish Assemblage for Land Exchange Alternative B

Combined Studies Within, or Within Vicinity of, Surface Water	Tract	Total Species (#)	Pollution-Intolerant Species (#)	Pollution-Tolerant Species (#)
Lands Conveyed				
Partridge River/Yelp Creek	Federal Lands	15	4	4
Lands Acquired				
Pike River	Tract 1	11	2	4
Net Increase (Decrease)		(4)	(2)	0

Adopted from Section 4.2.6.

Benthic Macroinvertebrate Assemblages

Macroinvertebrate baseline surveys completed within, and in the vicinity of, the smaller federal parcel ranked macroinvertebrate assemblages as fair within the second-order stretches of the Partridge River, as indicated by the HBI pollution index (see Table 5.3.6-15). The first- and fourth-order segments of the streams within the vicinity of Tract 1 indicated macroinvertebrate assemblages ranging from good to fair. A qualitative comparison using the attributes of HBI, stream order, total families (diversity), and percent pollution-tolerant organisms indicate that the macroinvertebrate assemblages would likely be similar under Land Exchange Alternative B. This qualitative comparison assumes the habitat and associated macroinvertebrate assemblages are similar in the stream segments within the third-order segment of the Pike River on Tract 1.

Table 5.3.6-15 Stream Macroinvertebrate Assemblage Comparisons for Land Exchange Alternative B

Attributes	Federal Lands		Non-federal Lands (study areas within vicinity of Tract 1)	
Study site	PR-west	PR-east	MPCAB-05RN029	MPCAB-05RN077
Stream order	2	2	1	4
HBI score	6.4	6.0	5.7	5.1
HBI ranking	Fair	Fair	Fair	Good
Total families	11	10	11	31
Percent pollution-tolerant	8	18	3	5

Adopted from Barr 2011b and MPCA 2011c.

5.3.6.3.5 Aquatic Species of Greatest Conservation Need

The smaller federal parcel includes the Laurentian and Nashwauk Uplands ecological subsections, while Tract 1 includes only the Nashwauk Uplands.

As discussed in Section 5.3.6.2.5, SGCN species are associated with these ecological subsections based on occurrence and habitat considerations. Using the approach of comparing SGCN species by subsection association only, Land Exchange Alternative B would likely result in no net change to the federal estate of SGCN species (see Table 5.3.6-16).

Regardless of the potential indicated by subsection association, no SGCN species were identified within the boundaries of the smaller federal parcel. Habitat is present in at least some locations within these boundaries for SGCN species. Although no surveys were completed within the boundaries of Tract 1, occurrences of the creek heelsplitter, an SGCN species, have been documented within the vicinity of Tract 1 on segments of the Pike River (downstream of Tract 1). The predominant sand substrate documented in survey areas within the vicinity of this SGCN occurrence location and the possibility that similar substrates exist within the boundaries of Tract 1 indicate the creek heelsplitter may exist within the Pike River segments of Tract 1. A qualitative review of these data indicates that Land Exchange Alternative B may result in the added presence to the federal estate of the creek heelsplitter.

Table 5.3.6-16 Ecoregion SGCN Species Comparisons for Land Exchange Alternative B

SGCN Species	Common Name	Federal Lands (Laurentian and Nashwauk Uplands)	Tract 1 (Nashwauk Uplands only)
Fish			
Ichthyomyzon fossor	Brook lamprey	X	X
Mussels			
Lasmigona compressa	Creek heelsplitter	X	X
Ligumia recta	Black sandshell	X	X
Total species		3	3

Adopted from Section 4.3.6.

5.3.6.4 Land Exchange No Action Alternative

Under the Land Exchange No Action Alternative, the Superior National Forest would have an ongoing responsibility for managing aquatic resources on the federal lands in accordance with the Forest Plan. The Land Exchange No Action Alternative would not change the USFS responsibility for managing aquatic resources and would result in no further effects on existing aquatic species or habitats.

Fish and other aquatic life on the federal lands would be exposed to the water quality, hydrologic, and physical habitat conditions that currently exist as a result of past mining activities. There would be no change from existing conditions, although it is expected that the water quality of the Embarrass River may improve as a result of corrective actions potentially required by the reissuance of existing NPDES/SDS permits in the NorthMet Project area. Future actions conducted under the Cliffs Erie Consent Decree may also change these conditions.

The non-federal lands would not go into USFS ownership, and land use would be determined by the private land owners. Effects to aquatic resources are difficult to predict given the uncertainty of future potential land use. Some lands may be developed, resulting in potential effects to aquatic species at the individual and local population levels, decreases in habitat, and adverse effects on habitat connectivity.

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5.3.7 Air Quality

Because there are no current operations or activities on the non-federal parcels that would result in a change to ambient air quality, the Land Exchange Proposed Action (and alternatives) would not result in new effects on the federal estate. Indirect effects from the NorthMet Project Proposed Action on the non-federal parcels are considered under Class I area modeling and are discussed in Section 5.2.7.

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5.3.8 Noise and Vibration

Evaluation of potential noise, vibration, and airblast effects in the areas of the Land Exchange Proposed Action used the same methodologies and criteria that were described previously for the NorthMet Project Proposed Action. The results of the modeling indicate that noise, vibration, and airblast levels that would be experienced at or by sensitive receptors would be below the Minnesota standards. Therefore, operations at the Mine Site and Plant Site would not have a significant effect on human receptors within the federal and non-federal lands, including people that may use the non-federal lands for recreational activities such as hunting and hiking (if the Land Exchange Proposed Action were to occur and the non-federal lands were added to the Superior National Forest). As discussed in Section 5.2.8, tribal users of archaeological sites (Spring Mine Lake Sugarbush, *Mesabe Widjiu*, and BBLV Trail; see Section 4.2.9) in the immediate vicinity of the Mine Site and Plant Site could experience some effects from noise. The non-federal land tracts are approximately 10 to 90 miles from operations at the Mine Site and Plant Site; tracts located 50 to 90 miles away from the federal lands are outside the area of analysis for noise modeling and would be not affected by noise from operations at the Mine Site and Plant Site.

5.3.8.1 Methodology and Evaluation Criteria

The noise and vibration impact assessment area for the Land Exchange Proposed Action would involve transferring 6,495.4 acres of federal lands from public to private ownership, and up to 7,075.0 acres of land from private to public ownership. The spatial and temporal area of analysis assessed for noise, vibration, and airblast as part of the Land Exchange Proposed Action included the indirect effects resulting from the mining activities; therefore, the area of analysis is the same as that described in Section 5.2.8.1. As indicated before, three desktop computer models (ISO 9613-2 sound-propagation model, the Site Law formula, and the Terrock model) were used to evaluate noise, ground vibration, and airblast effects, respectively, on the federal and non-federal lands.

5.3.8.2 Land Exchange Proposed Action

5.3.8.2.1 Federal Lands

The topography and land cover of the federal lands are similar to those of the Mine Site previously discussed, but include additional area to the west and northwest that are mostly wetland. NorthMet Project Proposed Action-related activities that would result in noise, vibration, or airblast would not occur on the additional federal lands (3,776.1 acres) situated west and northwest of the Mine Site, so no additional noise, vibration, or airblast effects would occur in this area. It should be noted that the federal land excludes private lands (295.2 acres) situated south of Dunka Road. There are no residential areas or individual houses within the federal lands that could be affected by the NorthMet Project Proposed Action's noise and vibration-related activities (see Figures 5.3.8-1 to 5.3.8-4). As discussed in Section 5.2.8.2, noise and vibration levels from the Mine Site would be too low to significantly affect the recreational use of the federal land (i.e., minor effects in 11,456 acres around the Mine Site).

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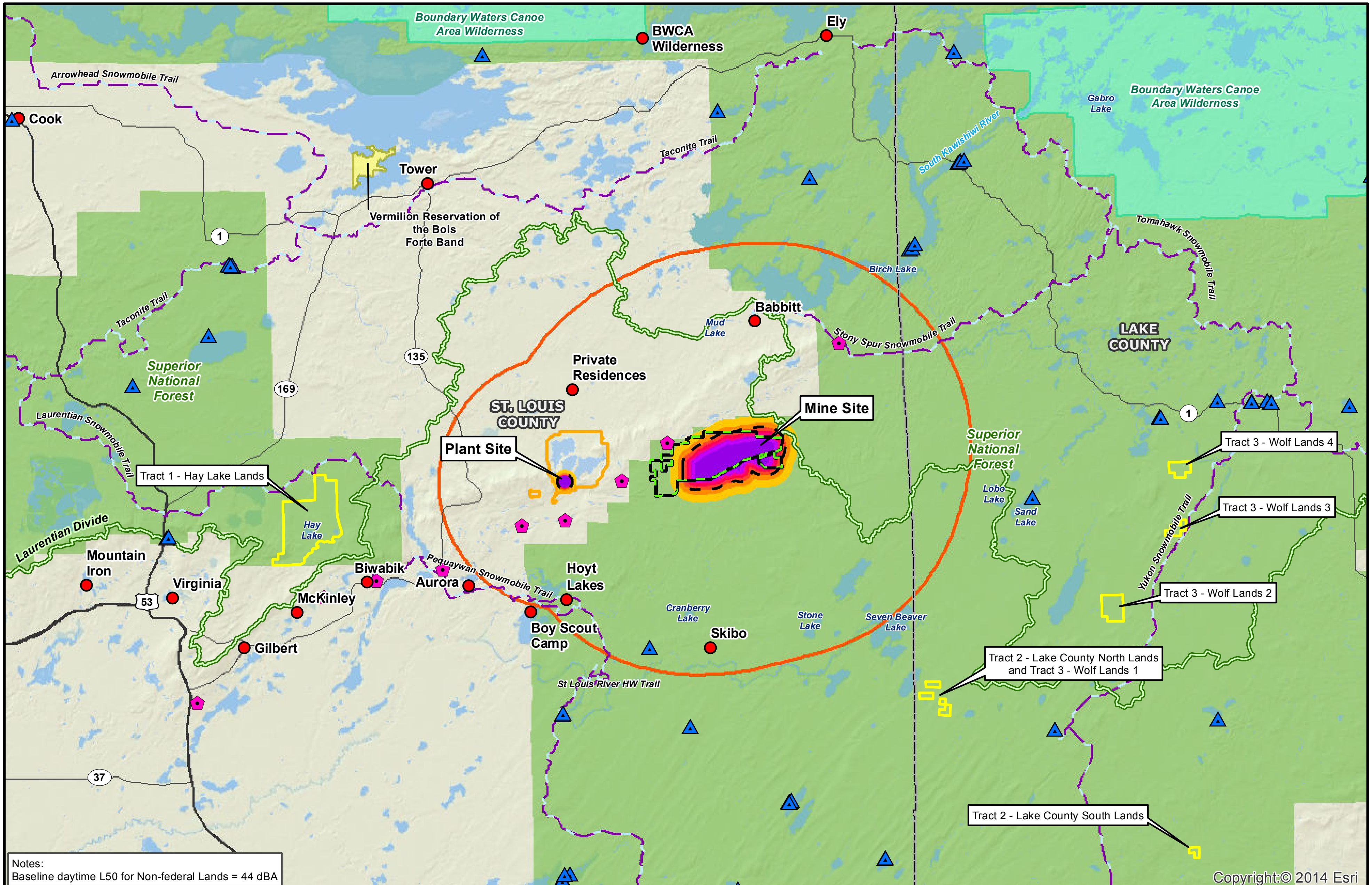

Noise Sensitive Receptor
Non-federal Lands
Federal Lands
Plant Site
Mine Site
Wildlife Travel Corridor
Recreational Site
Native American Reservation
Boundary Waters Canoe Area Wilderness
National Forest
MN L50 Daytime Noise Standard: 60 dBA
L50 Audibility Limit

L50 dBA Levels

50-54.9
55-59.9
60-64.9
65-69.9
70-74.9
75-79.9
80+

US Army Corps of Engineers
St. Paul District

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N
W E
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0 2 4 8 Miles

Figure 5.3.8-1

Predicted Daytime L50 Noise Contours at Non-federal Tracts (Includes Baseline L50 Levels)

NorthMet Mining Project and Land Exchange PFEIS

Minnesota

June 2015

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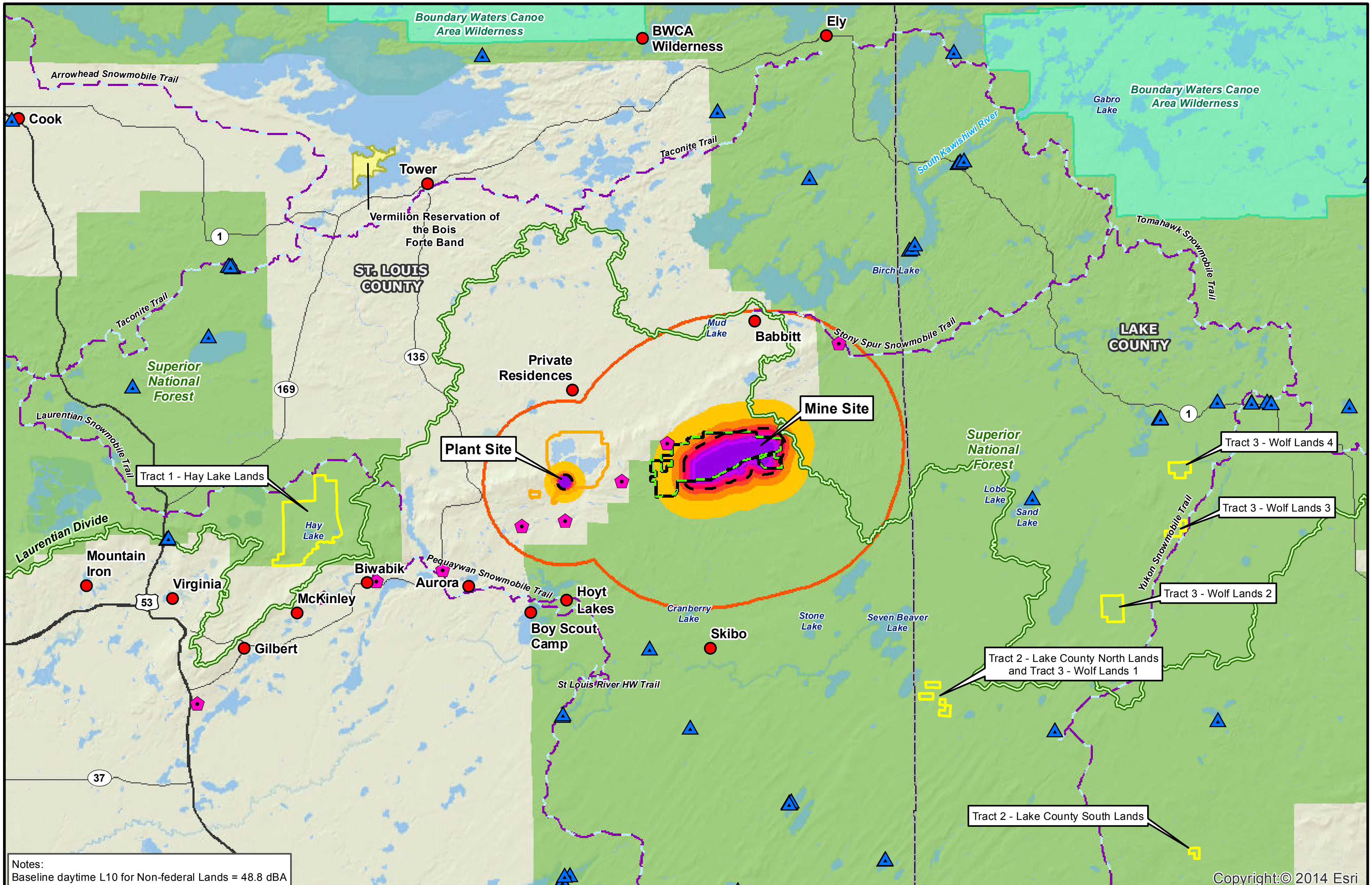

Noise Sensitive Receptor	Recreational Site	MN L10 Daytime Noise Standard: 65 dBA
Non-federal Lands	Native American Reservation	L10 Audibility Limit
Federal Lands	Boundary Waters Canoe Area Wilderness	**L10 dBA Levels**
Plant Site	National Forest	50-54.9
Mine Site		55-59.9
Wildlife Travel Corridor		

60-64.9
65-69.9
70-74.9
75-79.9
80+

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St. Paul District

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N W E S

0 2 4 8 Miles

Figure 5.3.8-2
Predicted Daytime L10 Noise Contours at Non-federal Tracts (Includes Baseline L10 Levels)
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

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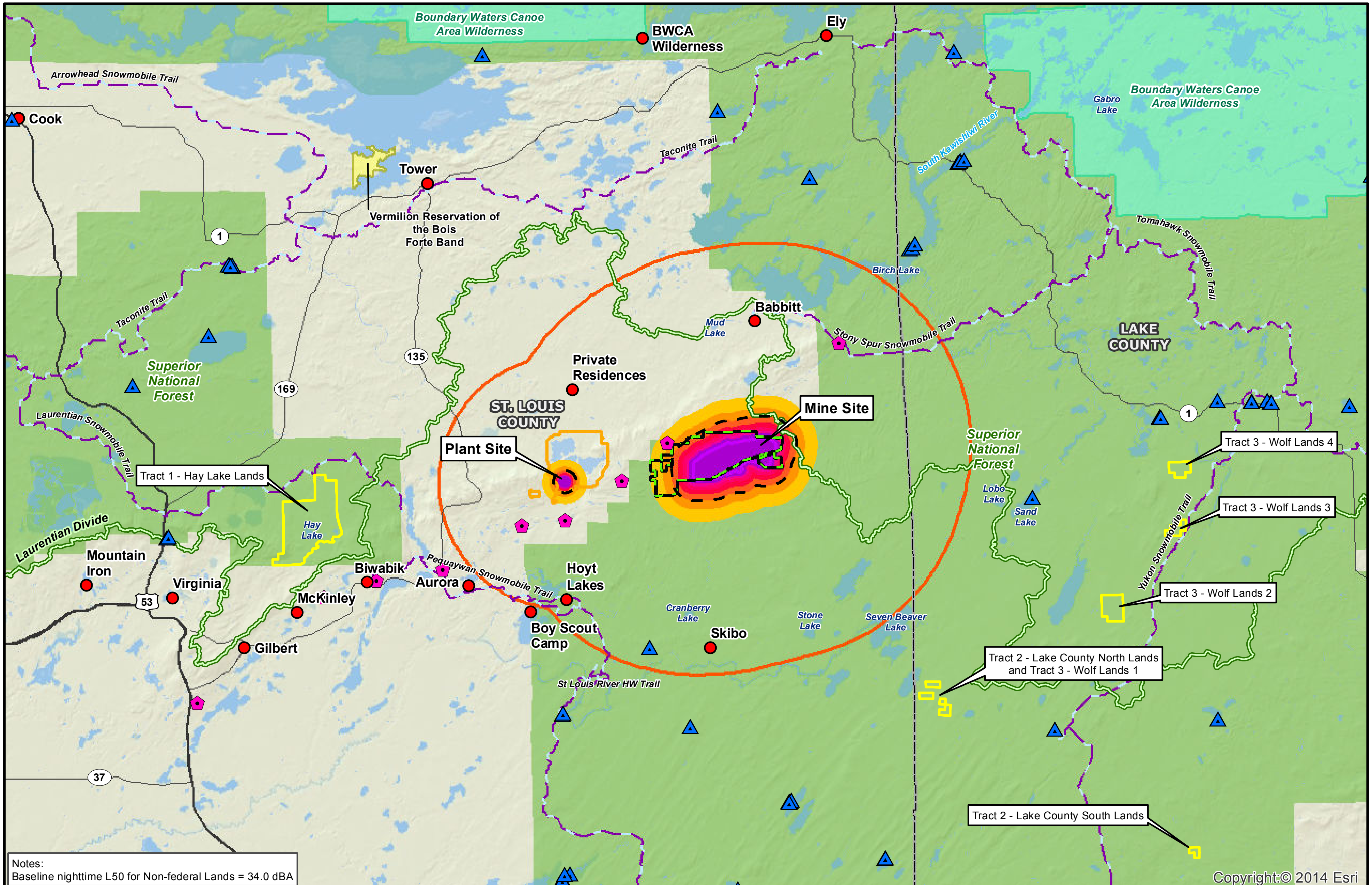

Noise Sensitive Receptor
Non-federal Lands
Federal Lands
Plant Site
Mine Site
Wildlife Travel Corridor
Recreational Site
Native American Reservation
Boundary Waters Canoe Area Wilderness
National Forest
MN L50 Nighttime Noise Standard: 50 dBA
L50 Audibility Limit
L50 dBA Levels
40-44.9
45-49.9
50-54.9
55-59.9
60-64.9
65-69.9
70+

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St. Paul District

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N W E S

0 2 4 8 Miles

Figure 5.3.8-3
Predicted Nighttime L50 Noise Contours at Non-federal Tracts (Includes Baseline L50 Levels)
NorthMet Mining Project and Land Exchange PFEIS
Minnesota
June 2015

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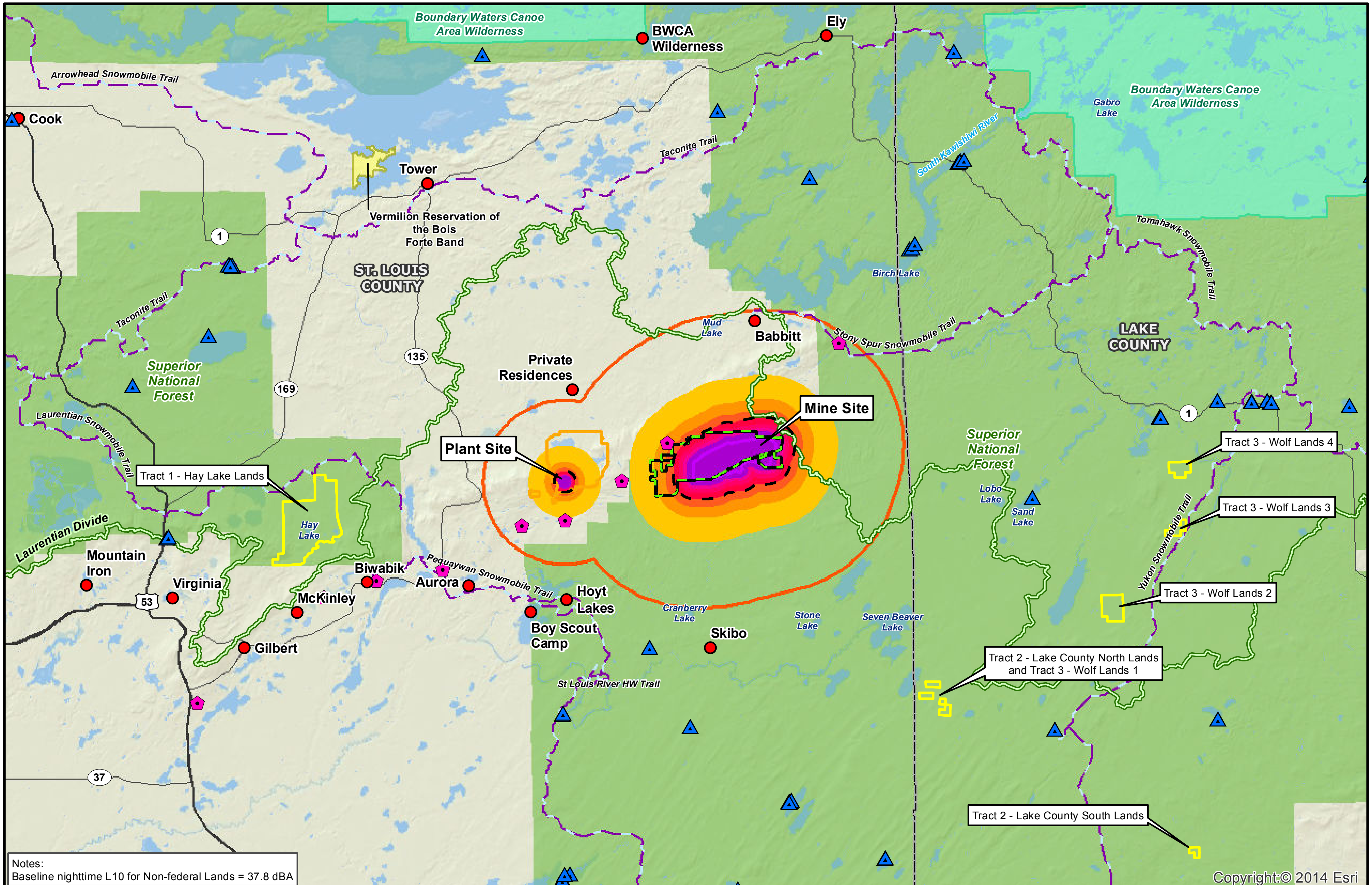

Noise Sensitive Receptor
Non-federal Lands
Federal Lands
Plant Site
Mine Site
Wildlife Travel Corridor
Recreational Site
Native American Reservation
Boundary Waters Canoe Area Wilderness
National Forest
MN L10 Nighttime Noise Standard: 55 dBA
L10 Audibility Limit

L10 dBA Levels

40-44.9
45-49.9
50-54.9
55-59.9
60-64.9
65-69.9
70+

US Army Corps of Engineers
St. Paul District

This document is a working document. This document may change over time as a result of new information, further deliberation, or other factors not yet known to the Co-lead Agencies.

0 2 4 8 Miles

Figure 5.3.8-4

Predicted Nighttime L10 Noise Contours at Non-federal Tracts (Includes Baseline L10 Levels)

NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

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5.3.8.2.2 Non-federal Lands

The non-federal lands would be managed consistent with the adjacent forest lands management (see Section 4.3.1). No direct effects from the Land Exchange Proposed Action are anticipated since the USFS currently has no plans for operations on the non-federal lands and no NorthMet Project Proposed Action-related activity (e.g., drilling, blasting, excavation work, material haulage via trucks, and ore crushing) would occur within the non-federal lands.

Review of the most-up-to-date aerial maps indicates that there are no human or residential receptors within or adjacent to the non-federal lands (Tracts 1 to 5). If the Land Exchange Proposed Action were to occur and the non-federal lands were added to the Superior National Forest (i.e., if the tracts became federal lands), public recreational use such as hiking and hunting would likely occur on these tracts.

To determine the indirect effect of operations at the Mine Site and Plant Site on people that may use the non-federal lands for recreational activities such as hiking and hunting, the modeled area was expanded to a 20-mile radius from both the Mine Site and the Plant Site. Daytime and nighttime noise contours (L_{50} and L_{10}) generated from the modeling are shown in Figures 5.3.8-1 through 5.3.8-4. During the daytime, all potential receptors within the non-federal lands were outside the 50-dBA (L_{50} and L_{10}) noise contours. During the nighttime, all potential receptors within the non-federal lands were outside the 40-dBA (L_{50} and L_{10}) noise contours. This shows that the predicted daytime and nighttime noise levels at the non-federal lands due to operations at the Mine Site and Plant Site are well below Minnesota's noise standards. The results of the noise assessment indicate that operations at the Mine Site and Plant Site would add no perceptible noise (0 dBA) to the current baseline levels experienced at the non-federal lands. Non-federal Tracts 4 and 5 are approximately 50 and 90 miles away, respectively, from the federal lands and are outside the area of analysis for noise modeling; neither tract would be affected by noise from operations at the Mine Site and Plant Site.

Based on the information above, it is anticipated that noise from typical mining and hauling operations at the Mine Site and ore-crushing operations at the Plant Site would not affect the people that may use the non-federal lands for recreational activities such as hiking and hunting under the Land Exchange Proposed Action. However, as discussed in Section 5.2.8, tribal users of archaeological sites (Spring Mine Lake Sugarbush, *Mesabe Widjiu*, and BBLV Trail; see Section 4.2.9) in the immediate vicinity of the Mine Site and Plant Site could experience some effects from noise. The non-federal lands are far from the Mine Site and Plant Site (10 to 90 miles away), so indirect vibration levels from operations at both locations would not affect potential receptors within the non-federal lands that would be acquired under the Land Exchange Proposed Action.

5.3.8.3 Land Exchange Alternative B

Under the Land Exchange Alternative B, 4,752.6 acres would be conveyed to PolyMet. The type, quantity, and location of noise- and vibration-related sources (i.e., drilling, blasting, excavation work, haul trucks, trains, and crushers) for the Land Exchange Alternative B would be the same as that for the Land Exchange Proposed Action. Therefore, the Land Exchange Alternative B would not change noise and vibration levels experienced at the federal lands or modify noise and vibration effects on nearest receptors. If the 4,752.6 acres of land were to become privately owned, public recreational use currently associated with the smaller federal parcel would no longer occur on that portion of the federal lands (i.e., the Land Exchange Alternative B would have no effects associated with public recreational use on that portion). Sections 5.2.8.2.1 and 5.2.8.2.2 provide a discussion of the noise and vibration effects on the federal lands.

Under the Land Exchange Alternative B, Tract 1 (4,926.3 acres) would be acquired by the USFS. The type, quantity, and location of noise- and vibration-related sources (i.e., drilling, blasting, excavation work, haul trucks, trains, and crushers) for this alternative would be the same as that for the Land Exchange Proposed Action. Therefore, the Land Exchange Alternative B would not change noise and vibration levels experienced at the non-federal lands or modify noise and vibration effects on the nearest receptors.

As indicated above, during the daytime, all modeled potential receptors within Tract 1 were outside the 50-dBA (L_{50} and L_{10}) noise contours (see Figure 5.3.8-1 and 5.3.8-2). Similarly, during the nighttime, all potential receptors within Tract 1 were outside the 40-dBA (L_{50} and L_{10}) noise contours (see Figure 5.3.8-3 and 5.3.8-4). The predicted daytime and nighttime noise levels at Tract 1 due to operations at the Mine Site and Plant Site are well below Minnesota's noise standards. The results of the noise assessment indicate that operations at the Mine Site and Plant Site would add no additional noise (0 dBA) to the current baseline levels experienced at Tract 1.

5.3.8.4 Land Exchange No Action Alternative

Under the Land Exchange No Action Alternative, the transfer of lands would not occur and there would be no increase in noise and vibration levels at the federal and non-federal lands. Therefore, there would be no change in noise and vibration levels at the nearest receptors.

5.3.9 Cultural Resources

This section summarizes the environmental consequences of the Land Exchange Proposed Action on historic properties that are present on the federal and non-federal lands, including the potential effects, types of avoidance, effect minimization measures, and potential mitigation measures that are relevant to these historic properties. Additionally, this section summarizes the environmental consequences of the Land Exchange Proposed Action and alternatives on 1854 Treaty resources—i.e., those areas and species that are traditionally or culturally important to the Bands. Under the Land Exchange Proposed Action and alternatives, the Superior National Forest would retain its ongoing responsibility for managing cultural resources on Superior National Forest lands in accordance with the Forest Plan.

The federal Co-lead Agencies have identified a historic property in consultation with the SHPO, Bands, and PolyMet. The federal Co-lead Agencies have also consulted with the SHPO, Bands, and PolyMet concerning NRHP eligibility of the BBLV Trail Segment. All other cultural resources identified as part of the Land Exchange Proposed Action, as identified in Section 4.3.9.1.1, were determined to be not eligible for inclusion in the NRHP, and therefore will not receive further consideration under Section 106 during review of the Land Exchange Proposed Action. The federal Co-lead Agencies are currently refining statements of significance and boundaries for this property.

An effect determination has been drafted by the federal Co-lead Agencies for review and comment by the SHPO, Bands, and PolyMet. The federal Co-lead Agencies believe that the BBLV Trail Segment would be adversely affected by the Land Exchange Proposed Action. This determination will be used to facilitate ongoing consultation with the SHPO, Bands, and PolyMet pertaining to the application of adverse effect criteria to this property. Mitigation measures to resolve adverse effects would be developed after consultation on the effect determination and consideration of any measures to avoid or minimize adverse effects.

5.3.9.1 Methodology and Evaluation Criteria

Effects associated with the Land Exchange Proposed Action would be the potential destruction of historic properties and the loss of the historic information and cultural significance that these properties could represent. An additional effect would be the loss of federal protection for any unknown historic properties, such as those provided under the NHPA, the Archaeological Resource Protection Act, and the Native American Graves and Repatriation Act. The methodology and evaluation criteria used to determine potential effects on cultural resources from the Land Exchange Proposed Action are similar to those used for the NorthMet Project Proposed Action (see Section 5.2.9).

The analysis of cultural resources was performed based on readily available information, and no additional field work was performed. Intensive analysis is only needed for the federal parcel leaving federal ownership. The non-federal lands that would be going into federal ownership would not be of primary concern since future management of these lands would be per Forest Plan direction for heritage resources.

The spatial area of analysis for Land Exchange Proposed Action effects on cultural resources included the boundaries of the federal tracts proposed for the exchange, while the temporal area of analysis was the point in time at which the change in ownership would occur. The geographic extent is appropriate because it includes all cultural resources that would be affected by a change in site protection. In a temporal sense, the change in ownership is appropriate because this is when there would be a gain or loss of legal protections.

The analysis of the cultural resources affected by the Land Exchange Proposed Action was guided by effects criteria that were developed by the USFS and the USACE. The analysis included a review of known and recorded heritage resources (i.e., historic structures, artifacts, TCPs) within or immediately adjacent to the federal and non-federal lands and a qualitative assessment to determine if there were portions of the federal and non-federal lands that have not been surveyed previously and would have a high probability to yield heritage resources.

5.3.9.2 Land Exchange Proposed Action

5.3.9.2.1 Federal Lands

As outlined in Section 5.2.9, the federal Co-lead Agencies, SHPO, Bands, and PolyMet agree that the BBLV Trail Segment is eligible for inclusion in the NRHP. The federal Co-lead Agencies, in consultation with the SHPO, Bands, and PolyMet, have determined effects for the eligible property and are currently working to resolve adverse effects. The federal Co-lead Agencies are currently in the process of developing a MOA, which identifies the steps the federal Co-lead Agencies would take to avoid, minimize, or mitigate the adverse effect. Cultural resources located on private lands being transferred to federal ownership would not be considered as adversely affected, but would be considered to have greater preservation protection under federal law.

The 1854 Treaty resources located within the Land Exchange Proposed Action would be similar to the Mine Site portion of the NorthMet Project area previously discussed in Section 4.2.9. Section 4.2.9 provides further discussion of the existing conditions on the Mine Site and associated federal lands. The Land Exchange Proposed Action represents an exchange of private and federal land, but it is also represents an exchange of access to natural resources expressed in treaties made between the United States and Bands of Ojibwe Indians in the 19th Century. Due to the nature of a land exchange, therefore, the effects would be limited to access to such resources versus direct or indirect effects, as would be the case with the Land Exchange Proposed Action.

An analysis of effects on 1854 Treaty resources, as described and discussed in Section 4.2.9, is limited by the lack of available information concerning the use of such resources. Determining how the Bands have traditionally conducted their usufructuary rights on or near the Land Exchange area would only be available through a detailed ethnographic study of individual Band members and their families. The cultural resources investigations included Band member interviews with Bois Forte, Fond du Lac, and Grand Portage, although only Bois Forte's results were made available. The results of the interviews and the cultural resources investigation did not find any natural resources that would be considered a TCP or other traditional cultural place.

There is also no quantitative analysis of current use of treaty resources in or near the federal lands. This lack of data also precludes the analysis of how Band members would be quantitatively affected socioeconomically by effects on 1854 Treaty resources, further discussed in Section 5.2.10. The primary source of data for assessing effects on treaty resources is from the analysis of the environment in other chapters of this FEIS as discussed in Section 4.2.9.4 and 5.2.9.2.2.

As discussed above, the Land Exchange Proposed Action could have effects on 1854 Treaty resources—i.e., lack of access to those areas and species that are traditionally or culturally important to the Bands. For example, coniferous bogs contain several plant species that are tribally harvested resources (e.g., cranberries, Labrador tea, creeping snowberry, etc.). Because the non-federal lands contain fewer acres of coniferous bogs than the federal lands, the Land Exchange Proposed Action would result in a net decrease of coniferous bog wetlands on the federal estate.

Band members' use of the federal lands is not well-defined through research at this time and did not emerge through interviews. A good faith effort was made on the part of the federal Co-lead Agencies to identify use areas in or adjacent to the federal lands; however, those efforts resulted in little specific information concerning historic subsistence use and no information regarding recent subsistence activity within the federal lands. As such, cultural effects on the Bands would be difficult to quantify in regards to such incremental increases below standards or effects on species where appropriate mitigation is used.

5.3.9.2.2 Non-federal Lands

There are no known cultural resources on the non-federal lands. Cultural resources located on private lands being transferred to federal ownership would not be considered adversely affected, but would be considered to have greater preservation protection under federal law.

The Land Exchange Proposed Action represents an exchange of non-federal and federal land, but it also represents an exchange of access to natural resources expressed in treaties made between the United States and Bands of Ojibwe Indians in the 19th Century. Due to the nature of a land exchange, therefore, the 1854 Treaty resources would be available for resource gathering and subsistence use by the Bands and would receive greater protection under federal law than they are currently receiving.

5.3.9.3 Land Exchange Alternative B

5.3.9.3.1 Federal Lands

All of the cultural resources and 1854 Treaty resources identified and discussed in Section 5.3.9 are located within the Land Exchange Alternative B. Effects on these resources would be the same as discussed in Section 5.3.9.

5.3.9.3.2 Non-federal Lands

There are no known cultural resources on the non-federal lands. The non-federal lands that would be going into federal ownership would not be of primary concern for cultural resources since future management of these lands would be as per the Forest Plan direction for cultural resources. Cultural resources located on private lands being transferred to federal ownership would not be considered adversely affected, but would be considered to have greater preservation protection under federal law.

The Land Exchange Alternative B represents an exchange of private and federal land, but it also represents an exchange of access to natural resources expressed in treaties made between the United States and Bands of Ojibwe Indians in the 19th Century. Due to the nature of a land exchange, therefore, the 1854 Treaty resources would be available for resource gathering and subsistence use by the Bands and would receive greater protection under federal law than they are currently receiving.

5.3.9.4 Land Exchange No Action Alternative

There would be no effects on cultural resources or 1854 Treaty resources under the Land Exchange No Action Alternative.

5.3.10 Socioeconomics

This section describes the potential socioeconomic consequences of the Land Exchange Proposed Action. Overall, the Land Exchange Proposed Action would have the following socioeconomic effects:

- positive economic effects due to the value of forestry products made available on the non-federal lands, as well as jobs and revenue due to increased visitation of the non-federal lands;
- undetermined effects for EJ populations and subsistence activities, due to the net increase in the amount of land available for subsistence activities, but unknown changes in the type and extent of subsistence resources on the federal and non-federal lands; and
- negligible effects on other socioeconomic considerations.

5.3.10.1 Methodology and Evaluation Criteria

As discussed in Section 5.2.10, the study area for socioeconomics differs from the study area used for much of the rest of this FEIS. It includes Cook, Lake, and St. Louis counties. This includes, where appropriate, the St. Louis County municipalities listed in Section 4.2.10. The primary issues related to socioeconomics on and near the non-federal lands, and therefore the potential for effects, would include the following:

- the amount of annual property taxes lost to the county from non-federal lands going to federal ownership;
- the potential change in payment in lieu of taxes to the county from the Land Exchange Proposed Action;
- the differences in assessed market values of federal lands compared to non-federal lands proposed for exchange;
- the difference between present values of recently harvested (past 10 years) products from the federal parcels and the value of products from the federal parcels;
- the difference between present and future values of potential forest products in Land Exchange Proposed Action parcels;
- the change in forestry employment on federal and non-federal parcels (estimated);
- a qualitative assessment of public visitation to the federal tract and estimated/potential visitation to non-federal tracts;
- the difference between present and future estimated spending on recreational tourism;
- the difference between present and future amounts of treaty resources in Land Exchange Proposed Action parcels; and
- a qualitative assessment of tribal use of the federal parcels and estimated/potential use of the non-federal parcels.

5.3.10.2 Land Exchange Proposed Action

This section describes the potential socioeconomic effects of the Land Exchange Proposed Action on communities in the socioeconomics study area. The Land Exchange Proposed Action would create moderate positive economic effects through increased opportunity for forestry and recreation and associated employment, earnings, and revenue. The Land Exchange Proposed Action would have negligible negative effects on other socioeconomic factors, including housing, public facilities and services, EJ populations, and subsistence.

5.3.10.2.1 Economic Activity

There is no current economic activity (e.g., forestry, etc.) on the federal lands, although harvesting of forest products is permitted by the Forest Plan. More importantly, the federal lands are not accessible to the public for economically measurable use, such as forestry or recreation (see Section 5.2.11). Thus, while the federal lands may hold some theoretical economic value for timber harvest, their practical economic value is zero. Table 5.3.10-1 lists data and observations relevant to the economic value of the federal and non-federal lands.

Tax Payments

Implementation of the Land Exchange Proposed Action would transfer ownership of the federal lands to PolyMet, and would result in an active mining operation that would generate federal, state, and local tax revenue, in addition to employment. As described in Section 5.2.10.2.3, total annual direct tax payments from the NorthMet Project Proposed Action during operations are expected to be in the range of $37 to $80 million, a positive economic effect, both on an absolute basis and when compared with the minimal current economic activity within the NorthMet Project area.

The amount of property taxes that would be paid to St. Louis County for the federal lands has not yet been determined; however, property taxes would be included in the overall taxes paid by PolyMet, shown in Table 5.2.10-3. For the non-federal lands, increases to federal payments in lieu of taxes to study area counties as a result of the Land Exchange Proposed Action would be negligible (compared to the current payment in lieu for the federal lands).

Table 5.3.10-1 Economic Value of Federal and Non-federal Lands (in 2012 dollars)

Land	Acreage	Annual Property Tax[1]	Annual Payment in Lieu of Taxes (PILT)[2]	Market Value of Land[3]	Other Economic Value
Federal Lands	6495.4	NA[3]	$2,273.39	TBD	NA
Tract 1	4,926.3	$20,714.68	$1,724.10	TBD	Potential recreational value due to the presence of Hay Lake (boating, fishing), existing trails, evidence of ongoing hunting, and other recreational activity (see Section 4.3.11).
Tract 2	381.9	$2,563.54	$133.70	TBD	NA
Tract 3	1,575.8	Unknown	$551.60	TBD	NA
Tract 4	160.2	$739.30	$56.00	TBD	NA
Tract 5	30.8	$1,938.00	$10.85	TBD	Potential recreational value. Former site of a cabin and camp site owned by Carleton College. Adjacent to highly scenic McFarland Lake (boating, fishing, access to BWCAW) (see Section 4.3.11).
Subtotal, Non-Federal Lands	7,075.0	$25,995.52	$2,476.25	TBD	NA
Net Change[5]	**579.6**	**NA**	**$202.86**	**TBD**	**NA**

[1] Source: Orehek, PolyMet, Pers. Comm., April 17, 2012.
[2] Source: DOI 2012
[3] See Market Value section below.
[4] Table 5.2.10-3 describes total estimated taxes that PolyMet expects to pay for the federal lands. The amount specifically anticipated for property taxes has not been determined.
[5] Calculated as (non-federal) minus (federal).

TBD = To be determined

Market Value

Federal regulations governing land exchanges, contained in 36 CFR 254.12, require that the assessed value of non-federal land being exchanged be equal to or within 25 percent of the assessed value of the federal land being exchanged. Assessment data have been updated and are included in this FEIS.

Recreation Value

Tracts 1 and 5 also have the potential for recreational use (whereas the federal lands are not easily accessible for any purpose). To the degree that the USFS manages these lands (and the other non-federal lands) for active recreational activity, the Land Exchange Proposed Action could increase economic activity associated with recreation and tourism. The non-federal lands comprise less than half of 1 percent of the 2,171,603.9 acres of Superior National Forest that are managed by USFS, so any such increase would be small.

Timber

There is no ongoing forestry activity on the federal lands, and no evidence of recent past forestry activity. Portions of Tracts 2, 3, and 4 show some evidence of timber harvesting, and a timber harvest agreement is in place through 2013 for the Wolf Lands 3 parcel (see Section 4.3.1). Likely USFS management area designations for the non-federal lands would allow timber harvesting on 6,547.1 acres of the non-federal lands (the lands designated General Forest or General Forest – Longer Rotation; see Table 5.3.1-1). Thus, the Land Exchange Proposed Action could increase timber production in Superior National Forest.

On average, 1 percent of timber land in Superior National Forest is harvested each year, with an estimated value of $400 (gross) per harvested acre (Deckard, MDNR, Pers. Comm. April 26, 2012). Timber harvesting on the non-federal lands (and any other USFS lands) would occur only after completion of forest planning, when acres that are eligible for harvest are identified and the offered for sale. For planning purposes, if 1 percent of the non-federal lands would therefore generate gross proceeds of approximately $26,188 per year. This represents approximately 2 percent of the $1,435,900 value of timber harvests in Superior National Forest in 2011 (Deckard, MDNR, Pers. Comm. April 26, 2012), although the markets for timber, and thus the value of harvested timber, can change dramatically. This additional activity would be estimated to generate fewer than 20 new jobs in the region. Minnesota averages approximately one forestry job (including logging and primary manufacturing) per 350 acres of annual harvest, and each direct forestry job generates another 3.6 indirect and induced jobs (Deckard, MDNR, Pers. Comm. April 26, 2012). Using these estimates, the Land Exchange Proposed Action could generate four direct and 12 indirect jobs. As of 2009, forestry activities employed approximately 1,287 individuals in the study area (Headwaters Economics 2009).

Environmental Justice and Subsistence

Potential EJ populations, as well as the EJ and subsistence effects of the Land Exchange Proposed Action on the federal lands, are described in Section 5.2.10.2.7. Although tribal entities possess usufructuary rights to hunt, fish, and gather throughout the 1854 Ceded Territory, the federal lands are not easily accessible for such subsistence activities. The Land Exchange Proposed Action would involve the transfer of 6,495.4 acres of inaccessible federal lands from public to private ownership, and up to 7,075.0 acres of publicly accessible land from private to public ownership. To the degree that increased availability of publicly accessible land improves property value and generates revenue (see above) in the study area, the Land Exchange Proposed Action could have positive effects on EJ populations.

As a result of the Land Exchange Proposed Action, the current federal lands would become unavailable for subsistence use. Resource-specific sections of the FEIS address the degree to which subsistence species and resources are likely to be available on the non-federal lands. As described in Section 5.2.9, subsistence has both economic and cultural components; for the Bands, the harvest of a particular animal or plant is intrinsically linked to the place and nature in which it was harvested. Thus, a “net change” in subsistence activity associated with the Land Exchange Proposed Action cannot be calculated in the same way as, for example, the net change in employment or income. The Land Exchange Proposed Action would result in the loss of subsistence resources and opportunities on the federal lands, and a gain in subsistence resources and opportunities on the non-federal lands.

Other Socioeconomic Considerations

The Land Exchange Proposed Action would result in slight increases in demand for public safety services to assist recreational or other users of the non-federal lands. This is a demand that currently does not exist on the inaccessible federal lands. The non-federal lands represent 0.2 percent of the Superior National Forest. Thus, any such increased demand would be marginal. No new housing (and thus no increased demand for educational facilities) is anticipated on the non-federal lands. Any utilities extended to the non-federal lands (such as electricity) would likely be minimal in nature (given the ROS categories assigned to the non-federal lands—see Section 5.3.11). Thus, the Land Exchange Proposed Action would have negligible effects on other socioeconomic considerations.

The Land Exchange Proposed Action would result in a loss of some of the ecosystem functions provided by the forest, wetland, and other natural habitats on the federal lands, particularly the portions of the federal lands (i.e., the Mine Site) where habitat would be replaced by mine facilities. Some of these functions could be restored during the post-closure period, when the federal lands (as well as the Plant Site) are revegetated. In exchange, the Land Exchange Proposed Action would enable the USFS to directly manage the ecosystems functions on the non-federal lands.

5.3.10.3 Land Exchange Alternative B

Under the Land Exchange Alternative B, 4,752.6 acres of federal lands would be exchanged for the 4,926.3-acre Tract 1. The remainder of the federal lands would remain inaccessible by land. The Land Exchange Alternative B would create moderate positive economic effects through increased opportunity for forestry and recreation and associated employment, earnings, and revenue (see Table 5.3.10-1); however, these benefits would be less than from the Land Exchange Proposed Action. Similarly, the Land Exchange Alternative B would have negligible negative effects on other socioeconomic factors, including housing, public facilities and services, EJ populations, and subsistence, although less so than the Land Exchange Proposed Action.

5.3.10.4 Land Exchange No Action Alternative

Under the Land Exchange No Action Alternative, the NorthMet Project Proposed Action would not be developed, there would be no change to the federal lands, and the non-federal lands would remain inaccessible to the public (including tribal entities). Given other private ownership (e.g., the Dunka Road and railroad), the federal and non-federal lands would remain generally inaccessible to the public. Therefore, there would be no direct or indirect effects on socioeconomics.

5.3.11 Recreation and Visual Resources

This section describes the potential environmental consequences of the Land Exchange Proposed Action on recreational facilities and activities that typically take place on the federal and non-federal lands. In this section, effects on the federal and non-federal lands are discussed together, to facilitate calculation of net changes in recreation and scenic classes. Under the Land Exchange Proposed Action and Land Exchange Alternative B, the Superior National Forest would retain its ongoing responsibility for managing recreational resources on National Forest System lands in accordance with the Forest Plan.

Overall, the Land Exchange Proposed Action would increase opportunities for recreational activity through the acquisition of up to 7,075.0 acres of publicly accessible land (the non-federal lands) in exchange for 6,495.4 acres of federal land that are not publicly accessible by land, and thus cannot be practically used for recreation. The Land Exchange Proposed Action would also increase the amount of land controlled by the USFS in the Superior National Forest with Moderate and High SIOs.

The Land Exchange Alternative B would have a lesser degree of the same type of benefits for recreation and visual resources as the Land Exchange Proposed Action, due to the reduced land area involved.

Table 5.3.11-1 shows the effects of the Land Exchange Proposed Action and the Land Exchange Alternative B on acreage of various ROS classes; Table 5.3.11-2 shows the effects on SIO classes.

Table 5.3.11-1 Net Increase or Decrease of Recreation Opportunity Spectrum Classes

	Increase (Decrease) of ROS Class (Acres)			
Alternative	**Semi-Primitive Motorized**	**Semi-Primitive Non-Motorized**	**Roaded Natural**	**Total**
Land Exchange Proposed Action	(2,243.3)	2,309.9	513.0	579.6
Land Exchange Alternative B	(2,972.7)	2,162.2	984.2	173.7

Table 5.3.11-2 Net Increase or Decrease of Scenic Integrity Objectives

	Increase (Decrease) of Scenic Integrity Objective (Acres)			
Alternative	**High**	**Moderate**	**Low[1]**	**Total[1]**
Land Exchange Proposed Action	136.3	1,644.6	(1,170.8)	610.1
Land Exchange Alternative B	20.4	1,315.4	(1,153.2)	182.6

[1] Mud Lake would not be managed by the USFS, and therefore does not have an SIO.

5.3.11.1 Methodology and Evaluation Criteria

5.3.11.1.1 Recreation

The primary issues related to recreational facilities and activities associated with the Land Exchange Proposed Action on and near the federal lands and non-federal lands include the following:

- change in areas of ROS classes within the Superior National Forest; and
- qualitative difference in recreation opportunities, as measured using ROS classes, between outgoing federal land and non-federal lands to be acquired.

ROS classes are defined by the USFS (1982) and ROS classes for the non-federal lands were mapped to match the existing mapped ROS Spectrum areas on surrounding adjacent federal lands. GIS analysis was employed to determine the net change in acreage by ROS class. ROS classes are discussed in Section 4.2.11.1.1.

5.3.11.1.2 Visual Resources

The primary issue related to visual resources on and near the non-federal lands is the change in acreage of High, Moderate, and Low SIO classified land within Superior National Forest lands. SIOs were provided by USFS (1995), and as with ROS classes, SIOs for the non-federal lands were mapped to match the existing mapped SIOs on surrounding adjacent federal lands. GIS analysis was employed to determine the net change in acreage by SIO. SIOs are discussed in section 4.2.11.1.2. This quantitative analysis was supplemented by a qualitative description of loss of scenery opportunities on federal lands that would be conveyed to PolyMet and the gain of scenery opportunities on non-federal lands to be acquired and managed by USFS.

5.3.11.2 Land Exchange Proposed Action

5.3.11.2.1 Recreation

ROS classes for the federal lands are shown on Figure 5.3.11-1; the classes that would be applied to the non-federal lands are also shown on Figures 5.3.11-2 and 5.3.11-3. These classifications are summarized in Table 5.3.11-3. No developed recreational sites or opportunities are planned at this time. All of the tracts would be open for non-motorized, dispersed recreational activities. The federal lands in the Land Exchange Proposed Action consist of 967.0 acres designated as Roaded Natural and 5,528.4 acres designated Semi-Primitive Motorized (see Table 5.3.11-3). As described in Sections 4.2.11 and 4.3.11, the Semi-Primitive (Motorized and Non-Motorized) classes indicate areas where interaction between visitors is rare, but where human activities may be visible. The Roaded Natural class indicates an area where evidence of human activity and interactions are more frequent, and occasionally prevalent.

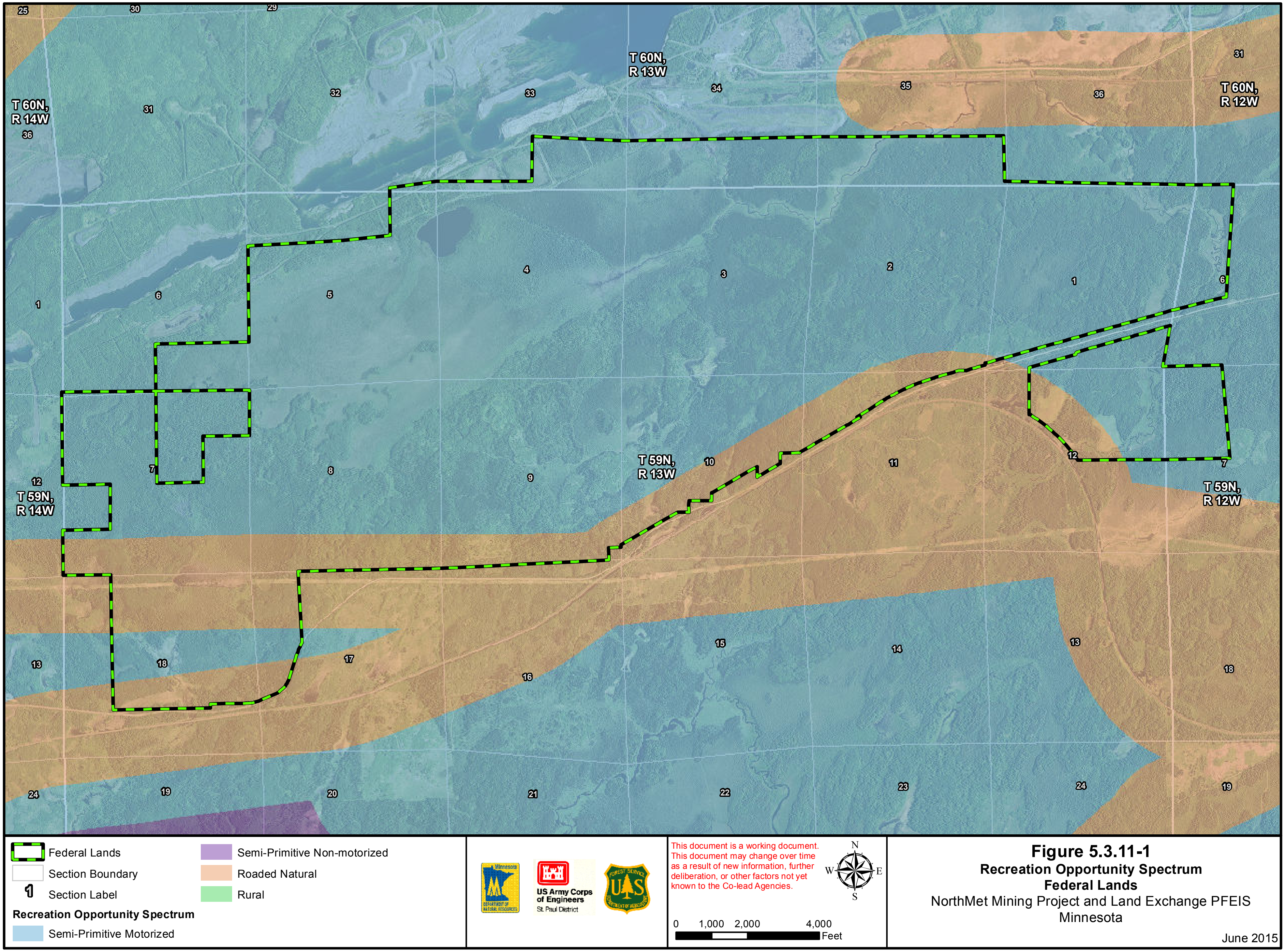

Figure 5.3.11-1
Recreation Opportunity Spectrum
Federal Lands
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

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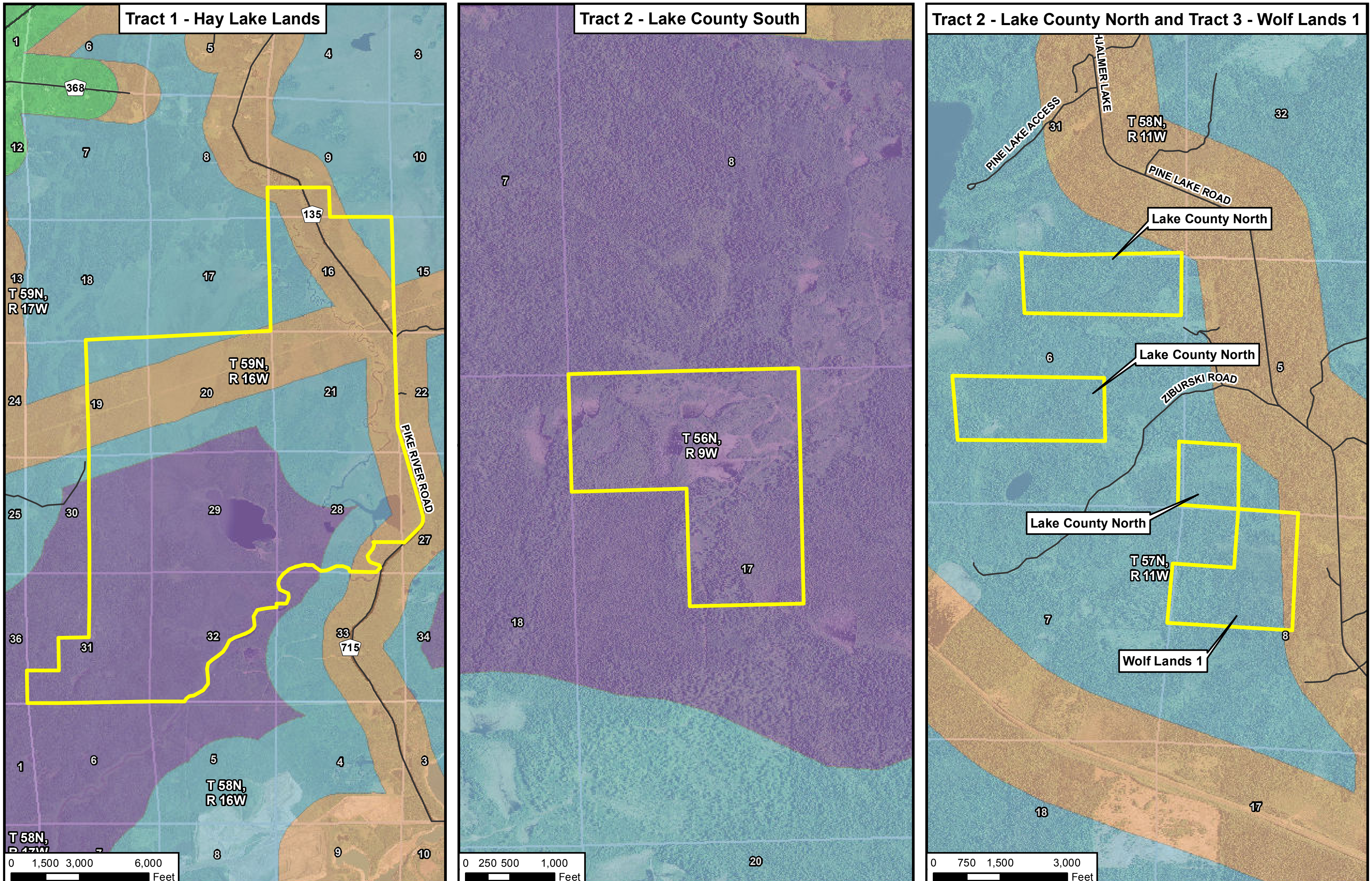

Non-federal Lands
Section Boundary
1 Section Label
Recreation Opportunity Spectrum
Semi-Primitive Motorized
Semi-Primitive Non-motorized
Roaded Natural
Rural

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N W E S

US Army Corps of Engineers
St. Paul District

Figure 5.3.11-2
Recreation Opportunity Spectrum
Tracts 1, 2, and 3
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

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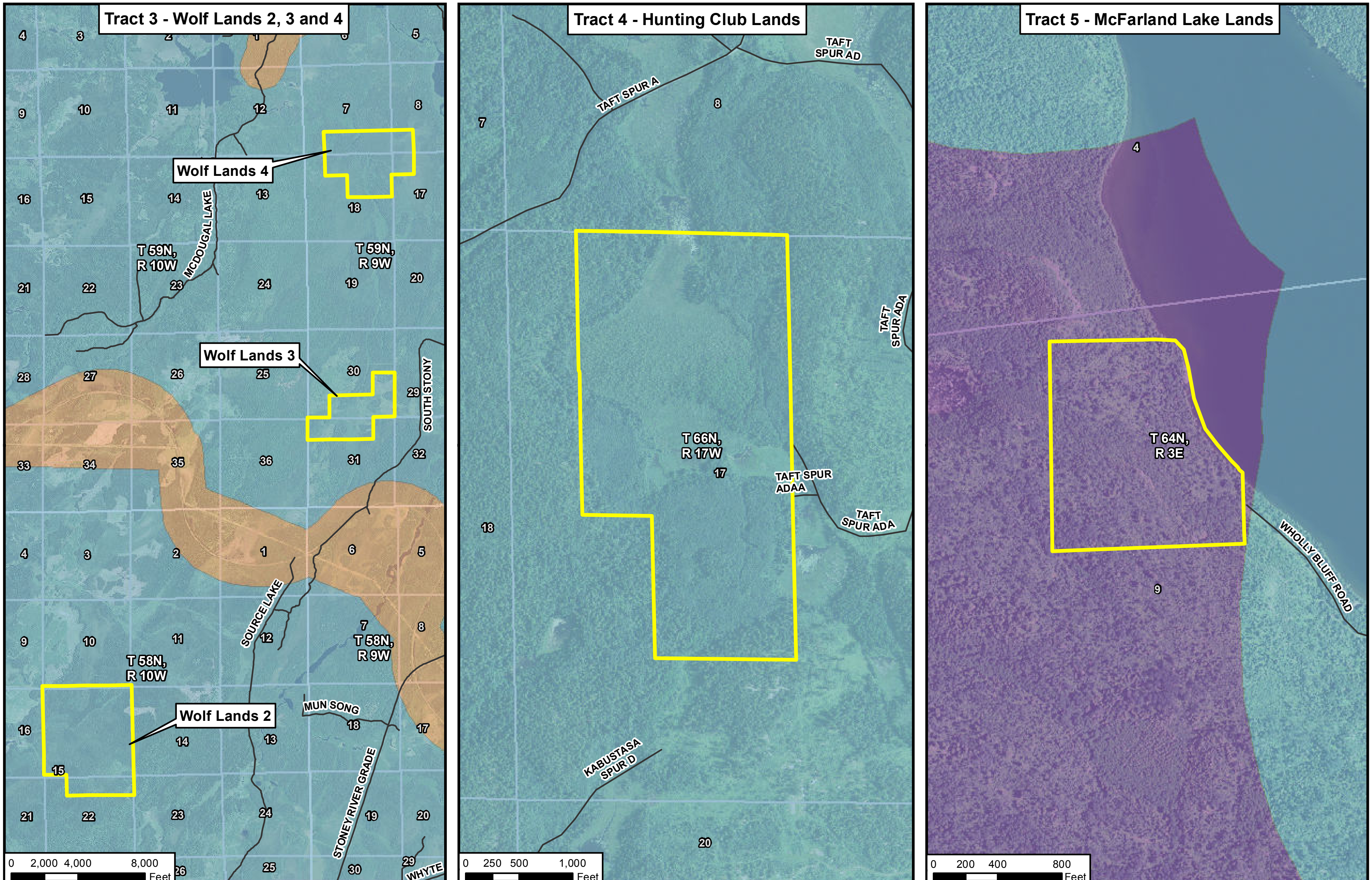

Non-federal Lands

Section Boundary

1 Section Label

Recreation Opportunity Spectrum

Semi-Primitive Motorized

Semi-Primitive Non-motorized

Roaded Natural

Rural

US Army Corps of Engineers
St. Paul District

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N W E S

Figure 5.3.11-3
Recreation Opportunity Spectrum
Tracts 3, 4, and 5
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

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Table 5.3.11-3 Recreation Opportunity Spectrum Classifications of Federal and Non-Federal Lands (Land Exchange Proposed Action)

	Acres of ROS Class			
Parcel	**Semi-Primitive Motorized**	**Semi-Primitive Non-Motorized**	**Roaded Natural**	**Total**
Lands Conveyed				
Federal lands	5,528.4	0.0	967.0	6,495.4
Lands Acquired				
Tract 1 - Hay Lake	1,303.8	2,162.2	1,460.3	4,926.3
Tract 2 - Lake County North	265.0	0.0	0.0	265.0
Tract 2 - Lake County South	0.0	116.9	0.0	116.9
Tract 3 - Wolf Lands 1	106.1	0.0	19.7	125.8
Tract 3 - Wolf Lands 2	767.9	0.0	0.0	767.9
Tract 3 - Wolf Lands 3	277.4	0.0	0.0	277.4
Tract 3 - Wolf Lands 4	404.7	0.0	0.0	404.7
Tract 4 - Hunting Club	160.2	0.0	0.0	160.2
Tract 5 – McFarland Lake	0.0	30.8	0.0	30.8
Subtotal: Non-federal Lands	3,285.1	2,319.9	1,480.0	7,075.0
Net Change				
Net Increase/(Decrease)	(2,243.3)	2,309.9	513.0	579.6

Source: Duffy and Ness, USFS, Pers. Comm., November 2011.

There is no public land access to and no practical opportunity for recreational activity on the federal lands, and the federal lands would remain inaccessible after completion of the Land Exchange Proposed Action. By comparison, the non-federal lands would be accessible to varying degrees, and therefore could host recreational activities, as defined by their respective ROS class. Tract 1 is the most accessible and therefore has the greatest potential for public recreational use. Tract 5 would likely be accessible from adjacent Superior National Forest land and/or the lake itself, while Tract 4 is also accessible via road and trail. Tracts 2 and 3 would be more difficult to access.

As Table 5.3.11-3 shows, the Land Exchange Proposed Action would result in a net decrease to the federal estate of 2,243.3 acres of land designated Semi-Primitive Motorized, an increase to the federal estate of 2,309.9 acres of land designated Semi-Primitive Non-Motorized, and an increase to the federal estate of 513.0 acres of Roaded Natural land. Although there would be a decrease of Semi-Primitive Motorized land to the federal estate, the Land Exchange Proposed Action overall would affect less than one-quarter of one percent of the total area of the Superior National Forest (approximately 3 million acres), and the reduction to the federal estate of this ROS type would be exceeded by the increase to the federal estate in other ROS types.

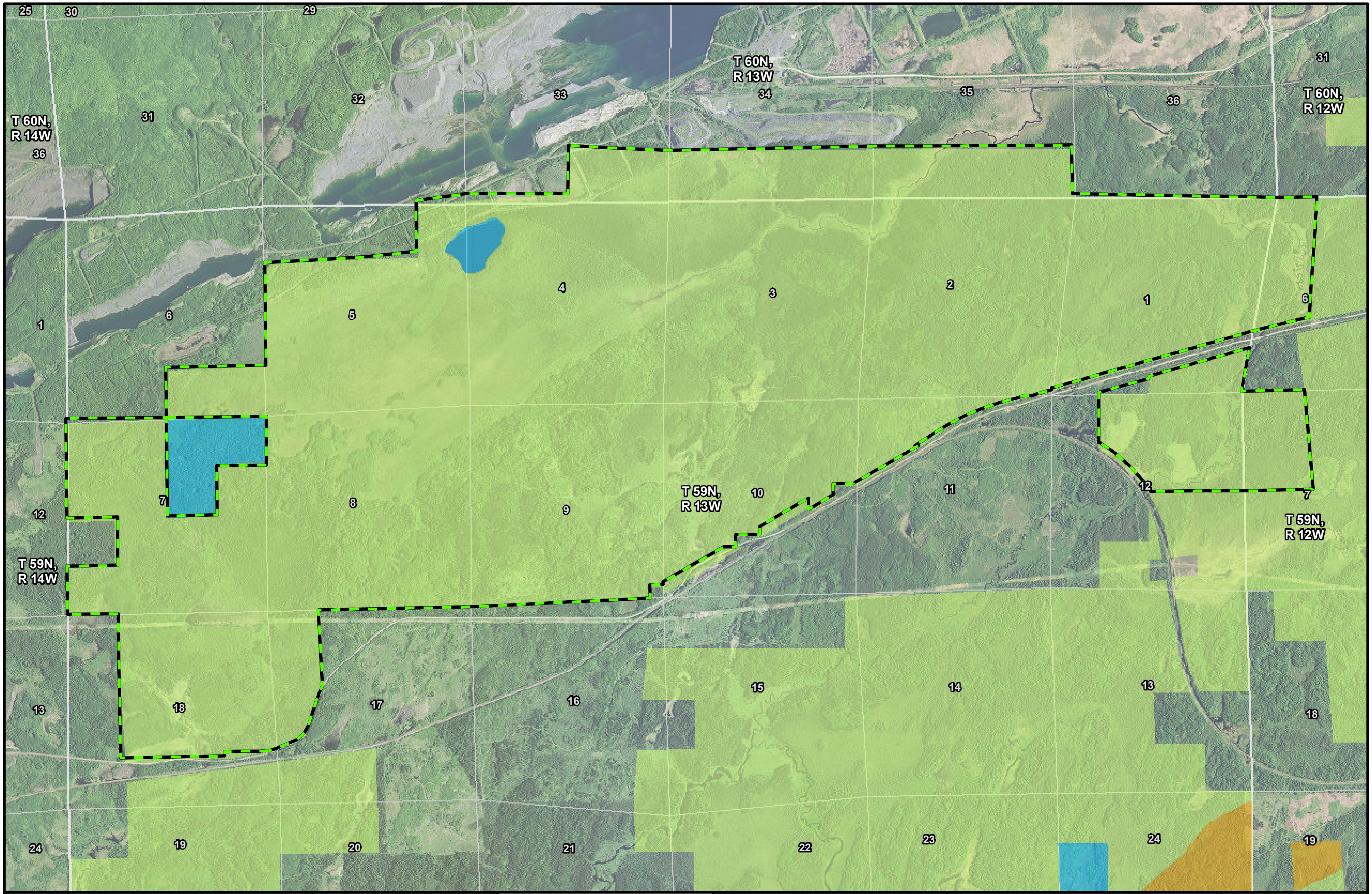
Because the federal lands are not accessible to the public by land, the Land Exchange Proposed Action represents an addition to the amount of potential publicly accessible land in the Superior National Forest. As a result, the Land Exchange Proposed Action would increase opportunities for hunting, fishing, and other recreational activities.

5.3.11.2.2 Visual Resources

SIOs for the federal lands are shown on Figure 5.3.11-4, while the SIOs that would be applied to the non-federal lands are shown in Figures 5.3.11-5 and 5.3.11-6. These are summarized in Table 5.3.11-4. The Low SIO of the federal lands indicates that the area may be dominated by management activities. Effects on visual resources on the federal lands are similar to those at the Mine Site, as discussed in Section 5.2.11.2.1.

The non-federal lands are only somewhat visible from public roads, few of which are elevated enough to afford views of the tracts themselves. Still, transfer of the non-federal lands to Superior National Forest ownership would generally help to preserve the scenic quality of those parcels. The NorthMet Project area would not be visible from any of the Land Exchange Proposed Action parcels.

The Land Exchange Proposed Action would result in a net decrease to the federal estate of 1,170.8 acres of land with a Low SIO and an increase to the federal estate of 136.3 acres of land with a High SIO and 1,644.6 acres of land with a Moderate SIO (see Table 5.3.11-4). This change in the composition of the visual character of the Superior National Forest, which affects less than one-quarter of one percent of the total area of the forest, would have generally positive effects. The addition of land with Moderate and High SIO (in lieu of land with a Low SIO) could affect the types of forestry and management activities that could occur on those lands. The USFS would acquire land with a wider diversity of SIOs (i.e., the addition of land with Moderate and High SIOs) and the Land Exchange Proposed Action would result in a net increase to the federal estate.



Federal Lands

Section Boundary

1 Section Label

Scenic Integrity Objective

High

Moderate

Low

N/A

US Army Corps of Engineers
St. Paul District

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N E S W

0 1,000 2,000 4,000 Feet

Figure 5.3.11-4
Scenic Integrity Objective
Federal Lands
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

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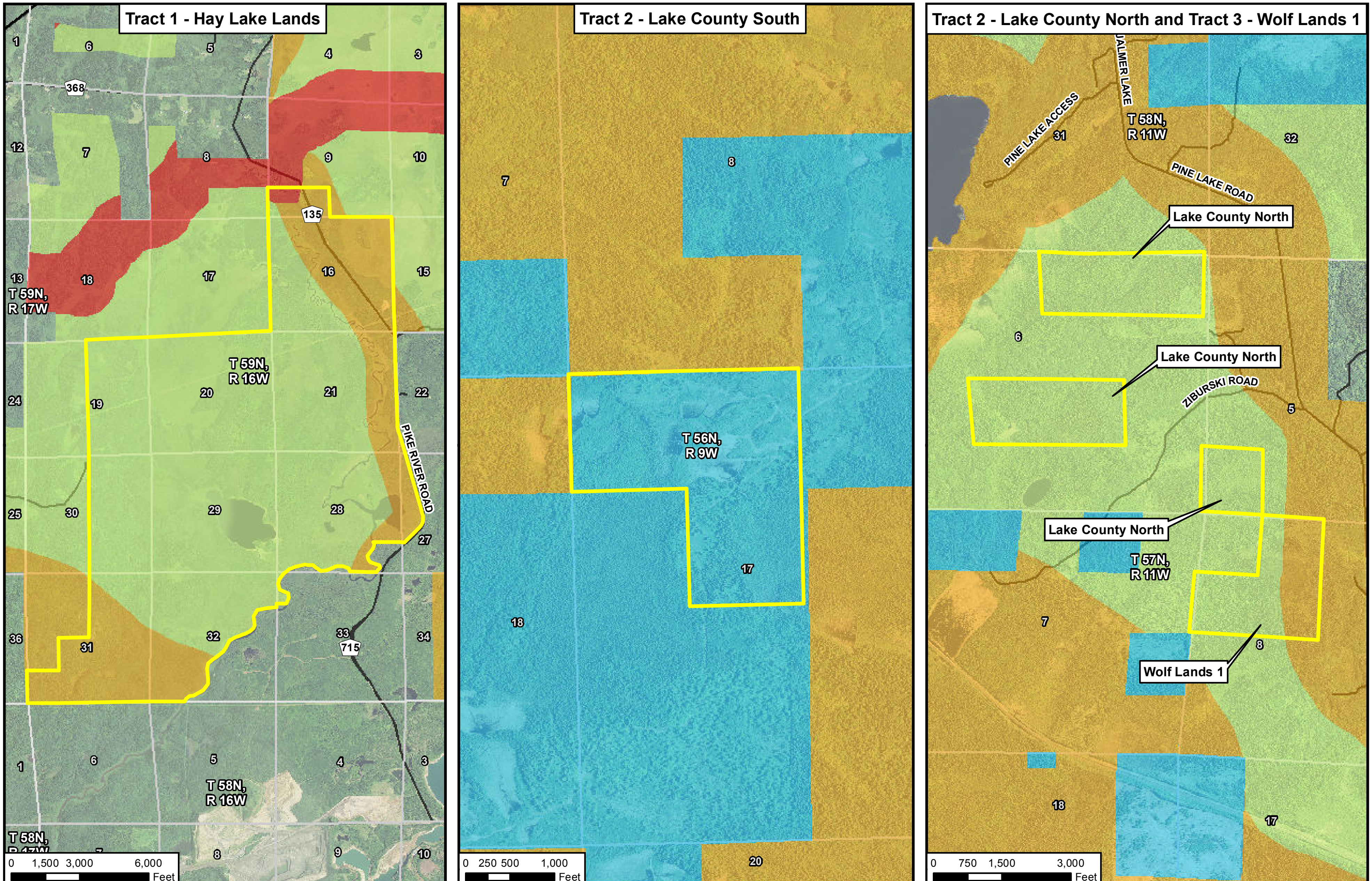

Non-federal Lands

Section Boundary

1 Section Label

Scenic Integrity Objective

- High
- Moderate
- Low
- N/A

US Army Corps of Engineers St. Paul District

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N W E S

Figure 5.3.11-5
Scenic Integrity Objective
Tracts 1, 2, and 3
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

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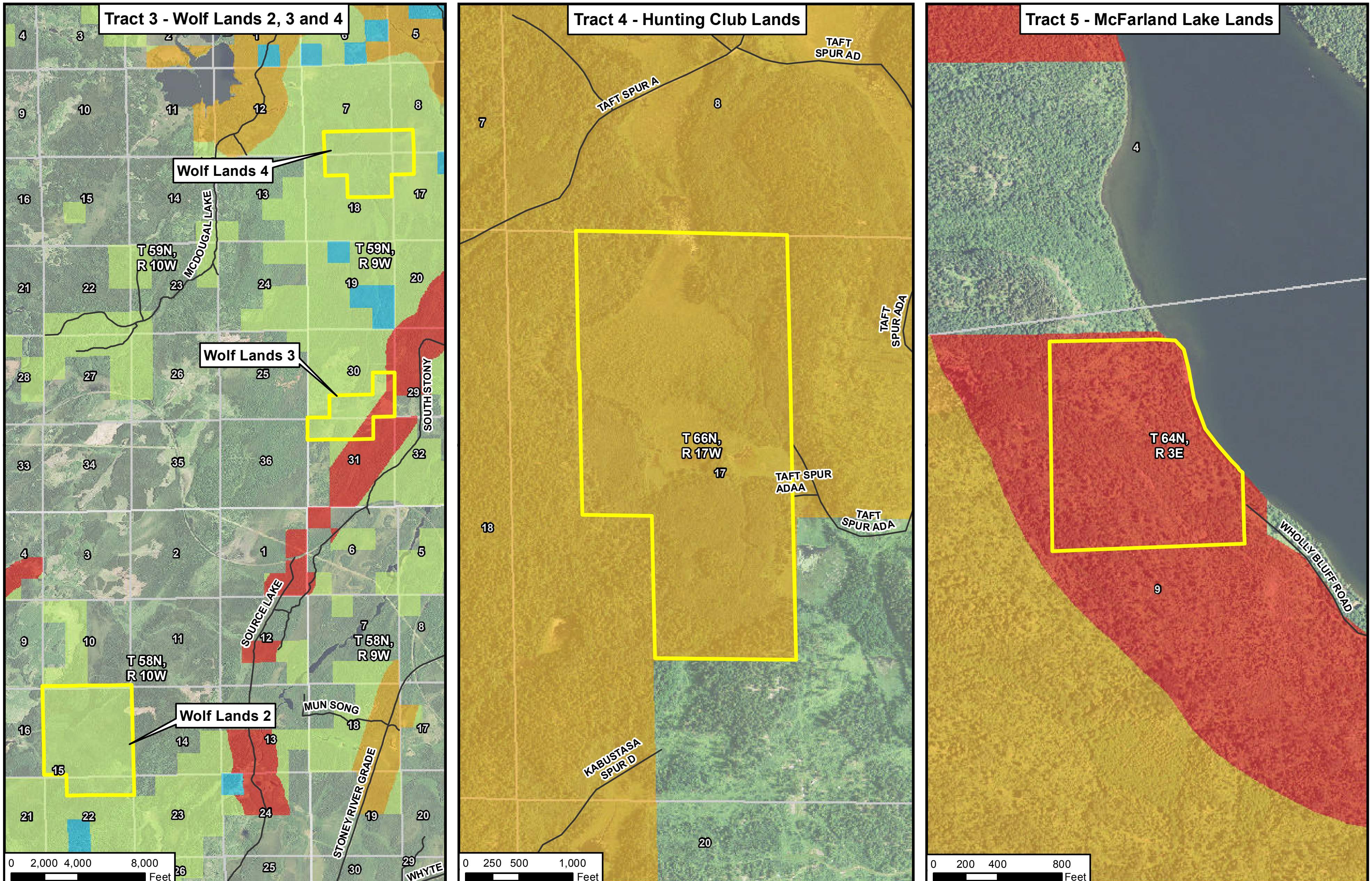

Non-federal Lands
Section Boundary
1 Section Label

Scenic Integrity Objective
- High
- Moderate
- Low
- N/A

Minnesota Department of Natural Resources
US Army Corps of Engineers St. Paul District
Forest Service U.S. Department of Agriculture

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N W E S

Figure 5.3.11-6
Scenic Integrity Objective
Tracts 3, 4, and 5
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

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Table 5.3.11-4 Scenic Integrity Objectives of Federal and Non-Federal Lands (Proposed Action)

Parcel	Acres of Scenic Integrity Objective			
	High	**Moderate**	**Low**	**Total**
Lands Conveyed				
Federal lands	0.0	0.0	6,464.9(1)	6,464.9(1)
Lands Acquired				
Tract 1 - Hay Lake	20.4	1,315.4	3,590.5	4,926.3
Tract 2 - Lake County North	0.0	0.0	265.0	265.0
Tract 2 - Lake County South	0.0	116.9	0.0	116.9
Tract 3 - Wolf Lands 1	0.0	52.1	73.7	125.8
Tract 3 - Wolf Lands 2	0.0	0.0	767.9	767.9
Tract 3 - Wolf Lands 3	85.1	0.0	192.3	277.4
Tract 3 - Wolf Lands 4	0.0	0.0	404.7	404.7
Tract 4 - Hunting Club	0.0	160.2	0.0	160.2
Tract 5 – McFarland Lake	30.8	0.0	0.0	30.8
Subtotal: Non-federal Lands	136.3	1,644.6	5294.1	7,075.0
Net Change				
Net Increase/(Decrease)	136.3	1,644.6	(1,170.8)	610.1

Source: Duffy and Ness, USFS, Pers. Comm., November 2011.

[1] Mud Lake (comprising 30.5 acres of the 6,495.4 acres in the federal lands) would not be managed by USFS, and therefore does not have a SIO.

5.3.11.3 Land Exchange Alternative B

5.3.11.3.1 Recreation

Under the Land Exchange Alternative B, 4,752.6 acres of federal lands would be exchanged for the 4,926.3-acre Tract 1. ROS classes for the federal lands portion of the Land Exchange Alternative B are shown on Figure 5.3.11-7 (Tract 1 classes would remain unchanged from the Land Exchange Proposed Action). Table 5.3.11-5 summarizes the ROS classes of these lands.

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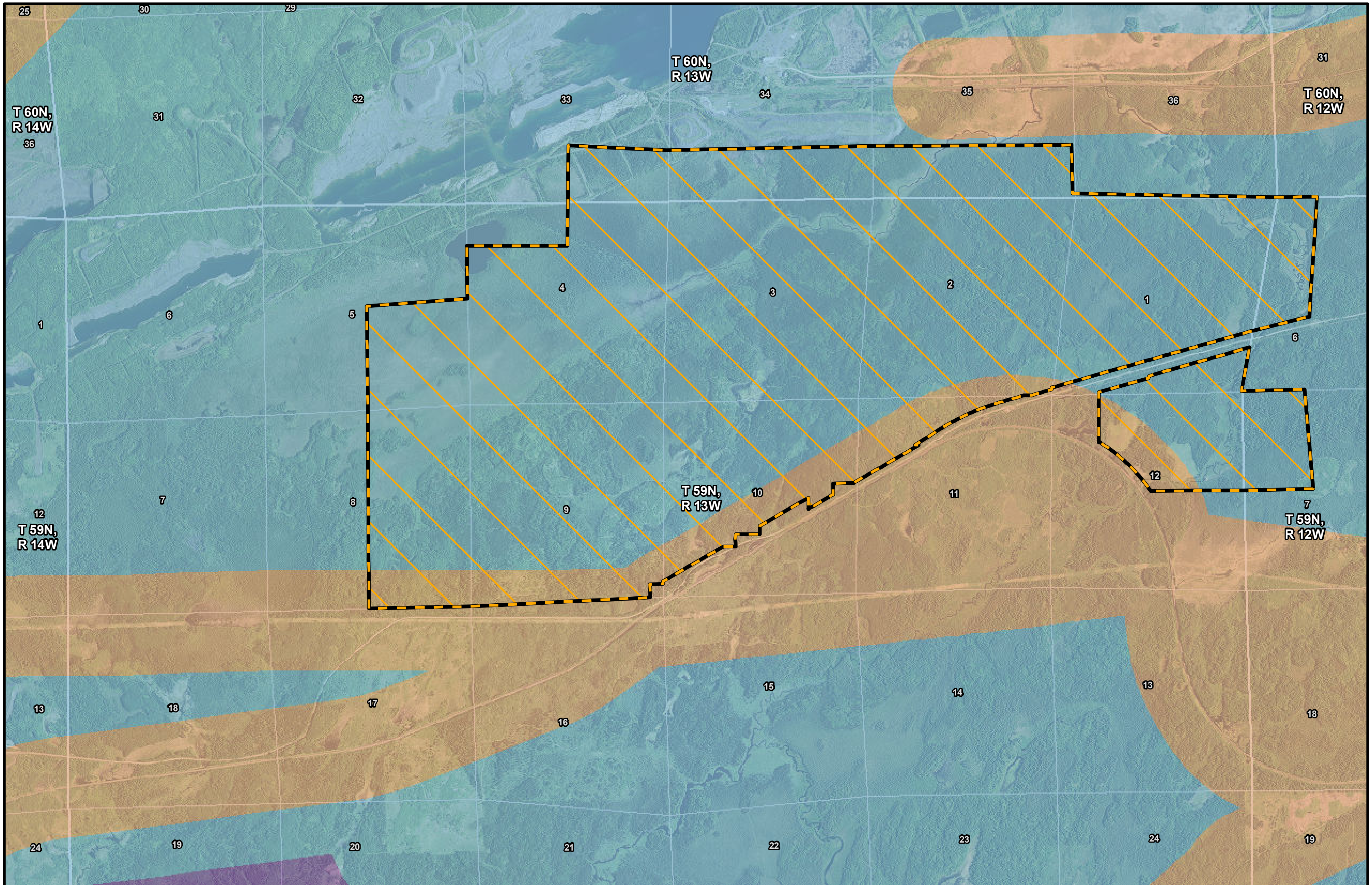

Alternative B: Smaller Federal Parcel
Section Boundary
1 Section Label

Recreation Opportunity Spectrum

Semi-Primitive Motorized
Semi-Primitive Non-motorized
Roaded Natural
Rural

US Army Corps of Engineers
St. Paul District

This document is a working document. This document may change over time as a result of new information, further deliberation, or other factors not yet known to the Co-lead Agencies.

N W E S

0 1,000 2,000 4,000 Feet

Figure 5.3.11-7

Recreation Opportunity Spectrum
Alternative B: Smaller Federal Parcel
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

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Table 5.3.11-5 Recreation Opportunity Spectrum Class of Federal and Non-federal Lands (Land Exchange Alternative B)

	Acres of ROS Class			
Parcel	**Semi-Primitive Motorized**	**Semi-Primitive Non-Motorized**	**Roaded Natural**	**Total**
Lands Conveyed				
Alternative B	4,276.5	0.0	476.1	4,752.6
Lands Acquired				
Tract 1 - Hay Lake	1,303.8	2,162.2	1,460.3	4,926.3
Net Change				
Net Increase (Decrease)	(2,972.7)	2,162.2	984.2	173.7

Source: Duffy and Ness, USFS, Pers. Comm., November 2011.

Similar to the Land Exchange Proposed Action, there is no public land access to and no opportunity for recreational activity on the federal lands, and the smaller federal parcel would remain inaccessible after completion of the Land Exchange Alternative B. By comparison, the non-federal lands (Tract 1) would be accessible (to varying degrees), and therefore would be capable of hosting recreational activities, as defined by their respective ROS classes. Tract 1 is accessible and therefore would result in the greatest potential for public recreational use.

As Table 5.3.11-5 shows, the Land Exchange Alternative B would result in a net decrease to the federal estate of 2,972.7 acres of land designated as Semi-Primitive Motorized, and an increase to the federal estate of 2,162.2 acres of Semi-Primitive Non-Motorized land and 984.2 acres of Roaded Natural land. Although there would be a decrease of Semi-Primitive Motorized land, the Land Exchange Alternative B overall would affect less than one-quarter of one percent of the total area of the Superior National Forest, and the reduction to the federal estate of this ROS class would be exceeded by the increase to the federal estate in other ROS classes.

As with the Land Exchange Proposed Action, because the federal lands are not accessible to the public, the Land Exchange Alternative B represents an addition to the amount of potential publicly accessible land in the Superior National Forest. As a result, the Land Exchange Alternative B would increase opportunities for hunting, fishing, and other recreational activities. Overall, the effects of the Land Exchange Alternative B on recreation are similar to those of the Land Exchange Proposed Action, but smaller in magnitude, due to the reduced amount of land involved.

5.3.11.3.2 Visual Resources

SIO classifications for the smaller federal parcel are shown on Figure 5.3.11-8 (Tract 1 classifications would remain unchanged from the Land Exchange Proposed Action) and are summarized in Table 5.3.11-6. As with the Land Exchange Proposed Action, the Land Exchange Alternative B has a Low SIO, indicating the lands may be dominated by management activities; however, Tract 1 would only be somewhat visible from public roads and would generally help to preserve the scenic quality of the parcel. The NorthMet Project area would not be visible from Tract 1.

159 -Page Intentionally Left Blank-

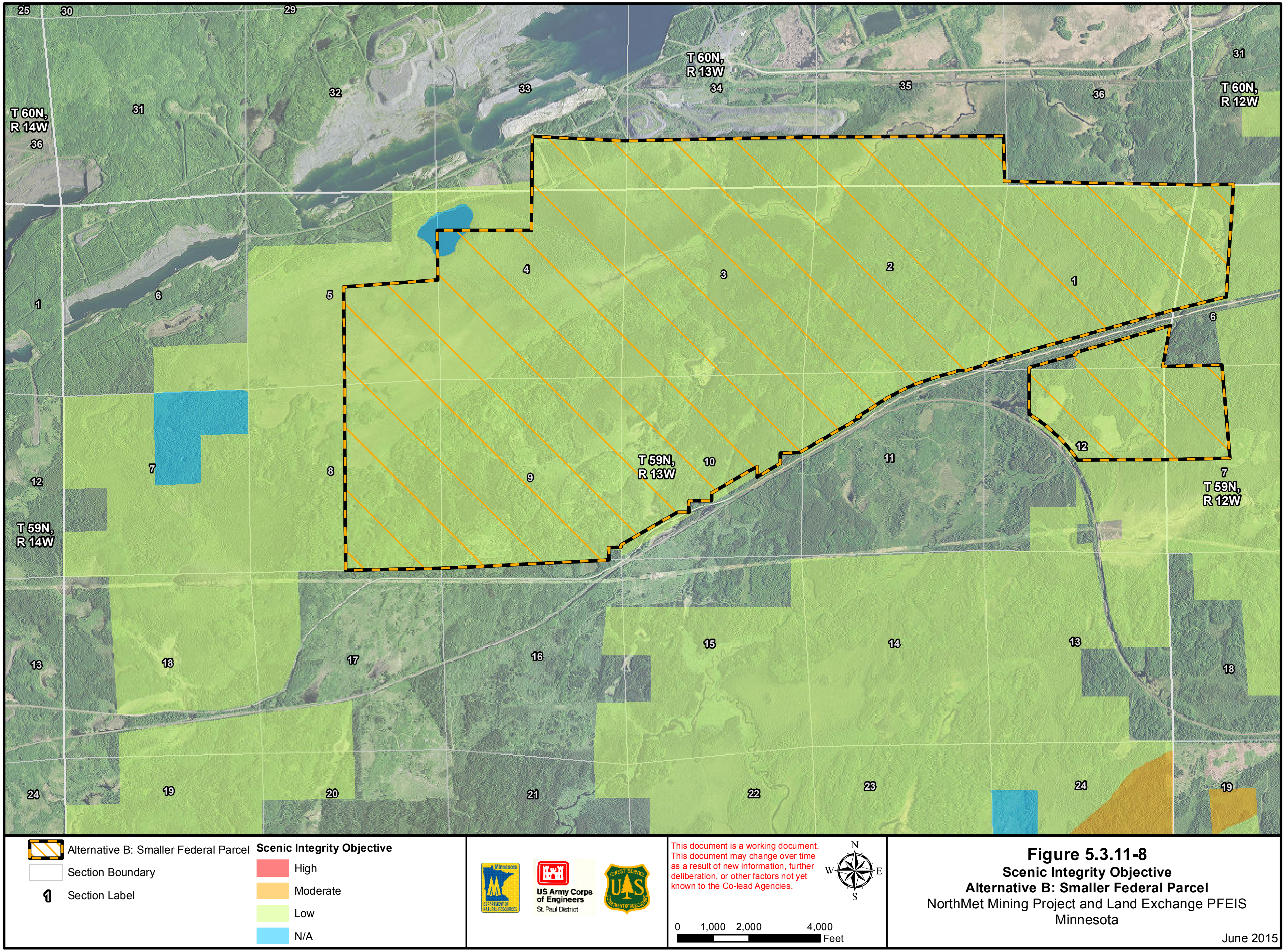

Figure 5.3.11-8
Scenic Integrity Objective
Alternative B: Smaller Federal Parcel
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

161 -Page Intentionally Left Blank-

The Land Exchange Alternative B would result in a net decrease to the federal estate of 1,153.2 acres of land with a Low SIO, in exchange for an increase to the federal estate of 20.4 acres of land with a High SIO and 1,153.2 acres of land with a Moderate SIO. This change in the composition of the visual character of the Superior National Forest, which affects less than one-tenth of one percent of the total area of the Superior National Forest, would have generally positive effects. The addition of land with Moderate and High SIOs (in lieu of land with a Low SIO) could affect the types of forestry and management activities that can occur on those lands. The USFS would acquire land with a wider diversity of SIOs and the Land Exchange Alternative B would result in a net increase to the federal estate, although less than in the Land Exchange Proposed Action.

Table 5.3.11-6 Scenic Integrity Objectives of Federal and Non-federal Lands (Land Exchange Alternative B)

	Acres of Scenic Integrity Objective Classification			
Parcel	**High**	**Moderate**	**Low**	**Total**
Lands Conveyed				
Alternative B	0	0	4,743.7[1]	4,743.7[1]
Lands Acquired				
Tract 1 - Hay Lake	20.4	1,315.4	3,590.5	4,926.3
Net Change				
Net Increase (Decrease)	20.4	1,315.4	(1,153.2)	182.6

Source: Duffy and Ness, USFS, Pers. Comm., November 2011.

[1] Mud Lake (comprising 8.9 acres of the 4,752.6 acres in the smaller federal parcel), would not be managed by USFS, and therefore does not have a SIO.

5.3.11.4 Land Exchange No Action Alternative

5.3.11.4.1 Recreation

Under the Land Exchange No Action Alternative, the federal and non-federal lands would remain generally inaccessible to the public for recreation or other uses.

5.3.11.4.2 Visual Resources

Under the Land Exchange No Action Alternative, the visual appearance of the federal and non-federal lands would remain unchanged.

185 -Page Intentionally Left Blank-

5.3.12 Wilderness and Other Special Designation Areas

This section describes the potential environmental consequences of the Land Exchange Proposed Action on wilderness and other special designation area resources that are on or near the federal and non-federal lands.

The Land Exchange Proposed Action would not result in a net increase or decrease in any wilderness areas. However, the Land Exchange Proposed Action would result in a net increase of 306.9 acres of cRNAs to the federal estate through exchange of Tract 1. Land Exchange Alternative B would still include exchange of Tract 1; therefore, it would result in the same net changes to cRNA acreage as the Land Exchange Proposed Action.

The Land Exchange No Action Alternative would not affect wilderness or special-designation areas as the Land Exchange would not occur.

5.3.12.1 Methodology and Evaluation Criteria

An evaluation was conducted to determine the potential effect that the Land Exchange Proposed Action would have on the wilderness character of the area. Potential effects on noise, water resources, and recreation and visual resources were evaluated. The analysis of the wilderness character affected by the Land Exchange Proposed Action was guided by evaluation criteria that were developed by the USFS and other Co-lead Agencies.

Estimated ambient noise levels at each of the sensitive receptor sites adjacent to the federal lands were compared with modeled noise levels to determine effects. An appropriate noise propagation model was used to generate noise contours from the Mine Site and Plant Site. To determine effects on water resources, in addition to available information from field efforts already performed by PolyMet for the NorthMet Project Proposed Action, analysis of air photos and available GIS layers for federal and non-federal lands included data layers and other collected data such as NWI maps, soil maps/ecological land type maps, and FEMA floodplain maps. Scenic quality and integrity of lands being acquired and conveyed was determined based on desktop study and limited field observations where necessary. The Forest Plan uses a nationally recognized classification system, the ROS, to describe different recreation settings, opportunities, and experiences. Reviewing existing information and consultation with area land managers provided the information needed to understand the existing and potential recreation opportunities.

5.3.12.2 Land Exchange Proposed Action

The Land Exchange Proposed Action would result in a net increase of cRNAs to the federal estate. As indicated in Section 5.3.1, the USFS has determined that Tract 1 would have the following management area designations: General Forest and cRNA. Therefore, the Land Exchange Proposed Action would include the Pike Mountain and Loka Lake cRNAs (southwest corner and northeast corner of the tract, respectively). The addition of Tract 1 into the federally managed areas would extend the Pike Mountain cRNA by 135.7 acres of primarily hardwoods plant community, and would extend the Loka Lake cRNA by 171.2 acres of lowland black spruce and tamarack swamp. The remaining 4,619.3 acres would be allocated to General Forest.

Tracts 2, 3, 4, and 5 would not result in a net change to wilderness or other special designation areas.

5.3.12.3 Land Exchange Alternative B

The Land Exchange Alternative B would result in the same net increase of cRNAs to the federal estate as the Land Exchange Proposed Action. The Land Exchange Alternative B would not result in a net change to any wilderness area.

5.3.12.4 Land Exchange No Action Alternative

Under the Land Exchange No Action Alternative, the Superior National Forest would have an ongoing responsibility for managing the wilderness and other special designations on or near the federal lands in accordance with the Forest Plan. The Land Exchange No Action Alternative would not change the USFS's responsibility for managing these resources and would result in no further effects on existing wilderness areas or other special designated areas.

5.3.13 Hazardous Materials

The Land Exchange Proposed Action and the Land Exchange Alternative B would not include operations or activities that involve the use of hazardous materials on federal or non-federal lands beyond those activities specific to the NorthMet Project Proposed Action described in Section 5.2.13. AOCs associated with legacy contamination by hazardous materials from former activities and operations on these lands are discussed in Section 5.3.1.

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5.3.14 Geotechnical Stability

Geotechnical stability considerations for the proposed stockpiles that would be located on federal land subject to the Land Exchange Proposed Action or Land Exchange Alternative B within the NorthMet Project area are discussed in Section 5.2.14. There are no other existing or proposed large-scale waste material storage facilities on land subject to the Land Exchange Proposed Action or Land Exchange Alternative B.

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6.0 CUMULATIVE EFFECTS

6.1 INTRODUCTION

Both NEPA and MEPA require an assessment of potential cumulative effects. The CEQ defines cumulative effects as:

...the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other action. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. (40 CFR § 1508.7)

The MEQB's regulations in *Minnesota Rules,* Chapter 4410.0200, subparts 11 and 11a, mirror the CEQ cumulative effects definition. In addition to the regulations, this analysis follows the guidance in the 1997 CEQ guidance presented in *Considering Cumulative Effects under the National Environmental Policy Act* and the USEPA's NEPA review guidance *Consideration of Cumulative Impacts in EPA Review of NEPA Documents* (CEQ 1997 and USEPA 1999, respectively.)

This section presents the resource-specific cumulative effects analysis of the NorthMet Project Proposed Action and Land Exchange Proposed Action that may result when combined with effects from other activities (e.g., projects and/or actions). Each resource has specific spatial (geographic) or temporal (time) boundaries, which are called Cumulative Effects Assessment Areas (CEAAs). The cumulative projects and/or actions applied to this analysis are those past, present, and reasonably foreseeable activities within the various resource-specific CEAAs that, when combined with the NorthMet Project Proposed Action and Land Exchange Proposed Action, may cause cumulative effects as measured by the evaluation criteria and defined by NEPA and MEPA. In addition to additive effects, cumulative effects may be further magnified by synergisms or cross-interactions in the environment.

This chapter is divided into two major subsections: Section 6.2 describes the cumulative effects of the NorthMet Project Proposed Action and Section 6.3 describes the cumulative effects of the Land Exchange Proposed Action. The analysis does not assess the cumulative effects of the Proposed Connected Actions (i.e., the NorthMet Proposed Action and Land Exchange Proposed Action), which are described in Chapter 7.

Two basic factors are used to quantify how a proposed project and/or action may cause cumulative effects. The first summarizes existing environmental conditions, which are the result of actions that have taken place in the past or are subject to present activities. It is not possible, however, to catalogue all past human actions to quantify how the natural environment has been affected by anthropogenic activities. Chapter 4 describes the baseline conditions for the NorthMet Project area and Land Exchange parcels, which may include contributions from past and present activities. Intensive land uses, such as towns, cities, roads, hunting, fishing and trapping, mines, forest practices, farming, and damming of rivers and creation of reservoirs have all had an influence on the natural environment of the region, which has resulted in present day conditions. In addition, natural trends in the environment would be affected into the future by currently permitted and approved land uses and projects. The direct and indirect effects of the NorthMet Proposed Action and Land Exchange Proposed Action are discussed in Chapter 5.

The second factor in determining how the NorthMet Project Proposed Action would, in combination with other reasonably foreseeable activities, cumulatively affect resources in the future constitutes the *reasonably foreseeable future actions*. The method and set of assumptions for identifying which projects, actions, and activities that could contribute to cumulative effects in described below in Section 6.1.1.1. In addition to the identified cumulative projects, actions, and activities, the USFS identified six projects which are land exchanges and/or land acquisition projects that are reasonably foreseeable to be considered in the cumulative effects assessment for the Land Exchange Proposed Action (see Sections 6.1.2 and 6.3).

Throughout this section, we refer to *Past, Present,* and *Reasonably Foreseeable Future Actions* when describing potential cumulative effects. The past and present actions are described in detail in Chapter 4, Affected Environment.

6.1.1 NorthMet Project Proposed Action

6.1.1.1 Cumulative Effects Analysis Approach

Potential cumulative effects for the NorthMet Project Proposed Action have been assessed at the resource level. The spatial and temporal extents of the CEAAs depend on several resource-specific factors. For example, given that noise effects decrease in direct proportion to the distance between the source and sensitive receptors, the geographic extent is necessarily limited. Conversely, air effects can extend many miles from the source and are conversely much broader. For the purposes of the cumulative effects assessment, the timing or scheduling of specific cumulative actions is also important to the context of the assessment given the overlapping and possibly synergistic effects they may have on some resources, such as sediment loading to waterbodies or dust and particle emissions to visual resources.

For all resources, future temporal boundaries are the expected service life of the mining activities, including closure and post-closure restoration. The spatial and temporal boundaries for each resource are defined within the respective resources' sections of this analysis.

Resource-specific spatial and temporal boundaries are used to identify past, present, and reasonably foreseeable future projects/actions that would likely affect the same environmental resources as the NorthMet Project Proposed Action. MEQB, CEQ, and USEPA guidance allow for a fairly broad interpretation of "reasonably foreseeable" to accommodate project-specific conditions, but indicate that actions that would be considered "speculative" should be excluded. For the purposes of this assessment, "reasonably foreseeable" actions are defined as those actions that are included in approved planning documents and have approved funding, are permitted, or have a currently active federal or state permit or site plan application under review. The discussion of potential cumulative effects assumes the successful implementation of the best management practices and mitigation measures discussed throughout this FEIS, as well as compliance with all applicable federal, state, and local regulations and permit requirements.

In addition to other cumulative effects that may be identified through the analysis, Section 6.2 also addresses the following cumulative effects topics, identified in the Final SDD (MDNR 2005):

- Hoyt Lakes area projects and air concentrations in Class II areas,
- Class I areas PM_{10} increment,
- ecosystem acidification resulting from deposition of air pollutants,
- mercury deposition and bioaccumulation in fish,
- visibility impairment,
- loss of threatened and endangered plant species,
- loss of wetlands,
- loss or fragmentation of wildlife habitat,
- streamflow and lake level changes,
- water quality changes,
- economic effects, and
- Social effects.

These topics are discussed under their respective resource sections in Section 6.2 below.

6.1.1.2 Past, Present, and Reasonably Foreseeable Actions and Projects

For the purposes of this analysis, the NorthMet Project Proposed Action may contribute to cumulative effects when considered along with 44 other actions and projects in the region. These projects and/or actions are shown on Table 6.1-1 and Figure 6.1.1-1, and are further described in Section 6.1.1.2.1. Air Resources and Wilderness and other Special Designation Areas have unique extents of consideration and the specific actions considered are identified under those resource sections. Existing conditions that may be related to past or present actions on specific environmental resources are fully described in their respective sections in Chapter 4 and the direct and indirect impacts of the NorthMet Proposed Action are described in Chapter 5. Section 6.1.1.2.1 provides a brief description of the cumulative actions considered in this assessment. Some actions unique to a particular resource are discussed under those resources.

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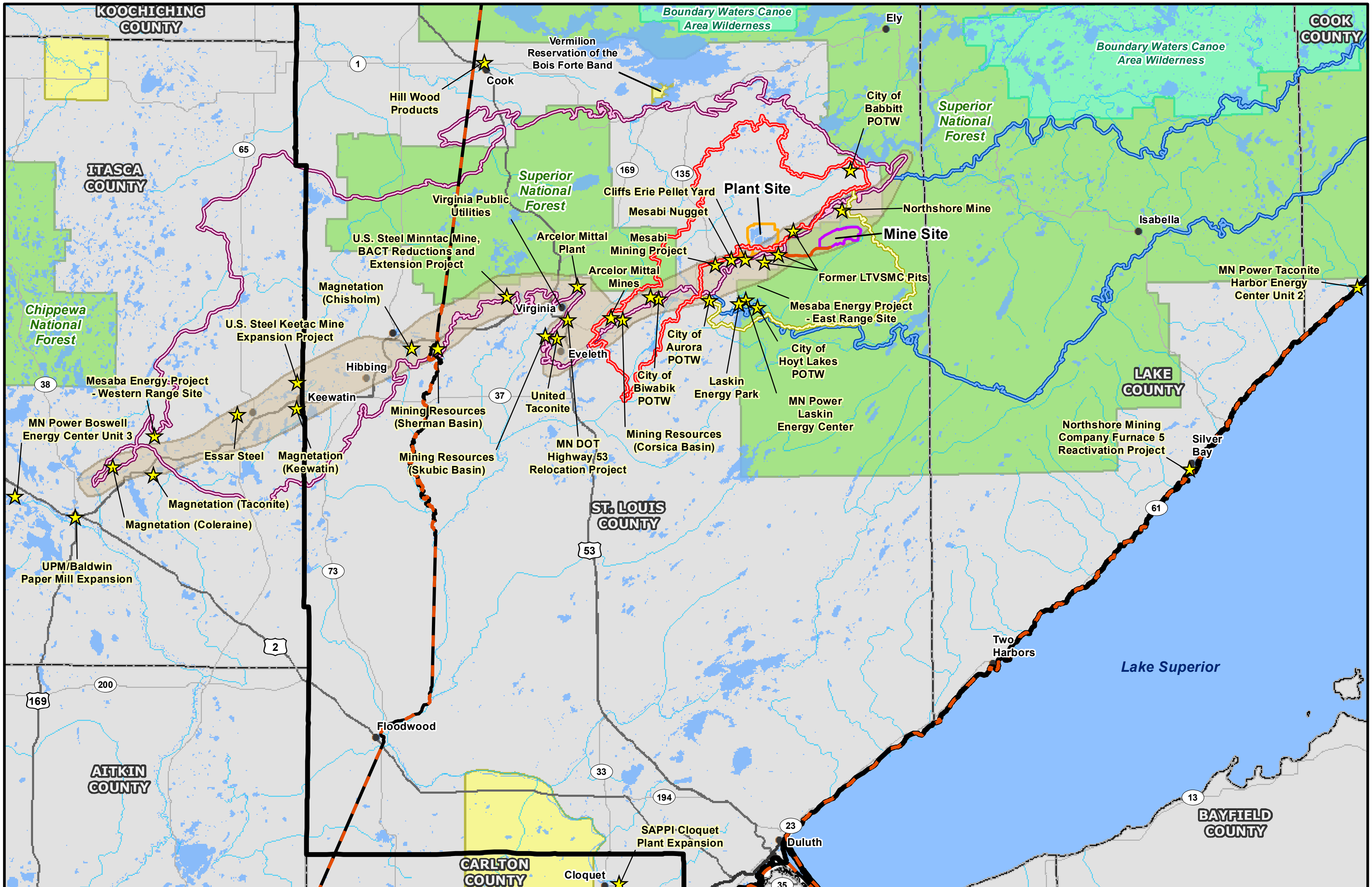

Cumulative Effects Assessment Area
Mine Site
Plant Site
Transportation and Utility Corridor
Mesabi Iron Range
1854 Ceded Territory
Embarrass River Watershed
Partridge River Watershed
MDNR Ecological Subsection
Laurentian Uplands
Nashwauk Uplands
Cumulative Actions
See Table 6.2-1
National Forest
Native American Reservation
Boundary Waters Canoe Area Wilderness

Minnesota Department of Natural Resources
US Army Corps of Engineers
St. Paul District
Forest Service U.S. Department of Agriculture

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N W E S

0 2.5 5 10 15 Miles

Figure 6.1.1-1
Cumulative Effects Assessment Area
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

108 -Page Intentionally Left Blank-

Table 6.1.1-1 Projects and Actions Considered and Affected Resources in the Cumulative Effects Assessment

	Activity	Status	Approx. Distance from NorthMet Project Area[1] (Miles)	Affected Environment
1	ArcelorMittal Deposits (Laurentian and East Reserve Deposits)	Present	18	Land Use, Water, Wetlands, Vegetation, Wildlife, Cultural, Socioeconomics, Recreation and Visual Resources
2	ArcelorMittal Deposit Push Back Project	Reasonably Foreseeable	18	Wetlands, Vegetation, Wildlife, Cultural, Socioeconomics, Recreation and Visual Resources
3	ArcelorMittal Plant and Modifications	Reasonably Foreseeable	18	Air Quality
4	City of Aurora POTW	Present	6	Water
5	City of Babbitt POTW	Present	10	Water
6	City of Biwabik POTW	Present	10	Water
7	City of Hoyt Lakes POTW	Present	7	Water
8	Cliffs Erie Pellet Yard	Present	<1	Vegetation, Wildlife, Air Quality
9	Essar Steel Mine	Present	55	Vegetation, Wildlife, Air Quality
10	Hill Wood Products	Present	50	Air Quality
11	Hill Wood Products Major Modification Amendment	Reasonably Foreseeable	50	Air Quality
12	Laskin Energy Park	Reasonably Foreseeable	5	Wetlands
13	LTV Steel Mining Company Former LTVSMC Pits	Present	<1	Water, Wetlands, Vegetation, Wildlife, Aquatic Species, Air Quality, Cultural, Socioeconomics, Wilderness
14	Magnetation Keewatin	Present	55	Vegetation, Wildlife
15	Magnetation Taconite	Present	61	Vegetation, Wildlife
16	Magnetation Chisholm	Present	41	Vegetation, Wildlife
	Magnetation Coleraine	Reasonably Foreseeable	63	Vegetation, Wildlife
17	MDOT US Highway 53 Virginia to Eveleth Relocation	Reasonably Foreseeable	23	Vegetation, Wildlife, Cultural
18	Mesaba Energy Project – Western Iron Range Site[2]	Reasonably Foreseeable	55	Cultural, Air Quality
19	Mesabi Nugget Project (formerly Mesabi Nugget Phase I)	Present	<1	Water, Wetlands, Vegetation, Wildlife, Aquatic Species, Air Quality, Noise, Socioeconomics, Cultural, Wilderness
20	Mesabi Mining Project (formerly Mesabi Nugget Phase II)[3]	Reasonably Foreseeable	2	Land Use, Water, Vegetation, Wetlands, Wildlife, Aquatic Species, Air Quality, Noise, Cultural, Socioeconomics, Recreation and Visual Resources, Wilderness
21	Mining Resources - Austin Powder Basin near Biwabik	Reasonably Foreseeable	10	Wetlands, Cultural, Socioeconomics
22	Mining Resources - Corsica Basin near McKinley	Reasonably Foreseeable	15	Wetlands, Cultural, Socioeconomics

	Activity	Status	Approx. Distance from NorthMet Project Area[1] (Miles)	Affected Environment
23	Mining Resources - Skubic Basin (SW of Virginia)	Reasonably Foreseeable	23	Cultural, Socioeconomics
24	Mining Resources Sherman Basin (SE of Chisholm)	Reasonably Foreseeable	41	Vegetation, Wildlife, Cultural, Socioeconomics
25	Minnesota Power Boswell Energy Center Unit 3		85	Air Quality
26	Minnesota Power Laskin Energy Center[4]	Present	5	Water, Wetlands, Air Quality, Wilderness
27	Minnesota Power Taconite Harbor Energy Center Unit 2, Emission control modifications	Reasonably Foreseeable	48	Air Quality, Wilderness
28	Northshore Mining Company: Furnace 5 Reactivation Project	Present	39	Air Quality, Wilderness
29	Northshore Mine	Present	7	Water, Wetlands, Vegetation, Wildlife, Aquatic Species, Air Quality, Cultural, Socioeconomics, Wilderness
30	Northshore Mine Ultimate Pit Progression Project	Reasonably Foreseeable	7	Vegetation, Wildlife, Cultural, Socioeconomics, Recreation and Visual Resources, Wilderness
31	Northshore Mine Closure	Reasonably Foreseeable	7	Land Use, Water, Wetlands
32	Northshore Mine BART Reductions	Reasonably Foreseeable	7	Air Quality
33	Sappi Cloquet Plant Expansion	Reasonably Foreseeable	73	Air Quality
34	St Louis County Public Works Bridge replacements	Reasonably Foreseeable	Within the Embarrass and Partridge River watersheds	Wetlands ,Vegetation, Wildlife,
35	U.S. Steel Keetac Mine	Present	45	Land Use, Vegetation, Wildlife, Socioeconomics, Recreation and Visual Resources
36	U.S. Steel Keetac Mine Expansion Project (Keewatin)[5]	Reasonably Foreseeable	45	Air Quality, Vegetation, Wildlife,
37	U.S. Steel Minntac Mine	Present	25	Vegetation, Wildlife, Aquatic Species, Air Quality, Cultural, Socioeconomics, Wilderness
38	U.S. Steel Minntac BACT Reductions	Reasonably Foreseeable	25	Air Quality
39	U.S. Steel Minntac Mine Extension Project	Reasonably Foreseeable	25	Land Use, Wildlife, Vegetation, Cultural, Aquatic, Air Quality, Socioeconomics, Recreation and Visual Resources, Wilderness
40	United Taconite Mine	Present	27	Air Quality
41	United Taconite Mine Modifications	Present		Vegetation, Wildlife, Air Quality
42	United Taconite Mine Expansions	Reasonably Foreseeable	27	Vegetation, Wildlife, Air Quality, Socioeconomics

	Activity	Status	Approx. Distance from NorthMet Project Area[1] (Miles)	Affected Environment
43	United Taconite Green Production Project	Reasonably Foreseeable	27	Air Quality
44	United Taconite Bart Reductions	Reasonably Foreseeable	27	Air Quality
45	UPM/Blandin Paper Mill Expansion, Project Thunderhawk	Reasonably Foreseeable	80	Air Quality
46	Virginia Public Utilities	Present	24	Air Quality
47	Community growth and development	Present and Reasonably Foreseeable	Regional, no specific locations	Vegetation, Wildlife, Cultural
48	Forestry practices on public and private lands	Past, Present, and Reasonably Foreseeable	Regional, no specific locations	Vegetation, Wildlife, Cultural

[1] At closest point to NorthMet Project area.
[2] The State of Minnesota has issued permits for the West Range site. However, the United States Department of Energy has not issued an ROD for this EIS. See below for more information. Given this, the East Range site is included as a reasonably foreseeable project for this cumulative effects assessment.
[3] This project was included in the cumulative effects analysis in the SDEIS. While the applications are still active, the likelihood of them occurring has diminished. Class II modeling for the Plant Site was already completed when the MPCA recommended that the Mesabi Mining project not be included; therefore, the modeling results reported can be considered conservative.
[4] Class II modeling for the SDEIS included this facility as burning coal. Natural gas is now the primary fuel; therefore, the modeling performed for the SDEIS was conservative.
[5] This project was included in the cumulative effects analysis in the SDEIS. While the applications are still active, the likelihood of them occurring has diminished.

Table 6.1.1-2 summarizes the CEAA spatial areas that were utilized by each resource area for the projects identified above.

Table 6.1.1-2 Summary of the Spatial Areas Used for the Cumulative Effects Analysis of the NorthMet Project Proposed Action

Resource Area	Spatial Area Assessed
Land Use, Recreation and Visual Resources, Wilderness	The portion of the Mesabi Iron Range encompassed by St. Louis County.
Water Resources, Wetlands[1], Aquatics[2]	Partridge River and Embarrass River watersheds.
Vegetation, Wildlife	The portion of the Mesabi Iron Range located within the Nashwauk Uplands and Laurentian Uplands ecological subsections.
Air Quality	Areas with sources that generally are located within the Arrowhead region and outside the boundaries of the NorthMet Plant Site and Mine Site, the Mesabi Nugget Ambient Air Boundary, Cliffs Erie Pellet Yard, and the Northshore Mine.
Noise and Vibration	An approximate 0.5-mile radius of the Mine Site and Plant Site; no past, present, or reasonably foreseeable actions located within a 0.5-mile radius of the Mine Site and Plant Site that would interact in such a way as to have cumulative effects on identified receptors.
Hazardous Materials, Geotechnical Stability	The topic areas were not assessed for cumulative effects because they would not interact with any other past, present, or reasonably foreseeable actions in such a way as to cause cumulative effects.
Cultural Resources	The portion of the 1854 Ceded Territory that is within the Mesabi Iron Range.
Socioeconomics	The Mesabi Iron Range within St. Louis, Lake, and Cook counties.

[1] A qualitative assessment for wetlands was also performed and the spatial area was the St. Louis River below the ordinary high water mark from its confluence with the Embarrass River to Lake Superior.
[2] A qualitative assessment for aquatics was also performed and the spatial area was the St. Louis River, as the Partridge River and Embarrass River are tributaries to the St. Louis River, which flows through the Fond du Lac Indian Reservation and empties into Lake Superior near Duluth.

6.1.1.2.1 Brief Description of Cumulative Actions Considered

ArcelorMittal Mines (Laurentian and East Reserve Deposits, Push-Back Project, and Plant)

ArcelorMittal operates two separate taconite deposits, the Laurentian and the East Reserve. These deposits are approximately 2 miles apart between Gilbert and Biwabik, in St. Louis County, Minnesota. Both are located approximately 18 miles from the NorthMet Project area.

The Laurentian Deposit has been operating since the early 1990s and is 2 miles southwest of the East Reserve Deposit. East Reserve Pit #1 began operations in 2008. A second pit, East Reserve Pit #2, has been permitted and stripping/site development has begun.

Ore from the East Reserve #1 Pit is being blended with, and intended to gradually replace, ore from the Laurentian Deposit. It is used to make steel, primarily for the automobile industry and the transportation sector.

ArcelorMittal plans to amend the Permit to Mine with a pushback project that would extend the limits of East Pits 1 and 2, which are referred to as push-back areas, to the south, allowing for economical mining/increased ore reserve. Specifically, there are two elements to the proposed push-back project: extending the permitted mining area by 103 acres and extending the permitted plant site by 11 acres to construct a new construction equipment pole area. The push-backs would not result in additional mining roads, production rates, plant emission rates, or dewatering rates.

The taconite facility is capable of producing up to approximately 3.2 million long tons of finished pellets per year. There are three main areas where emissions are released: the mine, the tailings basin, and the pellet plant. Emissions from the mine are fugitive emissions, which are primarily particulate matter, and are created from blasting, coarse ore loading and unloading, overburden loading and unloading, and haul truck traffic on unpaved roads. Emissions from the tailings basin are fugitive emissions, which are primarily particulate matter, and are created by tailings basin dike construction, truck traffic on unpaved roads, and wind erosion of exposed tailings beaches. Emissions from the pellet plant consist of point source emissions from crushing, concentrating, and agglomerating operations, which primarily create particulate matter emissions. The indurating furnace emits particulate matter, SO_2, NO_X, CO, and other pollutants such as HAPs. HAPs emissions tend to be metals and products of combustion. Fugitive emissions from the pellet plant are from pellet loadout and wind erosion of fine particles from the pellet storage piles and are particulate matter. The facility uses a variety of bag houses and wet scrubbers to control emissions from the point sources located in the pellet plant. Water and chemical dust suppressants are applied to haul roads and other fugitive sources to reduce particulate emissions when weather permits.

City of Aurora Publicly Owned Treatment Works

To support its POTW, the City of Aurora withdraws water from the St. James Pit, which is a former natural ore pit within the Embarrass River Watershed. The facility discharges treated wastewater into Silver Creek, which, in turn, drains into the St. Louis River.

City of Babbitt Publicly Owned Treatment Works

The City of Babbitt uses several wells, some of which are in the Dunka River Watershed, for its municipal water supply. The City POTW discharges treated wastewater effluent to the Embarrass River. Because some of the discharged water originates in the Dunka River Watershed and is transferred to the Embarrass River, the treatment work is assumed to increase the flow in the Embarrass River and decrease flow in the Dunka River.

City of Biwabik Publicly Owned Treatment Works

The City of Biwabik withdraws water from the flooded Canton Mine Pit for its municipal water supply and discharges treated wastewater to a tributary of Embarrass Lake.

City of Hoyt Lakes Publicly Owned Treatment Works

The City of Hoyt Lakes withdraws water from Colby Lake for municipal water supply and discharges treated wastewater to the Whitewater Reservoir. Most of this water returns to the Partridge River Watershed during droughts, when it is pumped from the Whitewater Reservoir to maintain water levels in Colby Lake or seeps into the Lower Partridge River through a dike.

Cliffs Erie Pellet Yard

Under Amendment 005 to Emission Permit No, 13700009, Cliffs Erie LLC would provide commercial taconite pellet shipping and storage for pellets produced on the Mesabi Iron Range utilizing the Cliffs Erie (formerly LTV Steel Mining Company) site in Hoyt Lakes. These facilities include a pellet yard at Hoyt Lakes, shipping docks at Taconite Harbor, and interconnected railroads. Modifications to the existing facilities are required to accommodate commercial pellet shipping operations.

Essar Steel Mine

Essar is permitted and has begun constructing a new taconite mine and processing plant near Nashwauk, Minnesota, in Itasca County. The project would produce 6.5 million metric tonnes per year (mtpy) of high-flux pellets, or 7.0 million mtpy of low-flux taconite pellets. Essar estimates that, once operational, the modifications would operate at full capacity for up to 15 years. The project is located approximately 55 miles southwest of the NorthMet Project area. Essar has stated that it intends to complete construction and begin operation in 2015.

Hill Wood Products (Hill Wood Products and Major Modifications Amendment)

Hill Wood Products is a sawmill and lumber-processing facility. The facility purchases birch log rough-cut wood to produce various wood products including wood pallets, wood biscuits, and flooring. The facility sources include:

- Two boilers and dryer combustion sources. The boilers and dryer burn wood waste. The dryer dries wood waste for processing in the hammermills for use as a fuel both on and off site. The dryer has an electrified filter bed and cyclone for emissions control. The boilers provide steam for a lumber kiln.
- Particulate emission sources such as debarking, skragging, sawing, trimming, molding, sanding, hammermills, and storage silos. Some units are vented internally without controls, some internally with controls, and some externally with controls.
- Miscellaneous sources such as a small extruder for surface coating, an emergency fire pump, and an emergency generator.

Non-permitted equipment was documented by MPCA staff during a site inspection in August 2007, which led to the signing of a Stipulation Agreement on October 13, 2008. A major permit amendment was issued in 2010 to incorporate 17 emission units, 2 fugitive sources, and 1 baghouse and to delete 21 removed emission units, 1 baghouse, and 1 stack vent from the permit.

Laskin Energy Park

The Laskin Energy Park is proposed 220-acre industrial park that is located in the Partridge River Watershed and south of the Minnesota Power Laskin Energy Center. It is located adjacent to Colby Lake and Whitewater Lake, near the City of Hoyt Lakes.

LTV Steel Mining Company Former LTVSMC Pits

LTVSMC mined and processed taconite from the 1950s to 2001, when it went bankrupt. Cliffs Erie LLC (a subsidiary of Cliffs Natural Resources, Inc. [both names for this company are used in this document, depending on the specific context of the citation]) acquired a port of the former LTVSMC lands and is currently managing legacy issues through voluntary actions (e.g., VIC agreements), NPDES/SDS permits, and a Consent Decree with the MPCA. Mesabi Nugget LLC (a joint venture of Steel Dynamics and Kobe Steel) and Mesabi Mining LLC, a subsidiary of Steel Dynamics, own the remainder of the former LTVSMC lands. The former LTVSMC processing plant and tailings facility now owned by Cliffs Erie is proposed for use by the

NorthMet Project Proposed Action. The former LTVSMC mine pits are now owned by Mesabi Nugget, Mesabi Mining, and Cliffs Erie and are located to the west, south, and east of the NorthMet Project area. Ownership and the current hydrologic status of each of these pits is described below.

Mesabi Nugget

Pit 1: Because of Mesabi Nugget, this pit has seasonal (September to March) discharges of approximately 4,000 gpm (9.0 cfs) to Second Creek; no discharges occur from April to August. The proposed Mesabi Mining Project would result in the partial dewatering of this pit to a currently unspecified water at an unspecified rate.

Mesabi Mining

- Pit 2WX: The pit is currently in the process of filling. Within a few years, this pit may overflow to an unnamed creek that discharges to the Partridge River just below Colby Lake.
- Pit 6: This pit currently releases water to Second Creek via the surficial aquifer. There is no surface water discharge.
- Pit 9S: This pit is currently stable (with likely groundwater discharge off-site and/or to Pit 6).
- Pit 9N: This pit is currently stable (with a likely groundwater connection to Pit 1).

Cliffs Erie

- Pit 2/2E: This pit is stabilized with no direct discharge. There is likely groundwater flow from this pit to Pit 2W.
- Pit 2W: This pit recently reached the level at which an overflow discharge occurs to Second Creek at a current rate of approximately 4,000 gpm (8.9 cfs)
- Pit 3: This pit currently discharges to Wyman Creek at approximately 350 gpm (0.8 cfs). Cliffs Erie is currently considering the feasibility of pumping the overflow from this pit to Pit 2W, which ultimately overflows to Second Creek, as part of its NPDES/SDS permit reissuance process.
- Pit 5SW: This pit overflows via "dispersed" discharge, at an estimated rate of less than 350 gpm (0.8 cfs) to Wyman Creek. PolyMet has an option agreement to purchase this pit; however, Pit 5SW is not part of the NorthMet Project Proposed Action.
- Pit 5NW: This pit has an overflow discharge of approximately 700 gpm (1.5 cfs) to Spring Mine Creek, a tributary of the Embarrass River. PolyMet has an option agreement to purchase this pit; however, Pit 5NW is not part of the NorthMet Project Proposed Action.

<u>Magnetation (Keewatin, Taconite, Chisolm, Coleraine)</u>

Magnetation is currently permitted and operating (or co-operating) scram mining operations near Keewatin, Taconite, and Chisholm. Scram mining is a mining process that produces natural iron ore, natural iron ore concentrates, or taconite ore from previously developed stockpiles, tailing basins, underground mine workings, or open pits and that involves no more than 80 acres of land not previously affected by mining, or more than 80 acres of land not previously affected by mining if the operator can demonstrate that impacts would be substantially the same as other scram operations. "Land not previously affected by mining" means land upon which mine wastes have not been deposited and land from which materials have not been removed in connection with the production or extraction of metallic minerals (*Minnesota Statutes* 93.46, Subd.10). Magnetation has received a permit for a new operation near Coleraine. Magnetation has an EAW underway for dewatering the Canisteo pit in order to explore potential future scram mining.

Minnesota Department of Transportation US Highway 53 Virginia to Eveleth Relocation

This highway project is needed to allow United Taconite to continue its permitted mining operations near Eveleth, St. Louis County, Minnesota. United Taconite has authority to continue its mining operations, including an area that crosses the current location of Highway 53. The Minnesota Department of Transportation (MDOT) has proposed a new route (Preferred Alternative E-2), analyzed in a Draft EIS released in December 2014 (MDOT 2014). No other details are available at this time regarding the timing and exact scope of this road construction project. The proposed road construction is planned for 2017.

Mesaba Energy Project – Western Iron Range Site

Excelsior Energy has received permits to develop the Mesaba Energy Project, a natural gas fueled electric power-generating station. The project would be designed, constructed, and operated in two phases, each phase generally producing 600 megawatts. Excelsior's preferred site is the Western Iron Range site near Taconite, Minnesota, about 55 miles from the NorthMet Project area. Pit 2/2E, Pit 2W, and Pit 3 of the LTVSMC mine (see above) could be drawn down as part of the Mesaba Energy Project. An FEIS was prepared in 2009 by the USDOE and MDC.

On March 12, 2010, the Minnesota Public Utilities Commission (PUC) granted Excelsior Energy's Mesaba Energy Project a Large Electric Power Generating Plant Site Permit, a High Voltage Transmission Line Route Permit, and a Pipeline Route Permit (together, "the Site and Route Permits"), for construction of an Integrated Coal Gasification Combined Cycle electric power-generating station. On May 31, 2012, Excelsior Energy requested that the PUC confirm that the Site and Route Permits issued in 2010 were valid for a construction of a gas-fired plant at the same site, and that no additional environmental review was required. On September 19, 2012, the PUC issued an Order finding the Site and Route Permits valid and requiring additional filings prior to construction of the natural gas-fueled facility. At the time of this FEIS, the project has not yet been constructed.

Mesabi Nugget (Formerly Mesabi Nugget Phase I)

The Mesabi Nugget facility, located within approximately 2 miles of the NorthMet Project area, is currently producing iron nuggets from iron ore concentrate. The concentrate is mixed, dried, and fed into a rotary hearth furnace and reduced to a metallic iron and slag material. Water is appropriate from Pit 1 and/or Pit 2WX for contact and non-contact cooling and air pollution control equipment. Treated wastewater is discharged into Pit 1, which, in turn, is discharged on a seasonal basis (September through March) into Second Creek.

Mesabi Mining Project (Formerly Mesabi Nugget Phase II)

The Mesabi Mining Project area is located approximately 2 miles from the NorthMet Project area, and is currently under a Closure Plan. This facility would involve the reactivation of a taconite mine and construction of a taconite concentration facility near Hoyt Lakes. Under the most recent proposal, Pits 2WX and 6 would be dewatered to access the iron ore and tailings would be disposed into Pit 1. Most of the concentrate generated at the Mesabi Mining Project facility would be used in the Mesabi Nugget facility, and the remainder would be shipped by rail to other facilities for processing. This project is currently on indefinite hold by the applicant, but was considered as reasonably foreseeable for this assessment.

Mining Resources (Austin Powder Basin, Corsica Basin, Skubic Basin, and Sherman Basin)

Mining Resources is a scram operation that received their original Permit to Mine in November 2011. Mining Resources is currently operating in the Duncan, Niles, Douglas, Dunwoody Tailings Basin just south of Chisholm, Minnesota (Section 35, Township 58N, Range 20 West). Proposed scram projects to extend the mine life of this operation include expansion into the Sherman Tailings Basin located approximately 1 mile east of the current facility, as well as expansion in to further afield basins, called “backhauls,” which refers to the plan to load tailings into trucks returning from the Mesabi Nugget facility. Mesabi Nugget currently runs Mining Resources’ concentrate through the pelletization process. Backhaul basins included in the current permit amendment application are the Austin Powder Basin located near Biwabik, the Corsica Basin located near McKinley, and Skubic Basin located southwest of Virginia.

Minnesota Power Boswell Energy Center Unit 3

In 2006, Minnesota Power submitted an emission reduction proposal, the Boswell 3 Environmental Improvement Plan, pursuant to *Minnesota Statutes* 216B.682 and 216B.6851. The proposal was designed to remove existing air pollution control equipment on Unit 3 of the Boswell station, and replace the equipment to control mercury, NO_x, SO_2, and particulate matter emissions. The project would result in considerable reductions in key pollutant emissions from the Boswell electric power generating station. Emissions of SO_2 would be reduced by 90 percent and NO_x would be reduced by 81 percent from Unit 3. Emissions of mercury would be reduced by more than 90 percent from Unit 3.

In 2007, the MPCA issued a major permit amendment (003) to the facility’s total facility operating permit. This amendment allowed for a project to be conducted to comply with USEPA’s Regional Haze Rule, CAIR, Minnesota’s Mercury Reduction Act, and USEPA’s Clean Air Mercury Rule. The amendment authorized the installation of new air quality control equipment, including wet flue gas desulfurization, low NO_x burners, selective catalytic reduction, baghouse filter, and a carbon injection system.

Minnesota Power Laskin Energy Center

The Minnesota Power Laskin Energy Center is currently a coal-fired power plant on Colby Lake between Aurora and Holt Lakes, about 5 miles from the NorthMet Project area. The facility was permitted in 2014 for conversion from coal to natural gas combustion. For the purposes of this cumulative effects analysis, it was assumed that the plant would be gas-fired. The project also included installation of low-NOx burners. The facility withdraws cooling water from Colby Lake and discharges it into the downstream portion of the lake. The plant produces more than 110 megawatts of power. The project also includes retrofits similar to Minnesota Power Taconite Harbor Energy Center Unit 2 described below. Work on these retrofits began in 2006.

Minnesota Power Taconite Harbor Energy Center Unit 2, Emission Control Modifications

In 2009, Minnesota Power was permitted for implementing emission control modifications to Unit 2 of its Taconite Harbor Center in Schroeder, Cook County, Minnesota. This facility is located approximately 48 miles east of the NorthMet Project area. The company installed a custom-designed control system that injects sorbents into the combustion process to control SO_2, NO_x, and mercury. Minnesota Power anticipates the system would cut NO_x emissions by more than 60 percent and SO_2 emissions by 65 percent.

The project also included similar retrofits at Minnesota Power's Laskin Energy Center in Hoyt Lakes. Work on these retrofits began in 2006.

Northshore Mining Company: Furnace 5 Reactivation Project

The Reserve Mining Company opened the facility in Babbitt, St. Louis County, Minnesota, in the 1950s and operated it until 1986, when the facility closed. Cyprus Minerals acquired and reopened the facility in 1989 and operated it until 1994, when Cliffs Natural Resources, Inc. acquired it. The Northshore Mining Company is a wholly-owned subsidiary of Cliffs Natural Resources, Inc.

In the early 2000s, the Northshore Mining Company reactivated Furnace 5, a pelletizing furnace at its taconite processing facility near Silver Bay on Lake Superior, Minnesota, about 39 miles to the southeast of the proposed NorthMet Mine Site and about 46 miles from the proposed NorthMet Plant Site.

The reactivated equipment included two crushing units and nine ore concentrator sections, as well as the construction of a concentrate handling system and an expansion of the facility's WWTP.

Northshore Mine (Mine, Ultimate Pit Progression, Closure and BART Reductions)

The Northshore Mine (also known as the Peter Mitchell Mine) is an open-pit taconite mine near Babbitt, St. Louis County, Minnesota, that opened in 1951, about 4 miles northwest and northeast from the NorthMet Plant Site and about 1 mile north of the NorthMet Mine Site. One of the mine areas currently discharges to the Partridge River. Northshore Mining Company has recognized at least another 60 years of minable reserves at current production rates. Conceptual post-closure plans for the Northshore Mine pit allow for the pit to flood due to groundwater inflow and runoff. Predicted ultimate outflow from the pit would be from the northeast end of the pit, to the Dunka River in the Rainy River Watershed. No water from mine dewatering would be anticipated to be flowing to the Partridge River post-closure (MDNR 2011s).

The mine is operated by Northshore Mining Company, Inc. the ore and processes it into pellets at Silver Bay, which ships it to steel producing blast furnaces throughout the country.

Northshore Mining Company is proposing a 108-acre progression of the Ultimate Pit Limit within its Permit to Mine at its Northshore Mine to access additional economic taconite ore, consistent with the company's long-term development plan for the mine. Environmental review is currently in progress for Northshore's proposed progression project and the DNR is the RGU for an EAW on the proposed project.

Sappi Cloquet Plant Expansion

Sappi Cloquet LLC is an existing pulp and paper mill that uses the Kraft process to make pulp from wood chips. The pulp is bleached and made into coated paper. Currently, the mill operates four boilers, including a chemical recovery boiler to provide heating and process steam and to generate electricity.

Other sources of air emissions, besides the boilers, include the sources in the chemical recovery system. The bleach plant sources include the chlorine dioxide plant and a bleach line. These sources are primarily sources of chlorine dioxide and chloroform emissions; the bleaching system is also a source of CO and VOC emissions. Some of the particulate emissions, besides the boilers and chemical recovery sources, include fugitive sources such as woodpiles and roadways.

Sappi controls odor-causing non-condensable gases by collecting them in three different systems: a Low-Volume/High Concentration system, a High-Volume/Low Concentration system, and a steam Stripper Off-Gas system. The non-condensable gases are currently burned in the Incinerator-Quencher scrubber, with Power Boiler #7 or #9 used as backup.

The latest permit amendment, 014, issued on March 13, 2012, authorizes Sappi to modify the pulp mill to manufacture chemical cellulose pulp, also known as dissolving pulp. The project emissions increases are quite small, but include a projected increase in ozone emissions, which is subject to PSD requirements at any increase greater than zero.

This project replaces a previously planned plant expansion (“Project Hercules”), which was authorized through permit amendment 011, issued on October 28, 2009. Most of the facility changes permitted through that permit action will be “unpermitted” through this permit action.

St. Louis County Public Works Bridge Replacement

St. Louis County Public Works will be conducting eight bridge replacements in the Partridge River and Embarrass River watersheds over the next 10 years. Bridge replacements generally directly impact 10,000 ft^2 of wetlands or less, so the maximum direct wetland impact from the bridge projects would be 1.8 acres.

U.S. Steel Keetac Mine and Mine Expansion Project (Keewatin)

U.S. Steel is permitted to restart an idled production line and expand contiguous sections at the Keetac Mine and taconite processing facility near Keewatin, Itasca County, Minnesota, about 45 miles from the NorthMet Project area, on the boundary between St. Louis and Itasca counties. The project would increase iron pellet production from 6 million to 9.6 million tpy.

The project involved preparation of a joint State-Federal EIS; the State ROD was issued in December 2010. The expanded facility is scheduled to begin full operations between 2013 and 2015. U.S. Steel has announced that this project is currently on indefinite hold. Media reports in September 2014 stated that U.S. Steel had cancelled these projects (Minneapolis/St. Paul Business Journal 2014). These projects, however, were included in the cumulative effects air quality assessment for the NorthMet Project Proposed Action SDEIS, so they have been included in this analysis, and until a final decision by the federal agency (USACE) is made, this project is considered reasonably foreseeable for the purposes of this assessment. This change would reduce overall air emissions in the cumulative effects analysis area for air resources. .

U.S. Steel Minntac Mine, Best Available Control Technology Reductions (Mountain Iron) and Minntac Mine Extension Project

The U.S. Steel Minntac Mine Project included three components for the cumulative effects analysis: the active mine, BACT reductions, and the proposed Minntac Mine Extension Project.

The BACT reductions project implemented technological modifications to reduce air emissions from the existing facility. In 2008, the MPCA issued a draft permit to U.S. Steel establishing BACT limits for VOCs, CO, and fluorides at the company's Minntac facility in Mountain Iron, Minnesota. The permit addresses potential effects on visibility from NO_x emissions and establishes a procedure to set a BACT limit for NO_x. The draft permits set interim NO_x limits and requires the ongoing testing of control technologies for NO_x, with a goal to reduce emissions more than 70 percent compared to the initial permit limit.

U.S. Steel is also proposing to extend its open pit facilities by 483 permitted acres at the Minntac Mine in Mountain Iron, St. Louis County, Minnesota. The project is expected to extend mine life and taconite production to 2031.

The Minntac Mine is a taconite mine and pelletizing operation about 25 miles from the NorthMet Project area. The Minntac plant consists of a series of crushers and screens, a concentrator, an agglomerator, and auxiliary facilities. Taconite produced from the extension would continue to be processed at the existing Minntac facility at the current levels of production.

MDNR issued a ROD on April 11, 2013, stating that the project would not cause significant environmental effects and that an EIS was not required (MDNR 2013f).

United Taconite Mine

This is a taconite mine near Eveleth, St. Louis County, Minnesota that began operations in 1965 and has an annual capacity of approximately 5.2 million gross tons of taconite pellets. It is located about 27 miles west of the NorthMet Project area. The United Taconite mine has six permitted mine pit dewatering discharges, all of which discharge to the St. Louis River Basin. United Taconite make-up water comes from the St. Louis River.

At the mine site, crushed ore is unloaded in a covered building. The ore is then transferred by a covered conveyor to the fine crusher building where it is immediately crushed at the third stage crusher or sent to the coarse ore surge pile. The coarse ore surge pile is used to store ore between train shipments or during times when the crusher is down.

Ore is returned from the coarse ore surge pile and fed into one of the 5 third-stage crushers. Particulate emissions from the third-stage crusher are controlled by wet scrubbers. The oversize material is conveyed to 1 of 8 fourth-stage crushers. Each fourth-stage crusher has a dedicated wet scrubber to control particulate emissions. Undersize material is transferred to the fine ore storage building. Oversize material is recirculated to the fourth-stage crushers.

Five concentrator lines receive ore from the fine ore surge building. Particulate emissions from the transfer of fine ore to the concentrator lines are controlled using wet scrubbers. Here ore is ground and magnetic separators remove the magnetite ore from the tailings. Low-magnetic coarse tailing are transported by truck for use as construction material for the tailings basin sidewalls. Fine tailings are pumped in slurry form to the tailings basin. Processes performed in the concentrator are wet operations. Concentrate is piped as a slurry to the pelletizing plant. The slurry is dewatered with filters and additives are introduced. Green pellets are produced in balling drums and conveyed to one of two travelling grate kilns. Grate feed, grate discharge, kiln induration, and kiln cooler emissions are controlled with wet scrubbers.

Fired pellets are conveyed to pellet storage silos. Pellets are then loaded into rail cars and transported from the facility. Particulate emissions from the pellets are controlled with wet scrubbers and dust suppressants. Intermediate products and byproducts, including but not limited to rocks, tailings, and concentrate, are also sold by the United Taconite.

United Taconite Mine Modifications

The MPCA issued a major air permit amendment in 2002 for the installation and operation of the replacement pellet reclaim screening system. Furthermore, the MPCA issued a major permit amendment in 2010 for the installation of air pollution control equipment, implementation of an energy reduction project, and conversion of fuel type. The MPCA is currently working on a major amendment that would authorize the replacement of particulate controls and modification of scrubber solids wasting requirements.

United Taconite Green Production Project

This project involves fuel changes and improvements to the concentrator and the Line 1 pellet plant to increase pellet production and was a PSD minor project. Because it was a PSD minor project, specific considerations for BACT/MACT were not required. However, the Line 1 pellet plant has an existing wet scrubber to control particulate and SO_2 emissions. Emission estimates are taken from the Technical Support Document for Permit No. 13700113-005 authorizing the project on August 19, 2010.

UPM/Blandin Paper Mill Expansion, Project Thunderhawk

This project would include the installation of a complete new paper manufacturing line, efficiency improvements to a second paper manufacturing line, shutdown of another existing paper machine and related infrastructure, additional pulping capacity, a new water intake structure, energy infrastructure improvements, a new paper warehousing facility, and WWTF modifications. Paper production would increase by an estimated 314,000 tons per year. The MPCA issued a permit action that incorporated a major amendment application (for Project Thunderhawk) dated August 23, 2005, for a modification that will increase paper production.

Virginia Public Utilities

The City of Virginia Department of Public Utilities provides steam and electricity to businesses and residents of the local Virginia area. The department has the potential to operate any combination of four boilers using coal and/or natural gas and/or wood as fuel. Boiler 7 (EU001) and Boiler 9 (EU003) can burn only coal, and Boiler 10 (EU004) is a natural gas fired boiler. Boiler 11 (EU006) is a wood-fired boiler to be used for district heating and electric generation. There is an additional boiler, Boiler 8, located at the facility but it is physically disconnected from the utility system. Pollution control equipment consists of wet scrubbers, baghouses, and/or electrostatic precipitators in combination with good combustion practices.

Community Growth and Development

Where community growth and development are assessed, they are based on historical and projected population and economic trends derived from state census data and regional land use plans as described in the appropriate resource sections.

Forestry Practices on Public and Private Lands

Where forestry practices are assessed, they are based on historical and projected trends derived from state databases and regional forestry plans as described in the appropriate resource sections.

6.1.1.2.2 Speculative Actions

Other projects in the early stages of development by mining companies are considered to be speculative by the Co-lead Agencies. While these projects have been identified to provide an indication of regional development interest, these actions have not been mapped or considered in the cumulative analysis.

Twin Metals

Twin Metals Minnesota Joint Venture (Duluth Metals Limited and Antofagasta PLC) has begun looking at the feasibility of creating an underground copper-nickel-PGE mine near Ely, Lake County, Minnesota. This venture is known as the Twin Metals Project. At this time, a permit application has not been submitted for activities that would require state and federal permits, including a DA permit pursuant to Section 404 of the CWA. This project would likely require preparation of a joint State-Federal EIS. Preliminary data collection and maps to support environmental review and permitting is underway by the company.

Essar Steel

The Essar Steel Nashwauk, Itasca County, Minnesota, facility was permitted in 2007 and is under construction, and a plant expansion of its taconite operations is permitted and under construction. The construction of a legacy scram processing facility is being considered. Scram operations produce natural iron ore or iron ore concentrates from previously developed stockpiles, basins, underground workings, or open pits. The legacy scram facility is exempt from state environmental review, but requires state permitting.

Rio Tinto (Kennecott Exploration)

Rio Tinto is currently performing exploration drilling of a non-ferrous (copper-nickel) deposit near Tamarack, Aitkin County, Minnesota, about 45 miles west of Duluth, St. Louis County, Minnesota. The project may require preparation of a joint State-Federal EIS. Preliminary data collection to support environmental review and permitting is currently underway by the company (Rio Tinto 2010).

Teck

Teck is considering operations to mine the Mesaba deposit near Babbitt, St. Louis County, Minnesota, approximately 3 miles east of the NorthMet Mine Site, for non-ferrous metals (copper-nickel). The current phase is exploration and drilling. The project may require a joint

State-Federal EIS. Preliminary data collection to support environmental review and permitting is underway.

North Star Blue Scope Steel

North Star Blue Scope Steel is considering a direct reduced iron (DRI) plant to process iron ore concentrate purchased from others into DRI-grade pellets. A site for the plant has not been selected. The project may require preparation of a joint State-Federal EIS.

ArcelorMittal

The ArcelorMittal facility is an operating iron taconite plant in Virginia, St. Louis County, Minnesota. The company is considering an expansion by initiating mining operations in a central pit, thereby connecting two existing pits. The project may require preparation of a joint State-Federal EIS and reissuance of NPDES permits for the mine and plant sites. The Town of McKinley is located between the two pits.

Cardero Resource Group (Two Projects)

Cardero Resource Group has initiated exploration activities for non-ferrous deposits (titanium) for its Longnose and Titac properties. Although both properties are located near Aurora, St. Louis County, Minnesota, they are separated by approximately 25 miles. The two are considered separate mines and each project may require preparation of a joint State-Federal EIS.

Cooperative Mineral Resources

Cooperative Mineral Resources is a subsidiary of Crow Wing Power located near Emily, Crow Wing County, Minnesota. The project is located 50 miles south and west of the Iron Range area and is proposed as a non-ferrous mine with an interest in manganese extraction from deposits 200 to 400 ft bgs. The project proposer has conducted small-scale pilot testing of extraction technology at the site. Based on results of the pilot-testing, the company does not intend to proceed with the project at this time. If the project were to move ahead, it would require preparation of a State EIS, and may require preparation of a joint State-Federal EIS.

Encampment Minerals

Encampment Minerals, Inc. is currently exploring the Serpentine copper-nickel deposit. This project would require a State EIS.

6.1.2 Land Exchange Proposed Action

6.1.2.1 Cumulative Effects Analysis Approach and Baseline Conditions

Potential cumulative effects for the Land Exchange Proposed Action have been assessed at the resource level. The spatial and temporal extents of the CEAAs depend on several resource-specific factors. As discussed in the NorthMet Project Proposed Action cumulative effects introduction, some resources would not be directly affected by the action of a land exchange. These topics include noise, cultural/historic resources, geotechnical stability, wilderness and other special designation areas, and hazardous materials. The cumulative effects analysis for these topics, including the indirect effects of mining operations following any land exchange, are identified in their respective headings under Section 6.2, NorthMet Project Proposed Action.

The resource discussions in Chapter 4 provide the baseline conditions of the natural and human environment affected by past and present actions. Future actions—also called reasonably foreseeable projects—are those activities that could combine with the Land Exchange Proposed Action to potentially cause cumulative effects. The focus of this analysis is on those future activities when placed against baseline conditions that include the effects of past and present activities.

Land exchanges are property purchase and transfer transactions, whereas land acquisitions are only property purchases. The land exchange and property acquisition actions described in this section are designed to consolidate and enhance the functional boundaries of the Superior National Forest. The effects measure the net increase or decrease of each specific resource that would result from the Land Exchange Proposed Action and other cumulative actions in context of the entire Superior National Forest system.

In addition to the Land Exchange Proposed Action, two alternatives have been carried forward: Land Exchange Alternative B and the Land Exchange No Action Alternative. A description of these alternatives is presented in Chapter 3.

6.1.2.2 Cumulative Forest Service Land Actions

Because past land exchange and land acquisition actions through 2011 have been incorporated into the existing Superior National Forest boundaries and the subsequent area and resource calculations, it is assumed that the aggregate effect of these past land exchange actions has been absorbed into and are represented in the current Superior National Forest baseline data. Based on this assumption, the Land Exchange Proposed Action and other current and foreseeable land exchange and land acquisition actions are evaluated as cumulative actions.

The USFS identified the following six current and reasonably foreseeable land exchange and land acquisition (Figure 6.1.2-1) actions that would be cumulative to the Land Exchange Proposed Action:

- Cook County Land Exchange;
- Crane Lake Land Exchange;
- Fall Lake Land Acquisition;
- Gunflint Land Acquisition;
- School Trust Land Exchange and Land Acquisition; and
- Wolf Island Phase 2 Land Acquisition.

A brief description of each of the current and reasonable foreseeable land exchange and land acquisition actions is presented below.

6.1.2.2.1 Cook County Land Exchange

The USFS proposes to exchange up to 1,620 acres for 1,911 acres of Cook County lands within the BWCAW to assist in meeting the goals and objectives of the BWCAW elements of the Forest Plan. The federal lands consist of 41 parcels located throughout Cook County and would be conveyed to Cook County to allow for sustainable development. The lands the USFS would receive would consolidate National Forest System land within the BWCAW.

6.1.2.2.2 Crane Lake Land Exchange

This land exchange proposal involves federal land located within and adjacent to the Town of Crane Lake for private land in the general vicinity of Crane Lake and the BWCAW. Under the land exchange, the USFS would acquire approximately 265 acres of non-federal land in exchange for up to approximately 352 acres of federal land. The federal lands to be conveyed are adjacent to the Town of Crane Lake in T67N, R17W, Sections 23 and 26. The non-federal lands proposed for exchange include three separate parcels in the general vicinity of Crane Lake and some distance south of the town.

The USFS's purpose is to acquire and consolidate land adjoining the BWCAW, the Vermillion River, and other existing National Forest System lands. The Town of Crane Lake's purpose is to acquire land that would better allow for sustainable municipal development and management of municipal facilities by the Town of Crane Lake.

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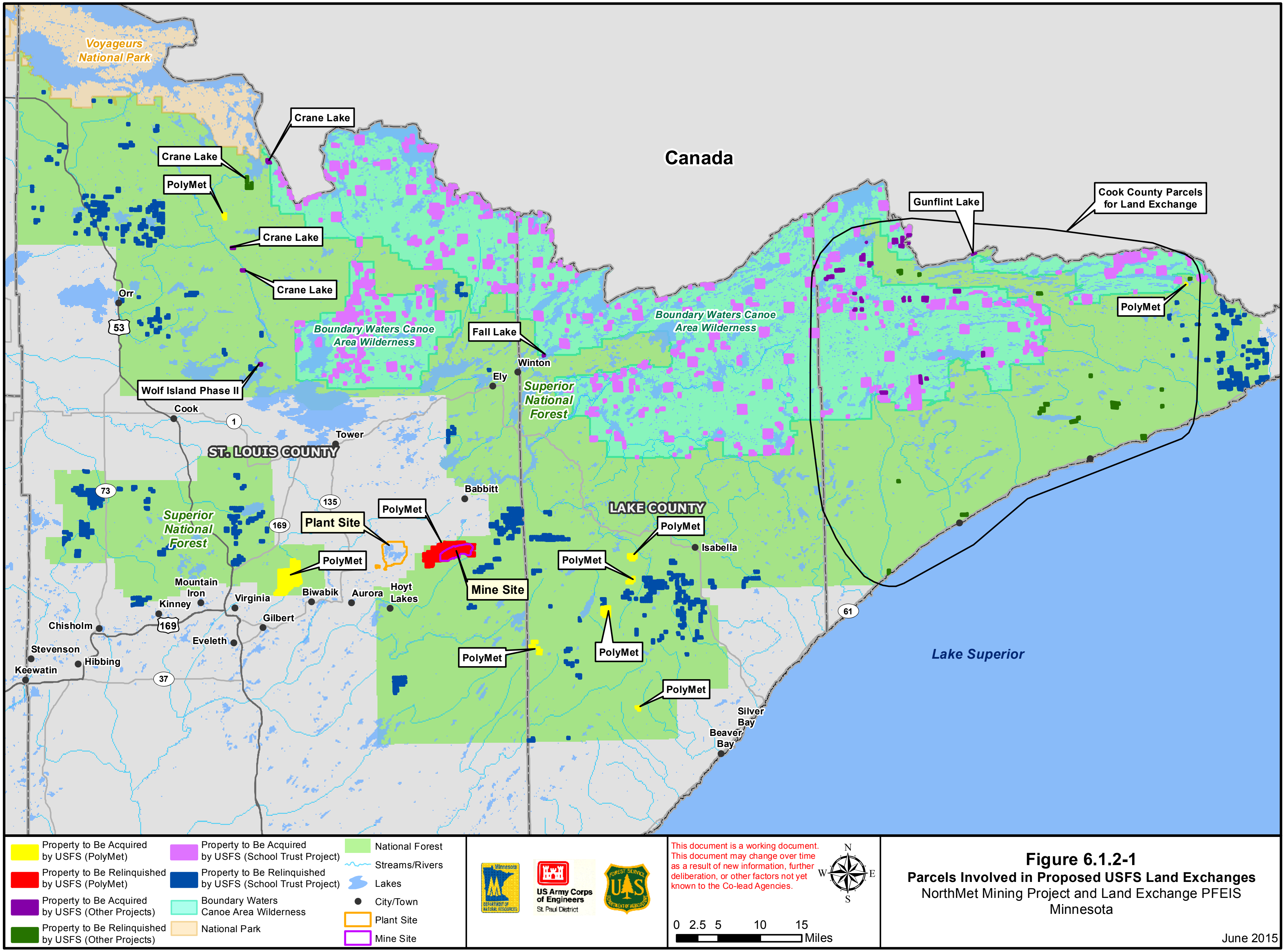

Figure 6.1.2-1
Parcels Involved in Proposed USFS Land Exchanges
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

637

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6.1.2.2.3 Fall Lake Land Acquisition

The Trust for Public Land purchased two properties totaling approximately 27 acres between 2009 and 2011 and is holding the title to these properties until the USFS has received funds to acquire these properties from the Trust for Public Land in order to consolidate them into the Superior National Forest. The request for funds to purchase these properties was included in the USFS's 2012 Land and Water Conservation Fund request with funding anticipated in 2014. The two properties include Duvall (11 acres of Fall Lake) and Laur (17 acres on Fall Lake).

The properties are located on the shores of Fall Lake, across from the Fall Lake boat landing/campground and within 0.5 mile of the Fall Lake entry to the BWCAW.

6.1.2.2.4 Gunflint Land Acquisition

The Conservation Fund purchased this 32-acre property in 2014 and is holding title until the USFS has received the funds to acquire the lands in order to consolidate them into the Superior National Forest. The request for funds to purchase these properties was included in the USFS's Land and Water Conservation Fund request with funding anticipated in 2015.

The property is located in Cook County along Gunflint and Little Gunflint Lakes at the US-Canadian border along the "Voyageurs Route." The acquisition would protect 5,465 ft of shoreline along Gunflint Lake and Little Gunflint Lake.

6.1.2.2.5 School Trust Land Exchange and Land Acquisition

The State of Minnesota and the USFS are working together on a mutually beneficial strategy to transfer ownership of approximately 86,000 acres of currently designated school trust lands, located within the BWCAW, to federal ownership as part of a combined purchase and land exchange. The USFS would exchange federal lands outside the BWCAW for one-third of the school trust parcels within the BWCAW. The USFS would purchase the remaining two-thirds of the school trust lands within the BWCAW.

6.1.2.2.6 Wolf Island Phase 2 Land Acquisition (Domine Phase 2)

The Trust for Public Land purchased this 27.54-acre property in 2007 and is holding title until Congress appropriates funds to purchase the land. This parcel represents the northern portion of Wolf Island in the northern arm of Lake Vermilion, 1 mile from the head of the Vermillion River. The USFS acquired the southern portion of Wolf Island in 2010. This purchase would consolidate the entire island under the USFS. Acquisition of the remainder of Wolf Island would result in public ownership of the entire 60-acre island and approximately 10,500 ft of lakeshore on Lake Vermilion. The island provides riparian habitat for sensitive species, including bald eagles and other resident and migratory birds such as osprey, loons, and blue herons.

671 -Page Intentionally Left Blank-

6.2 CUMULATIVE EFFECTS BY RESOURCE FOR THE NORTHMET PROJECT PROPOSED ACTION

This section considers cumulative effects by resource area. Only the direct and indirect effects of the NorthMet Project Proposed Action described in Chapter 5 of the FEIS are considered to potentially cause cumulative effects for the purposes of this analysis. For each of the resources analyzed in this chapter, the specific methodologies used to approach the cumulative analysis, as well as the spatial and temporal boundaries that limit the analysis, are described.

6.2.1 Land Use

The NorthMet Project Proposed Action would affect approximately 6,498 acres of land near Hoyt Lakes and Babbitt, in St. Louis County, Minnesota. This area includes public lands in the Superior National Forest, as well as private lands within the municipal boundaries of Hoyt Lakes and Babbitt.

6.2.1.1 Approach

The cumulative actions were evaluated against existing land use plans and ordinances. These include the St. Louis County Comprehensive Land Use Plan, provisions of the 1854 Treaty with the Chippewa of Lake Superior as they may affect or be affected by land use, and local (municipal) land use plans and zoning ordinances.

6.2.1.2 Cumulative Effects Assessment Area

6.2.1.2.1 Spatial

The CEAA for land use includes effects associated with the NorthMet Project Proposed Action combined with other industrial (including mining) or public works projects located within the portion of the Mesabi Iron Range encompassed by St. Louis County (see Figure 6.1.1-1). While changes in land use patterns do not necessarily depend on such projects, historical census data indicate changes in population in St. Louis County have been historically linked to such projects, especially mines. As discussed in Section 4.2.10, the iron deposits associated with the Mesabi Iron Range have been mined on an industrial scale for more than 100 years.

Recreation and natural areas (such as the BWCAW, Voyageurs National Park, and Superior National Forest) are also important economic and land use resources; however, the spatial extent of these designated lands is largely fixed (i.e., they have designated federal boundaries). Changes in use of these resources are due to evolving socioeconomic preferences, such as preferred type and amount of recreational activity.

6.2.1.2.2 Temporal

This evaluation focuses on existing and reasonably foreseeable land use patterns within the CEAA. Because mining and public resource management have been historically the primary drivers defining regional development and land use within the CEAA for over 100 years, existing conditions are considered indicative and representative of historical mining and resource management activities.

6.2.1.3 Contributing Past, Present, and Reasonably Foreseeable Actions

As noted previously, it is not possible to identify all past activities that may contribute to a cumulative effect. Similarly, all present activities would continue to affect the environment. The impacts of these combined activities are described in Chapter 4, Affected Environment. While not a new project, the Northshore Mine is anticipated to close in 2070.

The foreseeable future actions included in this analysis are discussed in Section 6.1.1.2. Activities specifically associated with potential cumulative effects on land use include permitted mines and other projects in the portions of the Mesabi Iron Range in St. Louis County where future activities are likely to be different from current activities. These projects include:

- ArcelorMittal Deposits (Laurentian and East Reserve Deposits),
- Mesabi Mining Project,
- Northshore Closure;
- U.S. Steel Keetac Mine (Keewatin), and
- U.S. Steel Minntac Mine, Extension Project.

6.2.1.4 Cumulative Effects Assessment

The cumulative actions described in Section 6.2.1.3 are largely existing, expanded, or reconfigured mines operating on private land. These activities total approximately 2,650 acres, including more than 2,000 acres at the Keetac mine alone (MDNR and USACE 2010). While much of this land has not previously been mined, all of the cumulative actions are found within the Mesabi Iron Range. Expanded mining in this area does not necessarily reflect a change in land use and is consistent with land use regulations (St. Louis County 2011).

Together, the five projects included in the cumulative assessment would generate new jobs (Section 6.2.10). As with the NorthMet Project Proposed Action, this could increase housing demand in the region although a majority of this increased demand could be absorbed by the substantial available housing stock in St. Louis County (see Section 5.2.10.2.4). Any new housing would need to be consistent with the St. Louis County Land Use Ordinance 27 (Comprehensive Plan Land Use).

Post-closure, the Northshore Mine pit lake is estimated to be approximately 2,800 acres at an elevation of 1,500 ft amsl. Mitigation for changes to the watershed includes in-pit aquatic habitat development and upland enhancements. Public access to the reclaimed pit lake would be provided (Barr 2010e).

The sources for data regarding cumulative actions include MDNR and USACE 2007, USDOE and MDC 2007, and MDNR and USACE 2010.

6.2.2 Water Resources

The FSDD identified several resources with the potential to be cumulatively affected, including water resources, which would be subjected to a cumulative effects analysis using guidance from the CEQ (CEQ 1997). The FSDD identified hydrology and water quality as elements with the potential for cumulative effects. The analysis within this FEIS also identified the potential for cumulative effects on surface water hydrology and water quality. Neither the FSDD nor this FEIS identified potential cumulative effects on groundwater. The NorthMet Project Proposed Action would supplant the existing seepage from the existing LTVSMC Tailings Basin and extend the duration of these effects, but these effects are localized and already incorporated in the groundwater quality models the results of which are in Section 5.2.2. The existing LTVSMC Tailings Basin is not considered a part of the cumulative effects because the NorthMet Project Proposed Action would replace these effects; therefore, they cannot be considered in addition to the NorthMet Project Proposed Action. Although the NorthMet Project Proposed Action would affect groundwater levels, this effect would be very limited geographically and temporally (e.g., groundwater levels would begin to restore once pit dewatering ceases) and not subject to any off-site cumulative effects. The effects of mine pit dewatering are considered in terms of effects on surface water flows. Therefore, the scope of this cumulative effects assessment focuses on the effects of past, present, and reasonably foreseeable future activities on surface water hydrology and quality.

6.2.2.1 Cumulative Effects Assessment Areas

In accordance with the CEQ guidance, a cumulative effects assessment should define the spatial and temporal scope of its analysis. These are described below.

6.2.2.1.1 Spatial

The FSDD identified the Partridge River and the Embarrass River as the geographic scope for the hydrology and water quality analyses. The analysis in this FEIS supports this study area. The St. Louis River was considered for inclusion in the cumulative effects assessment, but not included in the assessment of project-specific impacts for the reasons described below. The cumulative effects actions with the potential to affect flow within the Partridge River and Colby Lake include the Northshore Mine, Laskin Energy City of Hoyt Lakes, Mesabi Mining, and Mesabi Nugget. In the Embarrass River, the projects include ArcelorMittal Deposits (Laurentian and East Reserve Deposits), City of Aurora POTW, City of Babbitt POTW, and the City of Biwabik POTW.

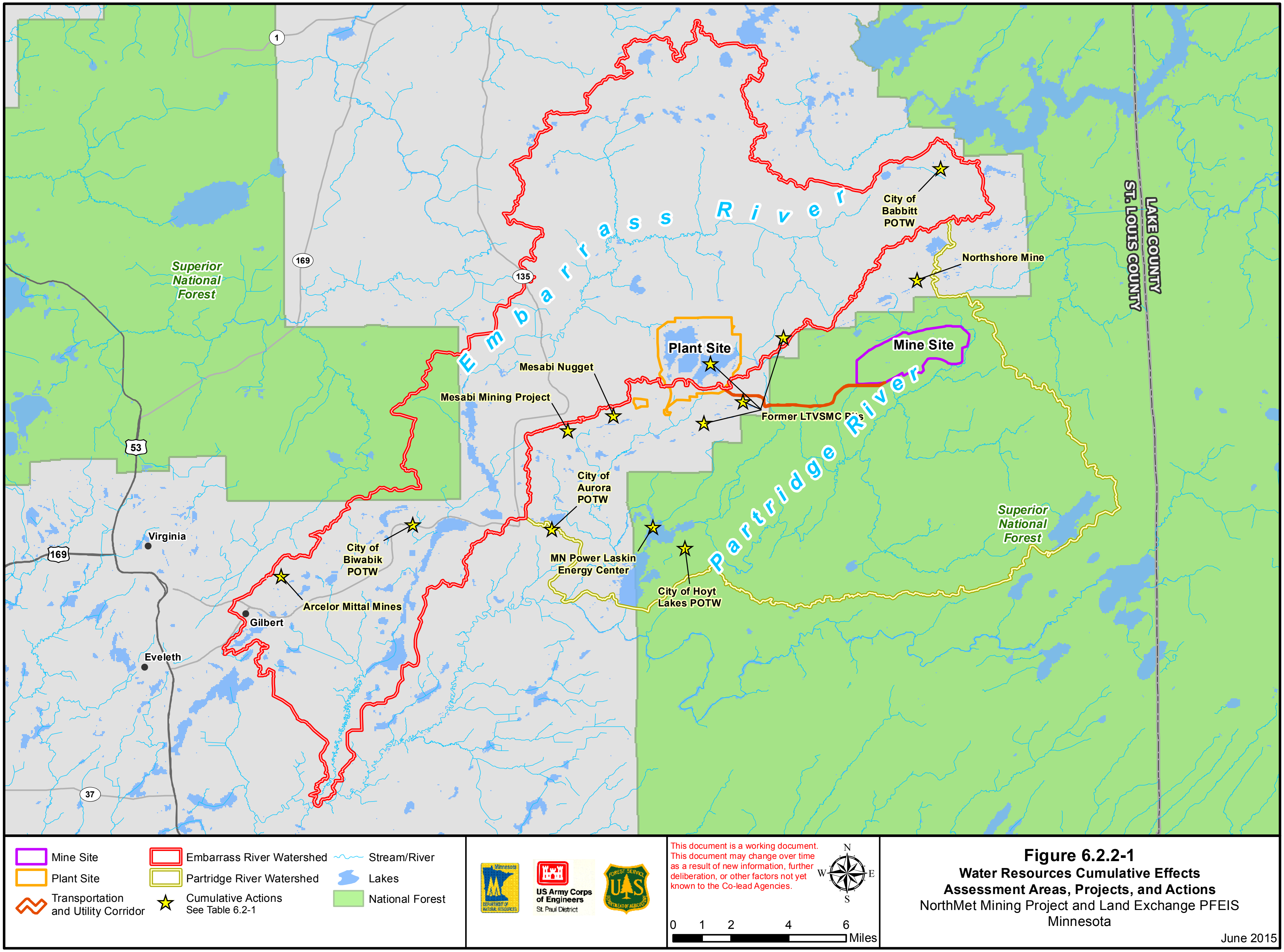
As concluded in Section 5.2.2, the NorthMet Project Proposed Action, which includes augmentation to Embarrass River tributaries, is predicted to only result in minor changes to hydrology within the Partridge River and Embarrass River.. Most of the actions considered in this cumulative effects analysis (see Table 6.1.1-1) with the potential to cumulatively affect hydrology within the Partridge River and Embarrass River exist and their hydrologic effects are already incorporated into the impact assessment water modeling for the NorthMet Project Proposed Action.

The water quality modeling for the NorthMet Project Proposed Action already takes into consideration low flow conditions, and even during low flows, it is not predicted to result in any direct exceedances of water quality evaluation criteria, although achieving this would require long-term water treatment and WWTF and WWTP maintenance. Other reasonably foreseeable actions may also increase metal and other solute loadings downstream, but it is assumed that these other actions would also be required to meet federal and state water quality requirements, including nondegradation. Therefore, the potential for exceedances of water quality evaluation criteria as a result of cumulative effects from the NorthMet Project Proposed Action and other reasonably foreseeable actions is considered unlikely.

Although not expected to result in any direct exceedances of water quality evaluation criteria, the NorthMet Project Proposed Action, in combination with other reasonably foreseeable actions, would increase metal and other solute loadings to the Partridge River and Embarrass River, and further downstream in the St. Louis River. These loadings would, however, be diluted as the solutes are transported downstream (i.e., average annual flow in the St. Louis River at the confluence with the Embarrass River is approximately four times more than in the Partridge and Embarrass rivers alone). Further, the MPCA will review the NorthMet Project Proposed Action for consistency with the State's non-degradation requirements prior to any permitting, as it would also do at the time of permitting for any other reasonably foreseeable actions.

Finally, sulfate and mercury loadings, two key constituents of concern, are predicted to decrease overall as a result of the NorthMet Project Proposed Action. Although sulfate loadings are predicted to increase slightly in the Partridge River Watershed (less than 1 percent) as a result of the NorthMet Project Proposed Action, this is offset by a large decrease in the Embarrass River Watershed (greater than 40 percent at PM-13), resulting in a significant net decrease in overall sulfate loadings to the St. Louis River as a result of the NorthMet Project Proposed Action. Similarly, mercury loadings are predicted to increase slightly in the Embarrass River Watershed (1 percent) as a result of the NorthMet Project Proposed Action, but this is offset by a larger decrease (5 percent) in the Partridge River Watershed, resulting in a net decrease in overall mercury loadings to the St. Louis River as a result of the NorthMet Project Proposed Action.

Therefore, the NorthMet Project Proposed Action is not considered to have the potential for cumulative effects on hydrology and water quality in the St. Louis River. As a result, the CEAA for surface water is defined by the Partridge River and Embarrass River watersheds as shown on Figure 6.2.2-1.



This document is a working document. This document may change over time as a result of new information, further deliberation, or other factors not yet known to the Co-lead Agencies.

Figure 6.2.2-1
Water Resources Cumulative Effects Assessment Areas, Projects, and Actions
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

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6.2.2.1.2 Temporal

In terms of temporal scope, this assessment considered past and present and reasonably foreseeable effects on flow and water quality in the Partridge River and Embarrass River as reflected in existing baseline hydrologic and water quality conditions. Limited flow data are available back to the 1940s for the Embarrass River and 1970s for the Partridge River. Limited water quality data are available dating back to the 1970s. In addition to the NorthMet Project Proposed Action, this assessment considered the activities identified below.

6.2.2.2 Contributing Past, Present, and Reasonably Foreseeable Actions

It is not possible to identify all past activities that may contribute to a cumulative effect. Similarly, all present activities would continue to affect the environment. The impacts of these combined activities are described in Chapter 4, Affected Environment. Existing and potential future actions, in combination with the NorthMet Project Proposed Action, which could cumulatively affect surface water hydrology and quality within the Partridge River and Embarrass River watersheds, include the following:

- ArcelorMittal Deposits (Laurentian and East Reserve Deposits);
- City of Aurora POTW;
- City of Babbitt POTW;
- City of Biwabik POTW;
- City of Hoyt Lakes POTW;
- LTVSMC Pits (Cliffs Erie Pits);
- Mesabi Mining Project;
- Mesabi Nugget Project;
- Minnesota Power Laskin Energy Center; and
- Northshore Mine and Closure.

6.2.2.3 Cumulative Effects on Hydrology

This section discusses cumulative effects on the hydrology of the Partridge River and the Embarrass River.

6.2.2.3.1 Partridge River

There are several mines (active, closed, and proposed), the City of Hoyt Lakes POTW, and Minnesota Power's Laskin Energy Center (a power plant) that have withdrawn or discharged water in the past and/or are currently withdrawing or discharging water that affects flows in the Partridge River (see Figure 4.2.2-10). Table 4.2.2-10 summarizes the NPDES/SDS discharges to and surface water withdrawals from the Partridge River and its tributaries. Most of these outfalls do not discharge continuously, and many, although still "active" in terms of permit status, have not discharged for many years (such as various mine pit dewatering discharges). The existing or predicted future hydrologic effects of these activities are briefly described below and summarized in Table 6.2.2-1. The average net hydrologic effect listed reflects the extent to which the listed activity impacts natural average annual flow in the Partridge River. For example, flooded pit overflows (without artificial management) are assumed to generally reflect natural flow contributions.

Table 6.2.2-1 Cumulative Effects on Partridge River and Colby Lake Hydrology by Activity

Activity	Average Net Hydrologic Effect (cfs)	Location of Effects	Timing	Magnitude	Future Duration
Northshore Mine	+2.6	Upper Partridge River and Colby Lake	Intermittent	Varies	>50 years ongoing
Northshore Mine Closure	0.0	Upper Partridge River and Colby lake	NA	NA	Beginning in 2070
City of Hoyt Lakes POTW	-0.1	Colby Lake	Continuous	Relatively consistent	Long-term ongoing
LTVSMC Pits	+1.7	Wyman Creek, Upper Partridge River and Colby Lake	Varies	Varies	Long-term ongoing
NorthMet Project Proposed Action Mine Site WWTF	+0.65	Upper Partridge River and Colby Lake	Continuous	Relatively consistent	Long-term
Mesabi Nugget	+5.6	Unknown	October to March	Relatively consistent	Ongoing
Mesabi Mining Project	Unknown	Second Creek and Lower Partridge River	Unknown	Unknown	Unknown
Mesabi Mining Site Existing Conditions	0.0	Second Creek and Lower Partridge River	NA	NA	NA
Minnesota Power Laskin Energy Center	-4.2	Colby Lake	Continuous	Relatively consistent	Long-term ongoing
NorthMet Project Proposed Action Plant Site WWTP	±0.1	Second Creek and Lower Partridge River	Continuous	Relatively consistent	Long-term

Sources: PolyMet 2015i; MPCA 2012m; MPCA 2012l; MPCA 2013j; MPCA 2013k; MPCA 2013h; MPCA 2014d; MPCA 2014e; MPCA 2014f.

- Northshore Mine – This is an open pit taconite mine. The mine consists of three mining areas, only one of which (water appropriation permit Area 003) discharges to the Partridge River Watershed. There are several permitted discharges from Area 003, but only two mine pit discharges and a crusher discharge, with a collective maximum water appropriation-permitted discharge to the Partridge River of 29 cfs, are active. Upper Partridge River flows are currently influenced by the timing and magnitude of Northshore Mine discharges from the Peter Mitchell Pit at SD-009, and would be influenced by the cessation of those discharges in approximately mine year 55.

  Available records show an average annual discharge to the Partridge River ranging from 6.8 to 15.1 cfs, with a highest reported monthly discharge of 34 cfs (Barr 2008f). Since 2004, the average annual daily discharge from the Northshore Mine has been approximately 5.8 cfs, but this rate is quite variable, ranging from zero (mostly during the winter and summer droughts) to as high as approximately 20 cfs.

However, monthly Peter Mitchell Pit pumping records for the Northshore Mine provide a poor estimate of actual contributions to the Upper Partridge River because the Northshore Mine does not discharge directly to the Partridge River. The Northshore Mine's actual contributions to the Partridge River are uncertain due to the variability of the Peter Mitchell pit pumping, complex storage and release mechanisms (e.g., wetlands, ponds, losses in the Partridge River, and ice storage), evapotranspiration, and seepage from the West Pond (see Figure 4.2.2-9). To address these uncertainties, the Co-lead Agencies relied on available sulfate and flow data to derive a continuous flow of 2.6 cfs from the Northshore Mine to use as the basis for water quality impact predictions in the FEIS (MDNR et al. 2014c). This estimated flow is reasonable for purposes of water quality impact predictions, and it is also reasonable to estimate cumulative effects to flow.

- Northshore Mine Closure – Following closure in year 2070 of the Northshore Mine, its discharge to the Partridge River Watershed would cease as the pit is allowed to flood with water. After the pit lake is flooded, the pit would discharge towards the Dunka River into the Rainy River Watershed, effectively removing the pit from the Partridge River Watershed. Discharge from the Northshore Mine to the Partridge River is expected to end in approximately 2070 (PolyMet 2015m).
- City of Hoyt Lakes POTW – The City of Hoyt Lakes is authorized to withdraw up to 2.3 cfs, but currently withdraws approximately 0.6 cfs of water from Colby Lake for municipal potable use, and discharges approximately 0.5 cfs of treated wastewater from its POTW to Whitewater Reservoir. Most of this water is returned to the Partridge River Watershed either via pumping during droughts to maintain water levels in Colby Lake or via seepage through its northwest dike to the Lower Partridge River. For purposes of this cumulative effects analysis, a consumptive loss of 0.1 cfs is assumed from the Partridge River Watershed.
- Mesabi Nugget, Pit 1 –This existing plant processes taconite concentrate into nuggets. It is not an active mine site. Wastewater from the plant is routed through a chemical precipitation unit and discharged into the west end of the Area 1 Pit. Water from the east end of the Area 1 Pit is then pumped to Outfall SD001 with ultimate discharge into Second Creek,This pit has seasonal (September to March) discharges to Second Creek that average approximately 5.6 cfs; no discharges occur from April to August.
- Mesabi Mining Project – This is a proposed project involving reactivation of a taconite mine and construction of a new taconite concentration facility. The iron ore concentrate would be used as feedstock for the Mesabi Nugget facility, with the remaining balance shipped by rail for use in other facilities. The project underwent some NEPA and MEPA review from 2009 to 2011, but that work is currently in suspension while the project is revaluated/redesigned. The water management strategy for this facility is still in the process of development, so the hydrologic effects of this action are unknown.

- Mesabi Mining Site Existing Conditions:
  - Pit 2WX: The pit is currently in the process of filling. Within a few years, this pit may overflow to an unnamed creek that discharges to the Partridge River just below Colby Lake.
  - Pit 6: This pit currently releases water to Second Creek via the surficial aquifer. There is no surface water discharge.
  - Pit 9S: This pit is currently stable (with likely groundwater discharge off site and/or to Pit 6).
  - Pit 9N: This pit is currently stable (with groundwater discharge to Pit 1 and the surficial aquifer).
- LTVSMC Pits (Cliffs Erie Pits) – These pits would influence the flow of the Upper Partridge River downstream of Wyman Creek's confluence with the Partridge River:
  - Pit 2/2E: This pit is stabilized with no direct discharge. There is likely groundwater flow from this pit to Pit 2W.
  - Pit 2W: There is no discharge from this pit.
  - Pit 3: This pit currently discharges to Wyman Creek, a tributary to the Upper Partridge River, at approximately 0.9 cfs.
  - Pit 5SW: This pit overflows to Wyman Creek via "dispersed" discharge, at an estimated rate of less than 0.8 cfs.
- Minnesota Power Laskin Energy Center – This is a coal-fired power plant that withdraws cooling water from Colby Lake. It discharges once-through, non-contact cooling water to the downstream portion of Colby Lake, but has a 4.2 cfs evaporative loss of water to the atmosphere. No changes to its current mode of operation are anticipated for the foreseeable future.
- NorthMet Project Proposed Action – The NorthMet Project Proposed Action would also influence future Partridge River flows through: 1) WWTF discharges starting in mine year 52; 2) a watershed reduction; 3) pit inflows during operations and reclamation; and 4) groundwater flowpath contributions from stockpiles and pits during operations, reclamation, and closure. The WWTF would discharge continuously at rate of 0.65 cfs. Watershed area reductions resulting from the NorthMet Project Proposed Action for SW-001, SW-002, SW-003, SW-004, and SW-004a range from 0 to 2.1 percent during closure and long-term maintenance, which translates to a reduction of 0.39 cfs below current and future flows at SW-004a. Pit inflows would reduce Partridge River flows by less than 2 cfs. Changes to groundwater flows are considered negligible. There would be a decrease in flows during operations (about mine year 12) when the rate of pit inflows would be the greatest. There would be an increase in flows during closure for about a 3-year period when the WWTF would be discharging to the Partridge River.

The south discharge from the Tailings Basin into Second Creek would be managed within ±20 percent of flows, estimated to be 0.5 cfs, prior to the installation of the containment system. The expected flows from the WWTP that would augment these flows are predicted to range between 0.4 and 0.6 cfs.

Upper Partridge River

The P50 average annual modeled flows were assessed for the 200-year simulation in the Partridge River at SW-004a. The NorthMet Project Proposed Action decreases flows by no more than 4 percent and increase by no more than 2 percent (See Section 5.2.2.3.2). This equates to a range of about +0.50 to –0.25 cfs. Figure 6.2.2-2 shows P10, P50, and P90 cumulative flowrates to capture the uncertainty in the hydrology. The decrease in flows would occur during operations. Downstream of SW-004a and upstream of Colby Lake, contributions from existing LTVSMC pits total approximately 11 cfs.

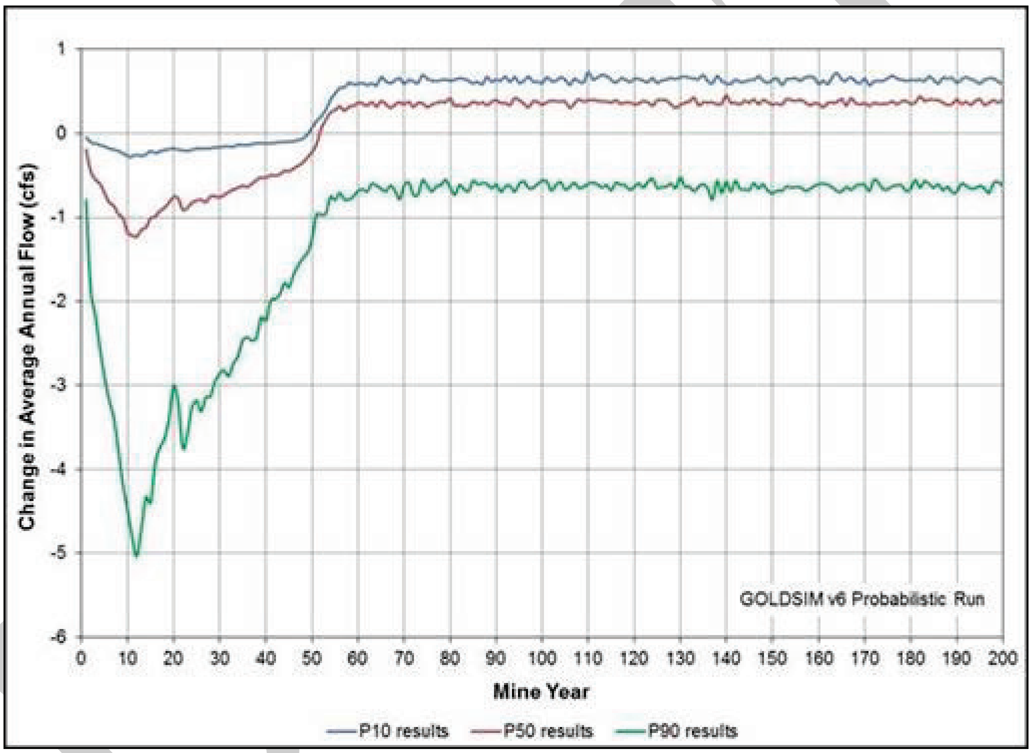

Figure 6.2.2-2 Change in Average Annual Stream Flow at SW-004a

Colby Lake

Cumulative hydrologic effects on Colby Lake would be influenced by activities identified in the Upper Partridge River identified above and three additional activities: 1) NorthMet Project Proposed Action pumping from Colby Lake in mine years 1 to 20, at an average rate of 1.7 cfs, for Plant Site operational needs; 2) Laskin Energy Center pumping from Colby Lake, at a rate of 4.2 cfs, to support its operations; and 3) City of Hoyt Lakes POTW pumping with a net effect of a 0.1 cfs decrease.

This recognized, Colby Lake water elevations are regulated and managed and this ultimately dictates flows from Colby Lake into the Lower Partridge River. Partridge River flows into Colby Lake during peak flow events are pumped to the Whitewater Reservoir, thereby mitigating potential increases in flows to the Lower Partridge River from this source. There is a minimum regulated water level threshold of 1,439 amsl on Colby Lake as required under MDNR Water Appropriation Permit 1949-0135. As this threshold is approached, water is diverted out of Whitewater Reservoir through set of gates to Colby Lake to increase water elevations in the lake and, with it, flow to the lower Partridge River. Due to Colby Lake's hydrologic relationship with the Whitewater Reservoir, as well as regulated management, no impacts to hydrology in Colby Lake are expected.

Lower Partridge River

Water would be discharged from SD-026 south of the Tailings Basin into Second Creek, a tributary to the Lower Partridge River. Flows from SD-026 would be augmented by the NorthMet Project Proposed Action to maintain flows that existed prior to the installation of the containment system. Due to this augmentation, discharges from SD-026 could deviate ±0.1 cfs from the baseline. This impact would be added to Mesabi Nugget's 5.6 cfs seasonal discharge increase and an unknown impact from the proposed Mesabi Mining Project.

6.2.2.3.2 Embarrass River

In general, flows in the Embarrass River have been affected to a minor extent by municipal water withdrawals and wastewater discharges, and, since the mid-1950s, by mining (e.g., seepage from the existing LTVSMC Tailings Basin). Most of these discharges are relatively continuous, although there can be wide variations in their magnitudes, most of which are attributable to precipitation trends. Larger discharges tend to coincide with either snow melt or large storm events when flows in the Embarrass River are typically high, thereby reducing the magnitude of these discharges. On the other hand, there can be less discharge during drier periods when river flows are lower. Including the NorthMet Project Proposed Action, there are seven past, present, and reasonably foreseeable future activities that could affect the hydrology of the Embarrass River. The existing or predicted future hydrologic effects of these activities are briefly described below and summarized in Table 6.2.2-2. The average net hydrologic effect listed reflects the extent to which the particular activity impacts natural average annual flow in the Embarrass River. For example, flooded pit overflows (without artificial management) are assumed to generally reflect natural flow contributions.

Table 6.2.2-2 Existing Cumulative Effects on Embarrass River Hydrology by Activity

Activity	Average Net Hydrologic Effect (cfs)	Location of Effects	Discharge Timing	Magnitude	Duration
City of Babbitt POTW	+0.1	Upper and Lower Embarrass River	Continuous	Relatively consistent	Long-term ongoing
LTVSMC Area 5NW Pit	+1.2	Upper and Lower Embarrass River	Continuous	Varies	Long-term ongoing
ArcelorMittal Laurentian Deposit	-5.1	Lower Embarrass River	Continuous	Varies	Ongoing until mid-2010s then ceasing
ArcelorMittal East Reserve Deposit	+9.3	Lower Embarrass River	Continuous	Varies	Ongoing until ~2025
City of Aurora POTW	-0.3	Lower Embarrass River	Continuous	Relatively consistent	Long-term ongoing
City of Biwabik POTW	0.0	Lower Embarrass River	Continuous	Relatively consistent	Long-term ongoing
NorthMet Project Proposed Action Plant Site WWTP	±1.0	Upper and Lower Embarrass River	Continuous	Relatively consistent	Long-term

Sources: PolyMet 2015i; MPCA2012i; MPCA 2012j; MPCA 2013g; MPCA 2013h; MPCA 2014c; MPCA 2014d.

- City of Babbitt POTW – The City of Babbitt uses several wells, some of which are in the Dunka River Watershed, as its water supply source, and discharges 0.33 cfs of treated wastewater effluent to the headwaters of the Embarrass River. Since some of this discharge is Dunka River Watershed water, it is estimated that the City of Babbitt provides an annual average net increase of 0.1 cfs to the Embarrass River.
- LTVSMC Pits (Cliffs Erie Pits) – Pit 5NW overflows to Spring Mine Creek, a tributary of the Embarrass River. This pit has an overflow discharge of approximately 1.2 cfs, but its flow varies with precipitation and has been measured as low as 0.23 cfs.
- NorthMet Project Proposed Action Plant Site – Tributaries extending north of the Tailings Basin would be augmented to maintain existing flows within ±20 percent. The effect of the NorthMet Project Proposed Action decreases with distance downstream, as can be seen at PM-13, where the maximum change in flow is an approximate 3 percent decrease in the annual average flow during operations, with a long-term closure decrease of less than 2 percent.
- ArcelorMittal Laurentian Deposit – This is a taconite mine that has been in operation since approximately 1993. The mine has three permitted dewatering discharges to an unnamed tributary of the Lower Embarrass River (immediately downstream of Esquagama Lake), but only one is actively used (SD-003). This mine is expected to close sometime in the late 2010s, at which time pit dewatering would stop, and flow to the Embarrass River would be reduced until the pit floods.

  Pit dewatering discharges averaged approximately 5.1 cfs annually between 2012 and 2014 (MPCA 2010a; MPCA 2011f; MPCA 2012i). Discharges were reasonably constant over the period, with most monthly values ranging between 4.5 and 6.0 cfs. Flows similar to these are expected until the mine closes, at which time pit dewatering and discharge to the Embarrass

River would stop. This would result in a net reduction in flow to the Embarrass River of approximately 5.0 cfs until the pit floods.

- ArcelorMittal East Reserve Deposit – This is an open-pit taconite mine, which began operations (East Reserve #1) in 2008. The second pit (East Reserve #2) is permitted and is expected to begin operations about the same time the Laurentian Mine closes.

  The first pit has a single permitted dewatering discharge (SD-005) to an unnamed tributary of the Lower Embarrass River (immediately downstream of Esquagama Lake). Pit dewatering discharges from East Reserve #1 averaged approximately 2.7 cfs from 2012 to 2014, but this discharge would likely gradually increase as the pit gets deeper. When discharging, the flow rate is constant, but currently there are several months of the year (primarily in winter) when no discharge occurs. At some yet-to-be-determined point, East Reserve #2 would be opened and pit dewatering would begin through a second permitted discharge (SD-006). The East Reserve Deposit (Pit 1 and Pit 2) would have a combined permitted discharge to the Lower Embarrass River of up to 9.3 cfs, though the actual discharge would likely vary seasonally, and as the mines are developed, at a rate somewhat lower than that. As with the Laurentian Mine, it is important to note that a substantial portion of the permitted discharge replaces natural runoff that is captured by the pit watershed.

- City of Aurora POTW – The City of Aurora withdraws approximately 0.32 cfs from the St. James Pit, a former natural ore pit within the Embarrass River Watershed, and discharges approximately 0.31 cfs of treated wastewater to Silver Creek, which drains to the St. Louis River. Therefore, this withdrawal represents a loss of water from the Embarrass River Watershed of 0.32 cfs.

- City of Biwabik POTW – The City of Biwabik withdraws approximately 0.25 cfs from the Canton Pit for municipal water supply and discharges treated wastewater to a tributary of Embarrass Lake at approximately the same rate. There is effectively no net loss of water associated with the City's water usage.

The net effect of these hydrologic changes would be an approximately 5.2 cfs increase in flow, plus about a 2.6 cfs (operations) to 1.6 cfs (closure) reduction as a result of the NorthMet Project Proposed Action, for a total increase in flow of between 7.8 and 3.6 cfs at the confluence with the St. Louis River, or about 7 percent of average annual flow (assuming an average annual flow of about 117 cfs for a 180.8 square mile watershed with an average annual flow of 0.65 cfs per square mile based on flow at the McKinley gage).

6.2.2.4 Cumulative Effects on Surface Water Quality

This section discusses cumulative effects on water quality for the Partridge River and the Embarrass River.

6.2.2.4.1 Partridge River

Water quality in the Partridge River has been affected by discharges from the Northshore Mine, discharges/overflows from several former LTVSMC pits, and two permitted discharges from Minnesota Power's Laskin Energy Center for decades. As mentioned in Section 5.2.2, the NorthMet Project Proposed Action does not propose any surface water discharges (other than flow augmentation to Second Creek) until the West Pit overflows and the WWTF begins discharging around year 52. However, non-contact stormwater runoff, unrecoverable groundwater seepage from the five groundwater flowpaths (i.e., from the waste rock stockpiles, pits, Ore Surge Pile, WWTF, and Overburden Storage and Laydown Area), and the WWTF discharge would all serve as potential contaminant sources. Stormwater from undisturbed areas of the proposed Mine Site would be similar in chemistry to current runoff from the proposed Mine Site area. The WWTF discharge would be permitted under the NPDES permitting program.

The NorthMet Project Proposed Action is predicted to meet or not cause or contribute to an exceedance of all surface water quality evaluation criteria at all evaluation locations within the Partridge River watershed for the entire 200-year modeling period. Consequently, the additional potential cumulative environmental impacts resulting from the NorthMet Project Proposed Action would be minimal. The scope of cumulative impacts analysis is therefore focused on parameters with a potential to bioaccumulate in or adversely impact wild rice, an important cultural resource. As a result, the cumulative effects analysis focuses on sulfate (because of its relationship with mercury methylation and wild rice) and mercury (because it is the only parameter on the Partridge River 303(d) list). Mercury is only discussed from a water quality perspective; the potential cumulative effects of the NorthMet Project Proposed Action on the bioaccumulation of methylmercury in fish are discussed in Section 6.2.6.3.3.

Sulfate

Sulfate is a concern along the Partridge River because of the presence of waters supporting the production of wild rice immediately downstream of the NorthMet Project area (including evaluation locations SW-005 and SW-006 immediately above Colby Lake and the portion of the river below Colby Lake). According to available surface water monitoring data, including sulfate sampling conducted as part of recent wild rice field surveys (Barr 2009b, 2011a, 2012a, and 2013m), sulfate concentrations in the Upper Partridge River range from 0.5 to 21 mg/L, which are slightly elevated relative to baseline conditions, assumed to be similar to values in the South Branch of the Partridge River reported in the 1970s (average of 5.2 mg/L). Sampling in Colby Lake found a range of concentrations between 37 and 42 mg/L. Downstream of Colby Lake, sulfate concentrations increase. Pit 1 water is discharged October through March with a daily average flow of 7.4 cfs and an average sulfate concentration of 478 mg/L (MPCA 2015). Pit 2WX, Pit 6, Pit 9, and Pit 9s are not currently discharging water. Average sulfate concentrations in the Partridge River in 2013 were 71.3 mg/L at station S005-752, which is just downstream of the confluence with Second Creek at the County Road 110 Bridge. The wild rice surveys found sulfate concentrations as high as 1,100 mg/L in Second Creek.

The baseline sulfate concentrations found in the Partridge River reflect the effects of discharges from existing activities within the watershed. Table 6.2.2-3 summarizes the relative sulfate load contributions from the various identified activities in the watershed. In terms of historic increases in Lower Partridge River sulfate concentration, three important existing loads of sulfate to the Lower Partridge River include the Mesabi Nugget operation, the previous SD-026 seep from the existing LTVSMC Tailings Basin, and the Mesabi Mining Pit 6 seepage, all entering Lower Partridge River via Second Creek.

Table 6.2.2-3 Cumulative Sulfate Loadings to the Partridge River by Activity

Activity	Average Discharge/ Release Rate (cfs)	Representative Sulfate Concentration (mg/L)	Average Sulfate Load (kg/d)
Northshore Mine Operations	2.6	28	178
Northshore Mine Closure	0.0	NA	NA
City of Hoyt Lakes POTW	0.4	~0 (1)	~0
Mesabi Nugget	5.6 (7 mo.)	473	6,480
Mesabi Mining Site Existing Conditions	0.0	0.0	0.0
Mesabi Mining Project	unknown	unknown	unknown
Laskin Energy Center	-4.2	No change in loading	No addition to ambient load
Cliffs Erie Pits 2E/2W	0.0	0.0	0.0
Cliffs Erie Pit 3	0.9	74	163
Cliffs Erie Pit 5SW	0.8	85	166
NorthMet Project Proposed Action Plant Site WWTP	5.4 (operations) 4.3 (closure)	10	132 (operations 105 (closure)
NorthMet Project Proposed Action Plant Site WWTF	0.65	9	14.3

Sources: PolyMet 2015i; PolyMet 2015r; MPCA 2012m; MPCA 2013h; MPCA 2014d; MPCA 2012l; MPCA 2013k; MPCA 2014e; MPCA 2013j; MPCA 2014f; USDOE and MDC 2009, Table 5.3-4; MDNR et al. 2014c) .

The NorthMet Project Proposed Action sulfate concentration is modeled to increase by 0.1 mg/L but is not predicted to cause or contribute to an exceedance of the evaluation criterion. Therefore, the NorthMet Project Proposed Action should not adversely affect downstream waters that support the production of wild rice. The potential cumulative effect of sulfate on mercury methylation in the Partridge River Watershed is discussed below.

Mercury

Based on sampling in studies done for PolyMet, it is estimated that current total mercury concentrations average about 3.3 ng/L in the Upper Partridge River (Barr 2011a) and between 4.6 and 8.7 ng/L in Colby Lake.

Details of the effect of the NorthMet Project Proposed Action on mercury deposition impacts and mercury concentrations are discussed in Section 5.2.7. Table 6.2.2-4 summarizes the relative mercury contributions from the various identified activities in the watershed. Research has found that taconite tailings are effective in sequestering mercury from seepage. Analog data from natural lakes and mine pit lakes in northeastern Minnesota suggest that mercury concentrations generally remain below the 1.3 ng/L standard, despite precipitation averaging approximately 13 ng/L mercury. Mercury in surface waters undergoes transformations when exposed to sunlight, which can limit its concentration in lakes. For example, methylmercury degrades to soluble oxidized mercury in sunlight, which in turn degrades to elemental mercury, which volatilizes from lakes. Further, much of the mercury in lakes associates with particulate matter, which often settles to the bottom.

The NorthMet Project Proposed Action is predicted to result in a net decrease in mercury loadings to the Partridge River from 24.2 grams per year to 23.0 grams per year. This would primarily be a result of a decrease in natural runoff (with a total mercury concentration of 3.6 ng/L) and a proportional increase in water discharged from the West Pit via the WWTF (with a total mercury concentration of 1.3 ng/L). As discussed above, sulfate concentrations and loadings from the NorthMet Project Proposed Action to the Partridge River are predicted to remain about the same as existing conditions, so the NorthMet Project Proposed Action would not be contributing additional sulfate that could promote mercury methylation. Therefore, the NorthMet Project Proposed Action would not contribute to cumulative effects on mercury loading in the Partridge River.

Table 6.2.2-4 Cumulative Mercury Loadings to the Partridge River by Activity

Activity	**Average Discharge/ Release Rate (cfs)**	**Representative Mercury Concentration (ng/L)**	**Average Mercury Load (kg/d)**
Northshore Mine Operations	2.6	0.7	4.5E-06
Northshore Mine in Closure	0.0	0.0	0.0
City of Hoyt Lakes POTW	0.4	7.7	7.5E-06
Mesabi Nugget	5.6	0.6	8.2E-06
Mesabi Mining Site Existing Conditions	0.0	0.0	0.0
Mesabi Mining Project	unknown	unknown	unknown
Laskin Energy Center	-4.2	No change in loading	0.0
Cliffs Erie Pits 2E/2W	0.0	0.0	0.0
Cliffs Erie Pit 3	0.9	0.55	1.2E-06
Cliffs Erie Pit 5SW	0.8	0.55	1.1E-06
NorthMet Project Proposed Action Plant Site WWTP	5.4 (operations) 4.3 (closure)	1.0–1.3	1.3E-05 to 1.7E-05 (operations) 1.1E-05 to 1.4E-05 (closure)
NorthMet Project Proposed Action Mine Site WWTF (closure)	0.65	1.0–1.3	1.6E-06 to 2.1E-06

Sources: PolyMet 2015i; PolyMet 2015r; MPCA 2014b; Clark, MPCA, Pers. Comm., March 24, 2015; MPCA 2012i; MPCA 2012j; MPCA 2012k; MPCA 2013g; MPCA 2013h; MPCA 2013j; MPCA 2014c; MPCA 2014d; MPCA 2014e; MPCA 2014f; (MDNR et al. 2014c).

6.2.2.4.2 Embarrass River

Section 5.2.2.3.3 contains a detailed discussion of modeled water quality changes in the Embarrass River at PM-13. The NorthMet Project Proposed Action is predicted to meet or not cause or contribute to an exceedance of all surface water quality evaluation criteria at all evaluation locations within the Embarrass River watershed for the entire 500-year modeling period. Consequently, the additional potential cumulative environmental effects resulting from the NorthMet Project Proposed Action are expected to be less than significant.

The placement of the Embarrass River headwaters and Spring Mine Creek on the MPCA 2012 Impaired Waters list indicates that aquatic biota are already under stress in this system (MPCA

2012n). Although stressors have not been identified, the water quality change predicted under the NorthMet Project Proposed Action would have potential to add to these stressors. Therefore, this cumulative effects analysis focuses on sulfate (because of its relationship with mercury methylation and wild rice) and mercury (because it is the only parameter on the 303(d) list). Mercury is only discussed here from a water quality perspective; the potential cumulative effects of the NorthMet Project Proposed Action on the bioaccumulation of methylmercury in fish are discussed in Section 6.2.6.3.3.

Sulfate

Sulfate is a concern within the Embarrass River because of the presence of waters supporting the production of wild rice downstream of PM-13. Present sulfate concentrations in the Embarrass River downstream of the NorthMet Project area are elevated well above natural background levels and currently exceed the wild rice sulfate standard of 10 mg/L. Median sulfate concentration at PM-12, upstream of any historic mining activity, is about 7.2 mg/L compared to a median of about 39.4 mg/L at PM-13. This increase in sulfate concentrations is primarily attributable to the Pit 5NW overflow (average discharge at SD-033 of 1.2 cfs and sulfate concentration of 1,088 mg/L) and seepage from the existing LTVSMC Tailings Basin (average surface and groundwater seepage of 5.7 cfs and a range of mean sulfate concentrations from 109 to 185 mg/L). The combined effects of the Tailings Basin containment system and stream augmentation would reduce the predicted P90 sulfate concentration (see Section 5.2.2.1.3) at PM-13 by about 50 percent relative to the CEC scenario model results.

Considering cumulative downstream effects, the Embarrass chain of seven lakes tend to attenuate the sulfate concentrations by dilution and biological uptake, with concentrations gradually declining in a downstream direction from 21.3 mg/L in Embarrass Lake to 17.1 mg/L at the outlet from Esquagama Lake.

The existing sulfate concentrations in the Embarrass River reflect the effects of discharges from existing activities within the watershed. Table 6.2.2-5 summarizes the relative sulfate load contributions from the various identified activities in the watershed.

Table 6.2.2-5 Cumulative Sulfate Loadings to the Embarrass River by Activity

Activity	Average Discharge/ Release Rate (cfs)	Representative Sulfate Concentration (mg/L)	Average Sulfate Load (kg/d)
City of Babbitt POTW	0.1	37.4	9.1
LTVSMC Area 5NW Pit	1.2	1,088	3,194
ArcelorMittal Mine (Laurentian and East Reserve Mine)	9.3	186	4,232
City of Aurora POTW	0.3[1]	NA	NA
City of Biwabik POTW	0.0	0.0	0.0
NorthMet Project Proposed Action Plant Site WWTP	5.4 (operations) 4.3 (closure)	10.0	132 (operations) 105 (closure)

Sources: MPCA 2012d; PolyMet 2014w; Clark, MPCA, Pers. Comm., April 29, 2013; MPCA2012i; MPCA 2013g; MPCA 2014c; PolyMet 2015i; MPCA 2012j; MPCA 2013h; MPCA 2014d.

Note:
[1] Discharge is to the St. Louis River.

The NorthMet Project Proposed Action would reduce the sulfate load from the existing LTVSMC Tailings Basin as a result of the containment of tailings seepage by the containment system and subsequent treatment via the WWTP before discharge as part of the tributary stream flow augmentation. This NorthMet Project Proposed Action would result in a greater than 40 percent overall reduction in sulfate loading at PM-13 and would have a positive effect on reducing the sulfate concentration in the Embarrass River downstream of PM-13 (where wild rice is present), the chain of lakes, and the Lower Embarrass River.

Mercury

The Embarrass River is not on the 303(d) list of impaired waters for mercury impairment; however, several lakes downstream of the NorthMet Project Proposed Action along the Embarrass River are listed for "mercury in fish tissue" impairment, including Sabin, Wynne, Embarrass, and Esquagama lakes. These lakes are not covered by the statewide mercury TMDL, but are impaired waters and in need of a TMDL pollution reduction study. These waters are not included in Minnesota's regional mercury TMDL because the mercury concentrations in fish are too high to be returned to Minnesota's mercury water quality standard through reductions in mercury emissions from Minnesota sources alone. Based on limited sampling in studies done for PolyMet, it is estimated that total mercury concentrations in the Embarrass River averaged 4.8 ng/L at monitoring station PM-12 and 4.0 ng/L at monitoring station PM-13 from 2004 to 2013. Methylmercury concentrations in the Embarrass River averaged 0.5 ng/L at PM-12 and 0.4 ng/L at PM-13 over the same period (see Section 4.2.2.1.4). The overall average total mercury concentration at two discharge locations at the existing LTVSMC Tailings Basin (SD-026 and SD-004) over a 5-year period was 1.0 ng/L, indicating relatively low mercury concentrations in the seepage from this basin. All monitoring results were well below average concentrations in precipitation (approximately 13 ng/L), suggesting that some mercury appears to be sequestered in the existing LTVSMC tailings.

As discussed in Section 5.2.2.3.4, mercury would be released from the Tailings Basin via seepage, discharge from the WWTP, and volatilization from the Tailings Basin pond. As with the Mine Site, analog data and simple mass balance model estimation methods were used to estimate future mercury concentrations. Table 6.2.2-6 summarizes the relative mercury contributions from the various identified activities in the watershed. As discussed in Section 5.2.2.3.4 and above, research indicates that mining itself is not expected to appreciably affect total mercury discharges; rather, the greater concern is the potential for sulfate discharges/releases to promote mercury methylation.

Table 6.2.2-6 Cumulative Mercury Loadings to the Embarrass River by Activity

Activity	Average Discharge/ Release Rate (cfs)	Representative Mercury Concentration (ng/L)	Average Total Mercury Load (kg/d)
City of Babbitt POTW	0.1	2.6	6.4E-07
Cliffs Erie Area 5 NW Pit	1.2	0.93	2.7E-06
City of Aurora POTW	0.3[1]	NA	NA
City of Biwabik POTW	0.0	0.0	0.0
ArcelorMittal Mines (Laurentian and East Reserve Mine)	9.3	1.6	3.6E-05
NorthMet Project Proposed Action Plant Site WWTP	5.4 (operations) 4.3 (closure)	1.0–1.3	1.3E-05 to 1.7E-05 (operations) 1.1E-05 to 1.4E-05 (closure)

Sources: MPCA 2014b; PolyMet 2014w; PolyMet 2015i; MPCA2012i; MPCA 2013g; MPCA 2014c; MPCA 2012j; MPCA 2013h; MPCA 2014d.

Note:
1 Discharge is to the St. Louis River.

The NorthMet Project Proposed Action is predicted to result in a net increase in mercury loadings to the Embarrass River of up to 0.2 grams per year (from 22.3 grams per year to 22.5 grams per year), which represents about a 1 percent increase. This increase is primarily attributable to the redirection of surface runoff diverted via the drainage swale constructed east of the Tailings Dam East Dam directly to Mud Lake Creek at an assumed mercury concentration of 3.5 ng/L (versus a seepage concentration of 1.0 ng/L). The Tailings Basin Containment System, which collects seepage from the Tailings Basin, with an estimated mercury concentration of 1.0 ng/L, routes it to the WWTP, which discharges with an assumed mercury concentration of 1.3 ng/L, which is considered conservative in that the WWTP and the greensand filter are expected to remove some mercury from effluent.

Overall, the NorthMet Project Proposed Action is predicted to result in a net decrease of mercury-loadings of approximately 1.0 grams per year (i.e., a net decrease of 1.2 grams per year in the Partridge River and a net increase of 0.2 grams per year in the Embarrass River), which is too small to distinguish from natural background variability using available laboratory methods. Therefore, the NorthMet Project Proposed Action would not contribute to cumulative effects on mercury loading to the St. Louis River.

6.2.3 Wetlands

The cumulative effects analysis for wetlands included both a quantitative analysis as well as a qualitative analysis for determining cumulative effects to wetlands. An analysis was done to determine cumulative effects of direct impacts from all past, present, and reasonably foreseeable future projects to wetlands, lakes, and deepwater resources (i.e., mine pits) located in the Partridge River and Embarrass River watersheds (PolyMet 2015b). Three time periods were used in the effects analysis, including pre-settlement, existing, and the foreseeable future. In addition, a qualitative analysis was done 1) to assess the potential cumulative wetland indirect effects (Section 6.2.3.4.4) and 2) for cumulative wetland effects for the St. Louis River below the ordinary high water mark from its confluence with the Embarrass River to Lake Superior (Section 6.2.3.4.5). A qualitative assessment of the potential impacts of climate change on wetlands is discussed in Section 5.2.7.2.4 and 6.2.7.

6.2.3.1 Approach

An estimate of pre-settlement wetland, lake, and deepwater (i.e., mine pits) acreages within the Partridge River and Embarrass River watersheds was developed using the USFWS NWI maps and the original survey maps developed using data from the original General Land Office surveys (PolyMet 2015b).

Existing wetland, lake, and deepwater resources were estimated using wetland delineations completed in the area, NWI maps, USGS National Hydrograph Dataset (to estimate lacustrine waterbodies), and MDNR Mesabi Mining features in combination with 2010 LiDAR data and aerial photographs from 2003, 2008, 2009, and 2010 to estimate deepwater or mine pit waterbodies (PolyMet 2015b).

Federal, state, and local agencies were contacted to identify foreseeable future actions within the Partridge River and Embarrass River watersheds. Agency officials were asked to identify actual or potential development projects that may occur in these two watersheds during the life of the NorthMet Project Proposed Action. The projects and their proposed mitigation for this assessment are provided below (PolyMet 2015b):

- The NorthMet Project Proposed Action, located in the Embarrass and Partridge River watersheds, would directly affect 913.8 acres of wetlands located within the NorthMet Project area over the next 20 years (see Table 6.2.3-1). Approximately 321 acres of deepwater habitat is planned at the Mine Site at the conclusion of the NorthMet Project Proposed Action.
- The proposed Mesabi Mining Project, located in the Partridge River Watershed, has identified the potential for approximately 267 acres of direct wetland impact over the life of the project (see Table 6.2.3-1). Approximately 1,601 acres of deepwater habitat is planned at the conclusion of the project, resulting in an increase of 49 acres from existing 1,552 acres of deepwater habitat (see Table 6.2.3-1).
- The ArcelorMittal Deposit East Reserve Project, located in the Embarrass River Watershed, has identified the potential for 116.2 acres of direct wetland impact over the life of the project (see Table 6.2-3-1). Through 2014 there have been 67.1 acres of direct wetland impacts, which have been accounted for under present conditions. Therefore, potential future

wetland impacts of 49.1 acres would still be anticipated over the life of the project (see Table 6.2.3-1). Approximately 275 acres of deepwater habitat is planned at the conclusion of the project, resulting in an increase of 275 acres from the existing zero acres of deepwater habitat.

- The ArcelorMittal Deposit Push Back Project, located in the Embarrass River Watershed, has identified the potential for approximately 23 acres of direct wetland impact over the life of the project (see Table 6.2.3-1). Approximately 107 acres of deepwater habitat may develop at the conclusion of the project, resulting in an increase of 107 acres from the existing zero acres of deepwater habitat.
- The Mining Resources Austin Powder Project, located in the Embarrass River Watershed, has identified the potential for 3.4 acres of direct wetland impact over the life of the project (see Table 6.2.3-1). No deepwater habitat is planned at the conclusion of the project.
- The Mining Resources Corsica Basin Project, located in the Embarrass River Watershed, has identified the potential for approximately 50 acres of direct wetland impact over the life of the project (see Table 6.2.3-1). No deepwater habitat is planned at the conclusion of the project.
- The Laskin Energy Park is located in the Partridge River Watershed and south of the Minnesota Power Laskin Energy Center (see Table 6.2.3-1). It is located adjacent to Colby and Whitewater Lakes, near the City of Hoyt Lakes. If every lot in the 220-acre industrial park was fully developed, the potential direct wetland impacts could range from zero to seven acres. The amount of wetland mitigation that may be conducted in the Partridge River Watershed is unknown at this time.
- St. Louis County Public Works are planning eight bridge replacements in the Partridge River and Embarrass River watersheds over the next 10 years. These bridge replacements generally directly impact 10,000 ft^2 of wetlands or less, so the maximum direct wetland impact from the bridge projects would be about 1.8 acres (see Table 6.2.3-1).

Table 6.2.3-1 below summarizes the direct wetland effects, proposed wetland mitigation, and the existing and future deepwater habitat, as well as the proposed net change for wetlands and deepwater habitat that would occur from the foreseeable future actions that were identified within the wetland CEAA. Tables 6.2.3-2 and 6.2.3-3 summarize the overall wetland and water resources found during the pre-settlement condition time period and that currently exist within the CEAA. Tables 6.2.3-4 and 6.2.3-5 summarize the overall wetland and water resources that would be expected future conditions within the CEAA when taking into account the projects that were assessed within the CEAA direct wetland effects and future deepwater habitat as presented in Table 6.2.3-1.

Table 6.2.3-1 Future Conditions for Wetland and Deepwater Habitat Resources for the Foreseeable Future Actions within the Partridge River and Embarrass River Watersheds

Project Name	Wetland Impact (acres)	Proposed Wetland Mitigation (acres)	Net Change in Wetlands (acres)	Existing Deepwater Habitat (acres)	Future Deepwater Habitat (acres)	Net Change in Deepwater (acres)
Partridge River Watershed[1]						
NorthMet Project Proposed Action	-767.6	0.0	-767.6	0.0	321.0	321.0
Mesabi Mining Project	-266.8	0.0	-266.8	1,552.0	1,601.0	49.0
Laskin Energy Park - worst case scenario	-6.8	0.0	-6.8	0.0	0.0	0.0
St. Louis County Public Works Bridge Replacements	-0.9	0.0	-0.9	0.0	0.0	0.0
Total - Partridge River Watershed with Project	**-1,042.1**	**0.0**	**-1042.1**	**1,552.0**	**1,922.0**	**370.0**
Total - Partridge River Watershed without Project	**-274.5**	**0.0**	**-274.5**	**1,552.0**	**1,601.0**	**49.0**
Embarrass River Watershed[1]						
NorthMet Project Proposed Action	-146.2	0.0	-146.2	0.0	0.0	0.0
NorthMet Project Proposed Action	-28.6[2]	NA[2]	-28.6	0.0	0.0	0.0
St. Louis County Public Works Bridge Replacements	-0.9	0.0	-0.9	0.0	0.0	0.0
ArcelorMittal East Reserve	-49.1	0.0	-49.1	0.0	275	275
ArcelorMittal Pushback	-23.5	0.0	-23.5	0.0	107	107
Mining Resources – Powder Basin (Biwabik)	-3.4	0.0	-3.4	0.0	0.0	0.0
Mining Resources – McKinley	-50.1	0.0	-50.1	0.0	0.0	0.0
Total - Embarrass River Watershed with Project	**-301.8**	**0.0**	**-301.8**	**0.0**	**382**	**382**
Total - Embarrass River Watershed without Project	**-127.0**	**0.0**	**-127.0**	**0.0**	**382**	**382**

Source: PolyMet 2015b.

Notes:
[1] The (-) represents a loss of water resources acres and the (+) represents a gain of water resources acres.
[2] These wetlands as exempt because the wetlands are located within the LTVSMC Permit to Mine Ultimate Tailings Basin Limit boundary and are not regulated by state and federal wetland regulations (see Section 5.2.3).

To estimate the future projected wetland, lake, and deepwater resource effects from the NorthMet Project Proposed Action, the Mesabi Mining Project, the Laskin Energy Park project, and the St. Louis County bridge replacement, the maximum effect acreages were used to calculate total acreages. The projected foreseeable future conditions were estimated by calculating the net change in wetlands, lakes, and deepwater resources (see Table 6.2.3-1) and then adding this future projected development of wetland, lake, and deepwater resources to the existing resource totals (PolyMet 2015b).

6.2.3.2 Cumulative Effects Assessment Area

6.2.3.2.1 Spatial

The Partridge River and Embarrass River watersheds were used as the spatial boundary for wetland cumulative effects, as these are the only watersheds in which proposed direct and indirect wetland effects would occur. A qualitative analysis of cumulative wetland effects for the St. Louis River below the ordinary high water mark from its confluence with the Embarrass River to Lake Superior was also evaluated based on a qualitative estimate of flow changes in the river.

6.2.3.2.2 Temporal

The pre-settlement condition time period represents wetland, lake, and deepwater resources as they existed prior to mining and urban development in the late 1800s to early 1900s. The existing conditions time period represents those resources as they exist today, prior to the development of the NorthMet Project Proposed Action. The future conditions time period represents wetland, lake, and deepwater resources expected to be present following the conclusion and long-term closure of the NorthMet Project Proposed Action. It was assumed that the future conditions represent the time period after the conclusion of the future projects when the mine pits would have flooded with water (PolyMet 2015b).

6.2.3.3 Cumulative Actions

This assessment included physical cumulative effects on wetland, lake, and deepwater resources associated with the current and foreseeable mining actions listed below (PolyMet 2015b). The following reasonably foreseeable cumulative actions were included in the cumulative effects assessment for wetlands:

- ArcelorMittal East Reserve Project;
- ArcelorMittal Deposits Push Back;
- LTV Steel Mining Company Former LTVSMC Pits;
- Laskin Energy Park;
- Mesabi Mining Project;
- Mesabi Nugget;
- Mining Resources Austin Powder Basin Project;
- Mining Resources Corsica Basin Project;
- Minnesota Power Laskin Energy Center;
- Northshore Mine;
- Northshore Closure; and
- St. Louis County Public Works Bridge Replacements.

6.2.3.4 Cumulative Effects Assessment

6.2.3.4.1 Pre-settlement Wetland and Water Resources

A relationship (ratio) was developed between the NWI mapping and pre-settlement mapping of wetland, lake, and deepwater resources to serve as an adjustment factor. This factor converted the original survey data to the standards of the NWI data for estimating the pre-settlement wetland, lake, and deepwater resources within disturbed areas of each watershed.

<u>Partridge River Watershed</u>

Using the disturbance at the township level (0.2 percent in the entire township and 0.4 percent for the portion within the watershed), the ratio of NWI to pre-settlement wetlands, lakes, and deepwater resources was calculated to be 1.21 for the least-disturbed township in the Partridge River Watershed. This ratio indicates there were approximately 21 percent more wetlands, lakes, and deepwater resources identified on the NWI maps than on the pre-settlement maps for the Partridge River Watershed (PolyMet 2015b).

Disturbance in the townships located within the Partridge River Watershed ranged between 0.4 and 52 percent, with approximately 15 percent of the entire Partridge River Watershed containing substantial human disturbance since settlement of the area. The disturbance types in the watershed consisted of: mining features such as stockpiles, mine pits, roads, and other infrastructure (82 percent of the disturbed areas); municipal/residential development (e.g., cities of Aurora and Hoyt Lakes) with some barren land and cultivated crops (13 percent of the disturbed areas); and roads and railroads (5 percent of the disturbed areas). Approximately 85 percent of the Partridge River Watershed was deemed to be relatively undisturbed; therefore, NWI mapping was used in these areas to represent pre-settlement conditions for wetlands, lakes, and deepwater resources (PolyMet 2015b).

Based on the original survey maps, approximately 2,991 acres of wetland were mapped within the disturbed areas in the Partridge River Watershed. This wetland acreage was adjusted to 3,620 acres using the 1.21 adjustment factor. After accounting for the disturbed areas, a total of 33,601 acres of wetlands was identified in the 101,812-acre watershed, comprising 33 percent of the watershed (see Table 6.2.3-2).

Based on the original survey maps, 24 acres of lake were mapped within the disturbed areas in the Partridge River Watershed. This lake acreage was adjusted to 29 acres using the 1.21 adjustment factor. After accounting for the disturbed areas, a total of 2,688 acres of lake was identified in the 101,812-acre watershed, comprising 3 percent of the watershed (see Table 6.2.3-2).

No deepwater resources were identified in the watershed for the pre-settlement conditions (see Table 6.2.3-2)

Table 6.2.3-2 Pre-settlement Wetland and Water Resources by Watershed

Watershed	Total Land Area (Acres)	Wetland Area		Lake Area		Deepwater Area	
		Acres	% of Watershed	Acres	% of Watershed	Acres	% of Watershed
Partridge River	101,812	33,601	33	2,688	3	0	0
Embarrass River	116,797	34,650	30	3,121	3	0	0

Source: PolyMet 2015b.

<u>Embarrass River Watershed</u>

Using the disturbance at the township level (0.6 percent in the entire township and 0.7 percent for the portion contained within the watershed), the ratio of NWI to original survey wetlands, lakes, and deepwater resources was calculated to be 0.85 for the least-disturbed township in the Embarrass River Watershed. Based on this analysis, the ratio of NWI to original survey wetlands, lakes, and deepwater resources was calculated to be approximately 15 percent fewer wetlands, lakes, and deepwater resources identified on the NWI maps than the original survey maps for the Embarrass River Watershed (PolyMet 2015b).

Disturbance in the portions of townships located within the Embarrass River Watershed range between 0.7 percent and 63 percent, with approximately 12 percent of the entire Embarrass River Watershed containing substantial human disturbance since settlement of the area. The disturbance types in the watershed consisted of: mining features including stockpiles, mine pits, roads, and other infrastructure (61 percent of the disturbed areas); municipal/residential development (e.g., cities of Babbitt, Biwabik, Gilbert, and McKinley) with some barren land and cultivated crops (27 percent of the disturbed areas); and roads and railroads (12 percent of the disturbed areas). Approximately 88 percent of the Embarrass River Watershed was deemed to be relatively undisturbed; therefore, NWI mapping was used in these areas to represent pre-settlement conditions for wetlands, lakes, and deepwater resources (PolyMet 2015b).

Based on the original survey maps, approximately 2,388 acres of wetland were mapped within the disturbed areas of the Embarrass River Watershed. This wetland acreage was adjusted to 2,030 acres using the 0.85 adjustment factor. After accounting for the disturbed areas, a total of 34,650 acres of wetlands was identified in the 116,797-acre Embarrass River Watershed, comprising approximately 30 percent of the watershed (see Table 6.2.3-2).

Based on the original survey maps, 224 acres of lake were mapped within the disturbed areas in the Embarrass River Watershed. This lake acreage was adjusted to 190 acres using the 0.85 adjustment factor. After accounting for the disturbed areas, a total of 3,121 acres of lakes was identified in the 116,797-acre watershed, comprising less than 3 percent of the watershed (see Table 6.2.3-2).

No deepwater resources (i.e., mine pits) were identified in the watershed for the pre-settlement conditions (see Table 6.2.3-2).

6.2.3.4.2 Existing Wetland and Water Resources

Partridge River Watershed

A total of 31,318 acres of existing wetlands was identified in the 101,812-acre watershed, comprising 31 percent of the land area (see Table 6.2.3-3). There has been a decrease of approximately 2,283 acres of wetland; this represents a 7 percent reduction in wetland area compared to pre-settlement conditions (PolyMet 2015b).

A total of 3,194 acres of lakes was identified in the 101,812-acre watershed, comprising 3 percent of the land area (see Table 6.2.3-3). There has been an increase of approximately 506 acres of lakes; this represents a 19 percent increase in lake area compared to pre-settlement conditions (PolyMet 2015b).

A total of 3,146 acres of deepwater resources (i.e., mine pits) was identified in the 101,812-acre watershed, comprising 3 percent of the land area (see Table 6.2.3-3). There has been an increase of 3,146 acres of deepwater resources in the watershed compared to no deepwater resources present under pre-settlement conditions (PolyMet 2015b).

The change in wetland, lake, and deepwater acreage has resulted primarily from mining projects, development of municipalities, and construction of transportation infrastructure such as roads and railroads.

Table 6.2.3-3 Existing Wetland and Water Resources by Watershed

Watershed	Total Land Area (Acres)	Wetland Area		Lake Area		Deepwater Area	
		Acres	% of Watershed	Acres	% of Watershed	Acres	% of Watershed
Partridge River	101,812	31,318	31	3,194	3	3,146	3
Embarrass River	116,797	34,249	29	2,904	3	977	1

Source: PolyMet 2015b.

Embarrass River Watershed

A total of 34,249 acres of existing wetlands was identified in the 116,797-acre watershed, comprising 29 percent of the land area (see Table 6.2.3-3). There has been a decrease of approximately 401 acres of wetlands; this represents a 1 percent reduction in wetland area compared to pre-settlement conditions (PolyMet 2015b).

A total of 2,904 acres of lakes was identified in the 116,797-acre watershed, comprising 3 percent of the land area (see Table 6.2.3-3). There was a decrease of approximately 217 acres of lakes in the watershed; this represents a 7 percent reduction in lake area compared to pre-settlement conditions (PolyMet 2015b).

A total of 977 acres of deepwater resources (i.e., mine pits) was identified in the 116,797-acre watershed, comprising less than 1 percent of the land area (see Table 6.2.3-3). There has been an increase of 977 acres of deepwater resources in the watershed compared to no deepwater resources present under pre-settlement conditions (PolyMet 2015b).

The change in wetland, lake, and deepwater acreage has resulted primarily from mining projects, development of municipalities, and construction of transportation infrastructure such as roads and railroads.

6.2.3.4.3 Future Wetland and Water Resources

<u>Partridge River Watershed</u>

The NorthMet Project Proposed Action in combination with present and reasonably foreseeable future projects would likely result in the following cumulative wetlands effects:

- Approximately 30,276 acres of wetlands are projected to be present in the 101,812-acre watershed in the foreseeable future, comprising 30 percent of the land area (see Table 6.2.3-4). The change in wetlands, as a proportion of all wetlands within the study area, would be a 10 percent reduction from pre-settlement conditions and a 3 percent reduction compared to existing conditions (PolyMet 2015b).
- Approximately 3,194 acres of lakes are projected to be present in the 101,812-acre watershed in the foreseeable future, comprising 3 percent of the land area (see Table 6.2.3-4). The change in lakes, as a proportion of the total study area, would be a 19 percent increase from pre-settlement conditions and there would be no changes compared to existing conditions (PolyMet 2015b).
- Approximately 3,516 acres of deepwater resources are projected to be present in the 101,812-acre watershed in the foreseeable future, comprising 3 percent of the land area (see Table 6.2.3-4). The change in deepwater resources, as a proportion of the total study area, would be an introduction of 3,516 acres of new deepwater resources (compared to zero pre-settlement) and a 12 percent increase compared to existing conditions (PolyMet 2015b).

Some of these projects would include mitigation of wetlands, lakes, and deepwater resources in the Partridge River Watershed.

Table 6.2.3-4 Future Wetland and Water Resources by Watershed under the NorthMet Project Proposed Action

Watershed	Total Land Area (Acres)	Wetland Area		Lake Area		Deepwater Area	
		Acres	% of Watershed	Acres	% of Watershed	Acres	% of Watershed
Partridge River	101,812	30,276	30	3,194	3	3,516	3
Embarrass River	116,797	33,947,	29	2,904	3	1,359	1

Source: PolyMet 2015b.

Under the NorthMet Project No Action Alternative, development of other projects (and associated effects on and mitigation of wetlands, lakes, and deepwater resources in the Partridge River Watershed) would still occur under the foreseeable future conditions.

Under the NorthMet Project No Action Alternative, approximately 31,044 acres of wetlands have been projected to be present in the 101,812-acre watershed in the foreseeable future, comprising 30 percent of the land area (see Table 6.2.3-5). The change in wetlands, as a proportion of all wetlands within the study area, would be an 8 percent reduction from pre-settlement conditions and a 1 percent reduction compared to existing conditions (PolyMet 2015b).

Similar to under the NorthMet Project Proposed Action, under the NorthMet Project No Action Alternative, approximately 3,194 acres of lakes are projected to be present in the 101,812-acre watershed in the foreseeable future, comprising 3 percent of the land area (see Table 6.2.3-5). The change in lakes, as a proportion of the total study area, would be a 19 percent increase from pre-settlement conditions and there would be no changes compared to existing conditions (PolyMet 2015b).

Under the NorthMet Project No Action Alternative, approximately 3,195 acres of deepwater resources are projected to be present in the 101,812-acre watershed in the foreseeable future, comprising 3 percent of the land area (see Table 6.2.3-5). The change in deepwater resources, as a proportion of the total study area, would be an introduction of 3,195 acres of new deepwater resources (compared to zero pre-settlement) and a 2 percent increase compared to existing conditions (PolyMet 2015b).

Table 6.2.3-5 Future Wetland and Water Resources by Watershed under the NorthMet Project No Action Alternative

Watershed	Total Land Area (Acres)	Wetland Area		Lake Area		Deepwater Area	
		Acres	% of Watershed	Acres	% of Watershed	Acres	% of Watershed
Partridge River	101,812	31,044	30	3,194	3	3,195	3
Embarrass River	116,797	34,122	29	2,904	3	1,359	1

Source: PolyMet 2015b.

<u>Embarrass River Watershed</u>

The NorthMet Proposed Project, in combination with present and reasonably foreseeable future projects, would likely result in the following cumulative wetlands effects:

- Approximately 33,947 acres of wetlands are projected to be present in the 116,797-acre watershed in the foreseeable future, comprising 29 percent of the land area (see Table 6.2.3-4). The change in wetlands, as a proportion of all wetlands within the study area, would be a 2 percent reduction from pre-settlement conditions and a 1 percent reduction compared to existing conditions (PolyMet 2015b).
- Approximately 2,904 acres of lakes are projected to be present in the 116,797-acre watershed in the foreseeable future, comprising 3 percent of the land area (see Table 6.2.3-4). The change in lakes, as a proportion of the total study area, would be a 7 percent reduction from pre-settlement conditions and there would be no changes compared to existing conditions (PolyMet 2015b).

- Approximately 1,359 acres of deepwater resources are projected to be present in the 116,797-acre watershed in the foreseeable future, comprising a 1 percent of the land area (see Table 6.2.3-4). There would be an introduction of 1,359 acres of new deepwater resources (compared to zero pre-settlement) and there would be a 39 percent increase in deepwater resources compared to existing conditions (PolyMet 2015b).

Under the NorthMet Project No Action Alternative, development of other projects (and associated effects on and mitigation of wetlands, lakes, and deepwater resources in the Partridge River Watershed) would still occur under the foreseeable future conditions.

Under the NorthMet Project No Action Alternative, approximately 34,122 acres of wetlands have been projected to be present in the 116,797-acre watershed in the foreseeable future, comprising 29 percent of the land area (see Table 6.2.3-5). The change in wetlands, as a proportion of all wetlands within the study area, would be a 2 percent reduction from pre-settlement conditions and less than 1 percent reduction compared to existing conditions (PolyMet 2015b).

Similar to under the NorthMet Project Proposed Action, under the NorthMet Project No Action Alternative, approximately 2,904 acres of lakes are projected to be present in the 116,797-acre watershed in the foreseeable future, comprising 3 percent of the land area (see Table 6.2.3-5). The change in lakes, as a proportion of the total study area, would be a 7 percent reduction from pre-settlement conditions and there would be no changes compared to existing conditions (PolyMet 2015b).

Similar to the NorthMet Project Proposed Action, under the NorthMet Project No Action Alternative, approximately 1,359 acres of deepwater resources are projected to be present in the 116,797-acre watershed in the foreseeable future, comprising 1 percent of the land area (see Table 6.2.3-5). The change in deepwater resources, as a proportion of the total study area, would be an introduction of 1,359 acres of new deepwater resources (compared to zero pre-settlement) and there would be a 39 percent increase in deepwater resources compared to existing conditions (PolyMet 2015b).

6.2.3.4.4 Qualitative Assessment of Cumulative Potential Indirect Effects

It is difficult to predict indirect wetland effects within the CEAA, as well as to know what the potential indirect wetland effects would be for the projects assessed other than the NorthMet Project Proposed Action. However, based on the amount of potential indirect wetland effects that could occur from the NorthMet Proposed Action, there could be 0.1 to 12.0 percent cumulatively lost, in addition to the direct wetland impacts assessed, within the Partridge and Embarrass River watersheds.

Based on the wetlands crossing analog zones analysis approach, the acreage of wetlands whose hydrology would have a high likelihood of being affected by drawdown at the Mine Site is 866.9 acres. The wetlands categorized as high likelihood are dominated by one alder thicket (848 acres) that has approximately 4 acres (less than 1 percent) within the 0-1,000 ft analog impact zone. The remainder of this wetland (more than 99 percent) is located more than 1,000 ft away from the edge of the mine pits and extends out to the edge of Area 1 (see Figure 5.2.3-6). Furthermore, based on this method, there would be 1,854.5 acres of wetlands within the 0-2,000 ft zone and 2,147.6 acres within the 0-3,500 ft zone that could be affected by potential drawdown. Based on this approach, the total projected potential indirect effects from all six factors that were assessed under this method could be up to 7,694.2 acres of wetlands potentially indirectly affected by the NorthMet Project Proposed Action. Therefore, the potential indirect cumulative effect from the NorthMet Project Proposed Action, in addition to the direct wetland impacts assessed, under this method would range between 1.3 to 12 percent.

Based on the method approach of wetlands within analog zones, the acreage of wetlands whose hydrology would have a high likelihood of being affected by drawdown at the Mine Site is 46.4 acres. Furthermore, based on this method, there would be 348.4 acres of wetlands within the 0-2,000 ft zone and 733.3 acres within the 0-3,500 ft zone that could be affected by potential drawdown. Based on this approach, the total projected potential indirect effects from all six factors that were assessed under this method could be up to 6,568.8 acres of wetlands potentially indirectly affected by the NorthMet Project Proposed Action. Therefore, the potential indirect cumulative effect from the NorthMet Project Proposed Action, in addition to the direct wetland impacts assessed, under this method would range between 0.1 to 10.2 percent.

6.2.3.4.5 Qualitative Analysis of Cumulative Wetland Impacts for the St. Louis River below the Ordinary High Water Mark from Its Confluence with the Embarrass River to Lake Superior

The XP-SWMM model developed for the Partridge River identified that the changes in average annual flow (and therefore stage) of the Partridge River would be within the naturally occurring annual variation for the Partridge River. Section 5.2.2 provides more details on the XP-SWMM model. Therefore, no potential indirect cumulative wetland effects are identified for the wetlands abutting the Partridge River.

The St. Louis River is located downstream of the Partridge River. Effects on flows (and, by extension, water surface elevations) generated by the NorthMet Project Proposed Action are anticipated to be less than those estimated for the Partridge River and within the natural variation of flow within the St. Louis River (e.g., less than 1 percent reduction in average annual flow as measured at the confluence of the Embarrass River with the St. Louis River). Therefore, no potential indirect cumulative wetland effects are identified for the wetlands within the St. Louis River below the ordinary high water mark, from its confluence with the Embarrass River to Lake Superior.

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6.2.4 Vegetation

The cumulative effects analysis for vegetation focuses on potential losses of vegetative cover types, plant communities, MBS Sites of Biodiversity Significance, and ETSC plant species. As described below, the NorthMet Project Proposed Action would contribute to a loss of vegetative cover and ETSC plant species populations, which would combine with other past, present, and reasonably foreseeable future actions in the CEAA. Given the risk to the viability of ETSC species and their sensitivity to changes to their habitat from development projects, the analysis focuses on these species. Wildlife habitat is addressed in Section 6.2.5.

6.2.4.1 Approach

The GIS data presented in Sections 4.2.4 and 5.2.4 was compared to other actions within the CEAA, and the cumulative effects were assessed. Specifically, GIS data were obtained from the MDNR regarding the GAP, which is vegetation land cover types derived from satellite imagery, and listed ETSC plant species within the NHIS database.

GIS analysis was used to calculate effects on the resources described above. The effects were calculated for habitat types, classifications, and species where they physically overlap tailings piles, mine pits, tailings basins, roads, buildings, or other new infrastructure associated with the cumulative actions below.

NorthMet Project Proposed Action-related effects on the 10 state-listed ETSC plant species that may be present in the NorthMet Project area were identified and evaluated in Section 5.2.4.2. As discussed below, of these 10, three have a distribution that may be subject to cumulative effects. No federally listed ETSC plant species would be affected by the NorthMet Project Proposed Action (see Section 5.2.4.2). Because six of the ETSC species are also RFSS plants, the analysis below also applies to the known RFSS plants in the NorthMet Project area.

This section evaluates the potential cumulative effects of the NorthMet Project Proposed Action on these 10 ETSC plant species. Potential future effects were identified by analyzing Take Permits (issued by the USFWS or MDNR to authorize activities resulting in the loss of federally or state-listed species), as well as GIS information from the MDNR, to determine the extent of expected losses from recently permitted projects.

6.2.4.2 Cumulative Effects Assessment Area

The NorthMet Project Proposed Action's CEAA boundary for vegetation is described below, both spatially and temporally.

6.2.4.2.1 Spatial

The CEAA for evaluation of cumulative effects on vegetation is defined geographically by the portion of the Mesabi Iron Range encompassed by the Nashwauk Uplands and Laurentian Uplands ecological subsections (see Figure 6.1.1-1). The ecological subsections are described in detail in Section 4.2.4.1. The area has been limited to the Mesabi Iron Range as it is a definable physiographic region encompassing the region's mining, which represents the largest and most influential land use within a reasonable distance from the NorthMet Project area.

6.2.4.2.2 Temporal

Overall habitat composition changes in the ecological subsections were evaluated as the temporal area of assessment, based on pre-settlement conditions (approximately 1890) through the present day (1990 to present). These timespans are indicative of past and relatively current trends in regional habitat changes relevant to the CEAA. An estimate of future trends would be based on estimated development/habitat loss, direct loss of species and individuals, and the regulatory requirements for protected species and habitats (i.e., approximately 40 years, which is consistent with the life of the NorthMet Project Proposed Action, including construction, operations, and closure).

6.2.4.3 Contributing Past, Present, and Reasonably Foreseeable Actions

As noted previously, it is not possible to identify all past activities that may contribute to a cumulative effect. Similarly, all present activities would continue to affect the environment. The impacts of these combined activities are described in Chapter 4, Affected Environment. This assessment includes physical cumulative effects on vegetation cover types and protected ETSC plant species associated with current and foreseeable mining actions listed below. The following reasonably foreseeable projects and/or actions, described further in Section 6.1.1.2, are included in the cumulative effects assessment for vegetation:

- ArcelorMittal Deposits (Laurentian and East Reserve deposits);
- ArcelorMittal Deposit Push Back;
- Cliffs Erie Pellet Yard;
- Community growth and development;
- Essar Steel;
- Forestry on public and private lands;
- Magnetation (Coleraine, Keewatin, Chisholm);
- Mining Resources (Sherman Basin);
- MDOT Highway 53 Relocation;
- St. Louis County Public Works Bridge Replacements;
- United Taconite Mine Expansions; and
- U.S. Steel Keetac Mine Expansion Project.

This analysis also looked at the six actions listed below:

- LTV Steel Mining Company (Former LTVSMC Pits);
- Mesabi Mining Project;
- Mesabi Nugget;
- Northshore Mine;
- Northshore Mine Ultimate Pit Progression Project; and

- U.S. Steel Minntac Mine.

Using best available information, the NHIS data and MDNR take permit data were reviewed and no vegetation records were available for these four actions. As a result, these actions are not considered in the cumulative effects analysis for vegetation.

6.2.4.4 Cumulative Effects Assessment

6.2.4.4.1 Evaluation Criteria

The cumulative effects assessment on vegetation is guided by evaluation criteria, which are outlined below:

- Direct effects on vegetative cover types, plant communities, MBS Sites of Biodiversity Significance, and rare species would occur through clearing, filling, and other construction activities. Direct effects would include the removal of vegetation in the construction, operation, maintenance, or closure of the NorthMet Project Proposed Action when an ETSC plant species is removed (i.e., taking of an individual plant or entire plant populations).
- An indirect effect occurs on vegetation when a change in conditions results in a change over time in cover type, plant community, or MBS Sites of Biodiversity Significance, or a rare species experiences a change in vegetative composition. Potential indirect effects on vegetation may include changes in hydrology, deposition of particulate matter (dust), changes in successional stage, alteration of microclimate (e.g., tree removal resulting in drier soil conditions, rise or fall in water table, loss of pollinators, or loss of fungal associates in the rooting zone), new or increased erosion and sedimentation, and invasion of non-native species.

6.2.4.4.2 Existing Baseline Conditions and Past Losses

As discussed in detail in Chapter 4, past changes in cover types show a mixed pattern of gains and losses from the 1890s to the 1990s (see Table 6.2.4-1). These trends are continuing today and would be expected to continue into the future. In the Laurentian Uplands subsection, few cover types discussed below have decreased. In the Nashwauk Uplands subsection, many of the cover types have experienced declines over this period, with the largest percentage decline to upland coniferous forests and upland conifer-deciduous mixed forests. Among the ETSC plant species that occur within the NorthMet Project area boundaries, ternate, or St. Lawrence, grapefern (*Botrychium rugulosum*) is most likely to occur in the upland coniferous type (see Table 6.2.4-2). Floating marsh marigold (*Caltha natans*) and least grapefern (*Botrychium simplex*) are most likely among these species to occur in the lowland deciduous type. Floating marsh marigold occupies edges of ponds, lakes, and streams in the lowland deciduous type, and least grapefern also occupies open wetlands, grasslands, and disturbed areas; consequently, a loss in lowland deciduous types is a less accurate reflection of trends in these species' habitats. While it appears the Laurentian Uplands subsection lost a large portion of shrublands, it is likely that habitat type was allowed to grow older, which explains the increases in upland coniferous and deciduous forests. The opposite is true for the Nashwauk Uplands subsection. Upland forest types were likely harvested in this subsection, which resulted in the increase of younger stands and shrubland habitat types.

Table 6.2.4-1 Changes in Habitat Acreage between 1890 and 1990 by Ecological Subsection

Habitat Type	Percentage of Laurentian Uplands Gain/(Loss)	Percentage of Nashwauk Uplands Gain/(Loss)
Lowland coniferous forest	7	(4)
Lowland deciduous forest	<1	2
Upland coniferous forest	4	(8)
Upland deciduous forest	2	(1)
Upland conifer-deciduous mixed forest	<1	(5)
Shrubland	(15)	9
Aquatic environments	1	<1
Disturbed[1]	na	na
Cropland/Grassland[1]	na	na

Source: MDNR 2006a.

Note:
[1] "na" indicates that insufficient data were available to determine percent coverage within the ecological subsections, although these habitat types likely occurred at low levels.

This conclusion should be qualified by the understanding that the mapped habitat type does not precisely match the habitat actually used by an ETSC or RFSS plant species. Because these plant species occupy preferred habitats within larger mapped habitat types, the effect of habitat loss may not directly correlate on a 1:1 basis to the effect on a plant species. Given this lack of precision and uncertainty, the analysis assumed that large losses in mapped habitat types represent a trend in losses of preferred habitat types for these ETSC or RFSS plant species.

Table 6.2.4-2 Preferred Habitat for State-listed ETSC/RFSS Plant Species and Most Likely Associated Habitat Types

Species	Preferred Plant Species Habitat	Corresponding Map Habitat Type
Botrychium campestre	Prairies, dunes, railroad sidings, fields	Disturbed; Cropland/ Grassland
Botrychium pallidum[1]	Open, disturbed habitats, log landings, roadsides, dunes, sandy gravel pits	Disturbed; Cropland/ Grassland
Botrychium rugulosum[1]	Generally open habitats, such as old log landings and edges of trails	Disturbed; Upland coniferous
Botrychium simplex[1]	Generally open habitats, such as old log landings, roadside ditch, trails, open fields, base of cliff, railroad rights of way	Disturbed; Cropland/Grassland; Lowland deciduous
Caltha natans[1]	Shallow water of pools, ditches, sheltered lake margins, slow moving creeks, sloughs/oxbows, pools in shrub swamps	Aquatic environments; Lowland coniferous; Lowland deciduous
Eleocharis nitida[1]	Mineral soil of wetlands, often with open canopy and disturbance, such as logging roads/ditches through wetlands	Lowland coniferous; Disturbed
Juncus stygius var. americanus[1]	Shallow pools in non-forested peatlands, often in a sedge-dominated community	Lowland coniferous
Platanthera clavellata	Coniferous swamps, fens	Lowland coniferous
Ranunculus lapponicus	Lowland conifer forests and peat bogs	Lowland coniferous
Torreyochloa pallida	Pond/stream margins, lowland coniferous forest	Aquatic environments; Lowland coniferous

Source: MDNR 2011k; USFS 2010d.

Note:
[1] These species are also RFSS plants as tracked by the USFS.

6.2.4.4.3 Environmental Consequences of Reasonably Foreseeable Actions on ETSC and RFSS Plant Species

Future effects on ETSC and RFSS plant species were evaluated by comparing ETSC plant species Take Permits from the MDNR to the reasonably foreseeable actions within the cumulative spatial boundary. In addition, MDNR Lands and Minerals Division data provided reasonably foreseeable action footprints for comparison. These were combined with best available data that identified all known populations of ETSC plant species. Populations are defined as a number of individuals of a species within proximity to each other and within a defined habitat that can be self-sustaining under current conditions. MDNR NHIS populations that match the ETSC Take Permits from the MDNR or are contained within them are presented below for the cumulative discussion. These populations can contain from a few to thousands of individual plants. Of the 10 ETSC plant species present in the NorthMet Project area, three species would also be affected by other cumulative projects within the CEAA (see Table 6.2.4-3). Cumulative effects on each of the state-listed ETSC species known to occur on the Mine Site are discussed below. As discussed in Section 5.2.4.2, no federally listed ETSC plant species would be affected by the NorthMet Project Proposed Action.

Table 6.2.4-3 Potential Future Effects on ETSC or RFSS Plant Species Populations Occurring from Reasonably Foreseeable Activities[1,2]

Species[1]	Other Projects Direct Effect (Populations)	Other Projects Indirect Effect (Populations)	NorthMet Project Proposed Action Total Effect (Populations)	Total Known Statewide Populations[3]	Percent of Known Statewide Populations Affected
Botrychium pallidum[4]	4	0	1	99	5
Botrychium rugulosum[4]	5	0	1	72	8
Botrychium simplex	3	0	3	210	3

Notes:
[1] Species upon which no other actions besides the NorthMet Project Proposed Action are expected to have effects are discussed in the "Proposed Action" section.
[2] Data included here were provided by the Division of Ecological Resources, MDNR, and were current as of August 5, 2014. These data are not based on an exhaustive inventory of the state. The lack of data for any geographic area shall not be construed to mean that no significant features are present.
[3] Statewide population data provided by Lisa Joyal (MDNR) on March 26, 2013.
[4] These species are also RFSS plants as tracked by the USFS.

Pale moonwort (*Botrychium pallidum*) is widely distributed across five Canadian provinces and eight U.S. states (Colorado, Maine, Michigan, Minnesota, Montana, South Dakota, Wisconsin, and Wyoming). The NorthMet Project Proposed Action would directly affect one population. The cumulative actions within the CEAA would directly affect four additional populations, while no populations are expected to be indirectly affected. In total, approximately 5 percent of the known populations in Minnesota would be directly affected by the NorthMet Project Proposed Action and other present or reasonably foreseeable activities (see Table 6.2.4-3). Due to its small size, the species is easily overlooked and additional populations may yet be located. *B. pallidum* was listed as a state endangered species in 1996 when there were just six documented occurrences in Minnesota. By 2009, the number had risen to 65 (MDNR 2011k). Its relatively short lifespan (emergence to senescence within four weeks) may account for the few populations documented to date. Given its preference for disturbed sites, the cumulative effects of the NorthMet Project Proposed Action and other reasonably foreseeable activities are not expected to jeopardize the presence of *B. pallidum* in Minnesota or in North America.

Ternate, or St. Lawrence, grapefern (*Botrychium rugulosum*) is widely distributed across three Canadian provinces and six U.S. states (Connecticut, Michigan, Minnesota, New York, Vermont, and Wisconsin). The NorthMet Project Proposed Action would directly affect one population of the species (see Section 5.2.4.2). Other reasonably foreseeable activities would directly affect five populations; no populations would be indirectly affected. In total, approximately 8 percent of the known populations in Minnesota would be directly affected by the NorthMet Project Proposed Action and other reasonably foreseeable activities (see Table 6.2.4-3). *B. rugulosum* was listed as a state threatened species in Minnesota in 1996 (MDNR 2011k). This species' tolerance for disturbance in early successional communities allows it to establish in areas previously disturbed by human activity. Because of this habitat preference, and the early successional habitats that develop around disturbed areas, the cumulative effects of the NorthMet Project Proposed Action and other reasonably foreseeable activities are not expected to jeopardize the presence of *B. rugulosum* in Minnesota or in North America.

Least grapefern (*Botrychium simplex*) is widely distributed across 34 U.S. states and 11 Canadian provinces. The NorthMet Project Proposed Action would directly affect three populations of the species. Other reasonably foreseeable activities would directly affect three populations; no populations would be indirectly affected. In total, approximately 3 percent of the known populations in Minnesota would be directly affected. Given its tolerance for disturbance and that the species is considered "secure," the cumulative effects of the NorthMet Project Proposed Action and other reasonably foreseeable activities are not expected to jeopardize the presence of *B. simplex* in Minnesota or in North America.

In addition to past, present, and reasonably foreseeable activities, other future changes in habitat types may affect ETSC plant populations. Forestry management generally has a greater influence on habitat acreage within the range of these ETSC plant species than does mining and other land development. It should be noted, however, that forestry management offers a greater range of options for ETSC plant species to co-exist with the practice, as it can mimic natural disturbances, whereas mining represents a complete land conversion that could affect long-term ETSC habitat availability. Between 2005 and 2014, the average annual forest acres within the Laurentian Uplands subsection that were harvested on state lands was approximately 1,034 acres (0.2 percent of the subsection) (MDNR 2006b). Between 2010 and 2019, the average annual forest acres within the Nashwauk Uplands subsection that were or will be harvested on state lands was approximately 1,189 acres (0.1 percent of the subsection) (MDNR 2010b). On average, 1 percent of timber land in the Superior National Forest is harvested annually (Deckard, Pers. Comm., April 26, 2012). Private timber harvest data are generally not available. The potential cumulative effects on the three state-listed ETSC species identified by this assessment are small relative to the extent of the populations and distribution within the Superior National Forest and within the state.

6.2.4.4.4 Effects from Acid (NO_2/SO_2) and Mercury Deposition

Acid (sulfuric and nitric) and mercury deposition from air sources could also affect vegetation and ETSC species. The sources and analysis are described in Section 6.2.7.5. These depositions may have an adverse effect on the overall biodiversity of terrestrial ecosystems, including forested habitats, cover types, and plant communities. These pollutants may travel long distances and contribute to complex chemical and physical reactions within a variety of forested habitats, which could contribute to increased vulnerability of sensitive vegetation. Additionally, these pollutants can be carried by precipitation into nearby lakes and rivers, which sustain some vegetation and forested habitats. The lakes (and their associated watersheds) in the vicinity of the CEAA include Heikkila Lake, Colby Lake, Sabin Lake, Wynne Lake, and Whitewater Lake.

As described in Section 6.2.7.5, since the NorthMet Project Proposed Action would have relatively low emissions of SO_2 and NO_2 and potential deposition of sulfate would be below both the Minnesota standard threshold value and the federal Class I threshold values, in combination with the overall reduction in sulfate and nitrate-producing emissions cumulatively since 2008, the actions and projects would not likely cause a cumulative effect on the ecosystems.

The MPCA estimated that over 90 percent of the mercury deposition within Minnesota is a result of other states and countries (MPCA 2013e). However, as described in Section 5.2.7.2.5, the Plant Site would be expected to contribute essentially all of the NorthMet Project Proposed Action-related mercury air emissions of 4.6 lbs/year, as the Mine Site only contributes potential emissions of less than 1.0 lb/yr (Barr 2011g). Based on the results of the MMREM evaluation summarized in cumulative effects Section 6.2.6.3.3, the potential additional mercury load that might be added to the Embarrass River and the Partridge River from air emissions is not expected to adversely affect these ecosystems when compared to the variability in background mercury concentrations. Similarly, the mercury deposition on terrestrial environments is not expected to adversely affect these ecosystems when compared to variability in background mercury concentrations. Additional information on the cumulative analysis of acid and mercury deposition associated with air emissions is summarized in Section 6.2.6.3.3 and 6.2.7.5.

6.2.5 Wildlife

The cumulative effects analysis for wildlife focuses on potential losses of sensitive wildlife species (federally and state-listed species and Species of Special Concern, SGCN, RFSS, and other wildlife species), effects on wildlife habitat, and effects on wildlife travel corridors. The analysis reveals that, while some loss and fragmentation of wildlife habitat would occur as a result of the NorthMet Project Proposed Action and other cumulative projects in the CEAA, these actions would not further threaten special status wildlife species. See Section 6.2.4 for the discussion of potential cumulative effects from loss of vegetation cover types.

6.2.5.1 Approach

Cumulative effects on wildlife may include the loss and/or fragmentation of habitat and encroachments into critical wildlife travel corridors. Similar to the direct and indirect effects for the NorthMet Project Proposed Action, analysis was also conducted for cumulative effects on sensitive species such as federally or state-listed species, SGCN, and RFSS. These effects were assessed by evaluating the effects of the NorthMet Project Proposed Action with other past, present, and reasonably foreseeable future federal, state, and private actions.

Analysis of cumulative effects on wildlife was assessed both qualitatively and quantitatively using the following methods:

- MCWCS Action Plan, *Tomorrow's Habitat for the Wild & Rare* (MDNR 2006d);
- Marschner's Original Pre-settlement Vegetation Map of Minnesota as interpreted and analyzed by researchers, the Minnesota Forest Resources Council, and at the subsection level in the MCWCS approach by the MDNR (MFRC 2003a; MDNR 2006d); and
- Reports on mining, infrastructure, and forestry effects (e.g., Emmons & Olivier 2006; USFS 2004b); state timber harvest reports (MDNR 2006b; MDNR 2010b).

The MCWCS is a central component of MDNR's strategy for managing wildlife populations in the state; use of the strategy is therefore appropriate as the basis for assessing cumulative effects on wildlife habitat loss and fragmentation.

6.2.5.2 Cumulative Effects Assessment Boundary

6.2.5.2.1 Spatial

The spatial CEAA for wildlife includes the portions of the Mesabi Iron Range located within the Nashwauk Uplands and Laurentian Uplands ecological subsections (see Figure 6.1.1-1). The area has been limited to the Mesabi Iron Range, as it is a definable physiographic region encompassing the region's mining, which represents an influential land use in regards to wildlife and wildlife habitat.

6.2.5.2.2 Temporal

Overall habitat composition changes in the ecological subsections were evaluated as the temporal area of assessment, based on pre-settlement conditions (approximately 1890) through the present day (1990 to present). These timespans are indicative of past and relatively current trends in regional habitat changes relevant to the CEAA. An estimate of future trends is based on estimated development/habitat loss, direct loss of species and individuals, and the regulatory requirements for habitat and protected species (e.g., approximately 40 years, which is consistent with the life of the NorthMet Project Proposed Action, including construction, operations, and closure).

6.2.5.3 Past, Present, and Reasonably Foreseeable Future Actions

The following projects and actions, described in Section 6.1.1.2, have been included in the cumulative effects analysis due to their potential effects on wildlife across the Laurentian Uplands and Nashwauk Uplands ecological subsections:

- ArcelorMittal Deposits (Laurentian and East Reserve Deposits);
- ArcelorMittal Deposit Push Back;
- Cliffs Erie Pellet Yard;
- Community growth and development (regional), including road construction and expansion projects;
- Essar Steel Mine;
- Forestry practices (regional);
- LTV Steel Mining Company Former LTVSMC Pits;
- Magnetation (Coleraine, Keewatin, and Chisholm);
- Mesabi Mining Project;
- Mesabi Nugget;
- Mining Resources (Sherman Basin);
- MDOT US Highway 53 Virginia to Eveleth Relocation;
- Northshore Mine and Northshore Ultimate Pit Progression Project;
- United Taconite Mine Expansions;
- U.S. Steel Mine Expansion Project (Keetac); and
- U.S. Steel Minntac Mine and Extension Project.

6.2.5.4 Cumulative Effects Assessment

6.2.5.4.1 Wildlife Habitat

The study area for loss and fragmentation of habitat is the 810,000-acre Nashwauk Uplands and the 567,000-acre Laurentian Uplands ecological subsections. Forest composition changes from the pre-settlement period through current conditions are indicative of wildlife habitat trends. The MCWCS approach uses Marschner pre-settlement mapping as a baseline for describing changes taking place in vegetation types/ecosystems since the 1800s, using recent land cover data from the Minnesota GAP land cover data and reported by ecological subsection (MDNR 2006d). The effects on wildlife were evaluated by noting the change in amount of each Marschner habitat type in terms of the effect on wildlife species that use that habitat type.

Wildlife habitats that decreased in acreage from pre-settlement to current conditions present a higher risk of future SGCN population decreases and are in greater need of conservation in Minnesota.

The changes in habitat types in the Nashwauk Upland and Laurentian Upland subsections from pre-settlement through today are presented in Section 6.2.4.4, in Table 6.2.4-1. These data indicate an overall decrease in upland and lowland forest types in the Nashwauk Uplands ecological subsection during these periods. Forest types increased in the Laurentian Uplands.

In the majority of the region, forest communities have transitioned from predominately pine- and tamarack-dominated forests to aspen and other non-pine community-dominated forest species. Further, research indicates that current mature forest represents only about 4.4 percent of the old growth acreage that existed in the 1800s (Jaakko Poyry 1994). Forest composition has changed, and the MFRC (2003b) concluded that forest fragmentation has increased, with decreased patch sizes and more miles of forest edge.

Within the Laurentian Uplands and Nashwauk Uplands subsections, agricultural land use is minimal. Developed land including mined lands, non-mine related industrial use, commercial and residential use, cropland, and pasture total 11 percent of the Nashwauk Uplands and 1 percent of the Laurentian Uplands. The balance is higher quality wildlife habitat, including forest, wetlands, and open water.

Some wildlife species in northeast Minnesota are sensitive to habitat changes and may be adversely affected by change. Disturbance (such as fire and forestry) produces a landscape pattern that contains less habitat for species needing large habitat patches, such as ovenbirds, and poorer quality habitat for species requiring older and more diverse forest vegetation, such as northern goshawks (MFRC 2003a). Some wildlife populations are more affected by timber harvest and forest composition than others, and species whose habitat range edges are affected by forest composition changes are more likely to be affected (Jaakko Poyry 1994).

An assessment of cumulative effects through 2014 from forestry, and for an unstated near-term period from mining and non-mining development, was completed for the 12.5 million-acre Arrowhead Region, which includes the Laurentian Uplands and Nashwauk Uplands ecological subsections (Emmons & Olivier 2006). Potential disturbances to wildlife habitat within the Laurentian Uplands ecological subsection were primarily due to timber harvest and mining, and habitat types most likely to be affected included upland and lowland coniferous forest, upland deciduous forest, and upland shrub/woodland. Within the Nashwauk Uplands ecological subsection, mining activities and urban development were more likely to affect wildlife habitat, with upland deciduous forests and upland shrub/woodland habitats most affected (Emmons & Olivier 2006).

A subsequent study for the Keetac Expansion Project (Barr 2009a) expanded on a previous wildlife corridor and habitat analysis and quantified the effects on habitat from reasonably foreseeable mining and urban/development projects along the Iron Range (Emmons & Olivier 2006). The study differentiated between “high-impact” and “moderate-impact” features as related to mining and other urban/development. High-impact features create physically impenetrable barriers to wildlife including mining pits, in-pit activities, and operations plants and buildings. Moderate-impact features are areas that experience a change in topography, community structure, diversity, and function but would not be physically impenetrable for many species, such as stockpiles, tailings basins, borrow areas, settling ponds, and haul roads. Moderate-impact areas may naturalize and revegetate over time (Barr 2009a).

6.2.5.4.2 Wildlife Travel Corridors

Wildlife could be affected by the NorthMet Project Proposed Action and other actions through a cumulative disruption of their travel corridors. These actions could pose additional barriers to wildlife movement by increasing the number of isolated patches of suitable habitat, increasing mortality during transit, and physically blocking travel. This may lead to increased population and genetic isolation and decreased meta-population dynamics, which in turn could lead to decreases in overall population stability and persistence. See Section 5.2.5.2.3 for a discussion on studies regarding wildlife corridor mitigation options.

Two studies have examined the potential cumulative effects of mining operations on wildlife movement along the Iron Range, the conclusions of which form the base of cumulative effect analysis in this FEIS: Emmons & Olivier (2006) supplemented with additional findings from Barr (2009a).

As noted in Chapter 4, there are 13 major wildlife travel corridors connecting large roadless blocks along the Mesabi Iron Range (Emmons & Olivier 2006). These corridors range from less than 0.1 mile to over 3.2 miles wide, with a total combined length of 20.2 miles.

Barr Engineering (2009a) also analyzed wildlife corridors along the Mesabi Iron Range, identifying five additional corridors (for a total of 18) along the same extent and differentiating between mine features that precluded wildlife movement (high-impact features) and mine features that were still passable and would potentially revegetate over time (moderate-impact features) (see Figure 6.2.5-1).

Effects on these wildlife travel corridors were classified as: 1) direct loss of habitat inside the corridor, 2) fragmentation of habitat inside the corridor, 3) isolation of a corridor by the creation of a barrier inside or near its termini, and 4) direct loss or fragmentation of large habitat blocks outside the corridor, which are the presumed destinations of the animals using the corridors. This analysis included the following projects that could potentially represent barriers to wildlife travel:

- ArcelorMittal Deposits (Laurentian and East Reserve Deposits);
- Essar Steel Mine;
- Magnetation (Chisholm);
- Mesabi Mining Project;
- Mesabi Nugget;
- Mining Resources (Sherman Basin);
- Northshore Mine;
- U.S. Steel Keetac Mine Expansion Project; and
- U.S. Steel Minntac Mine Extension Project.

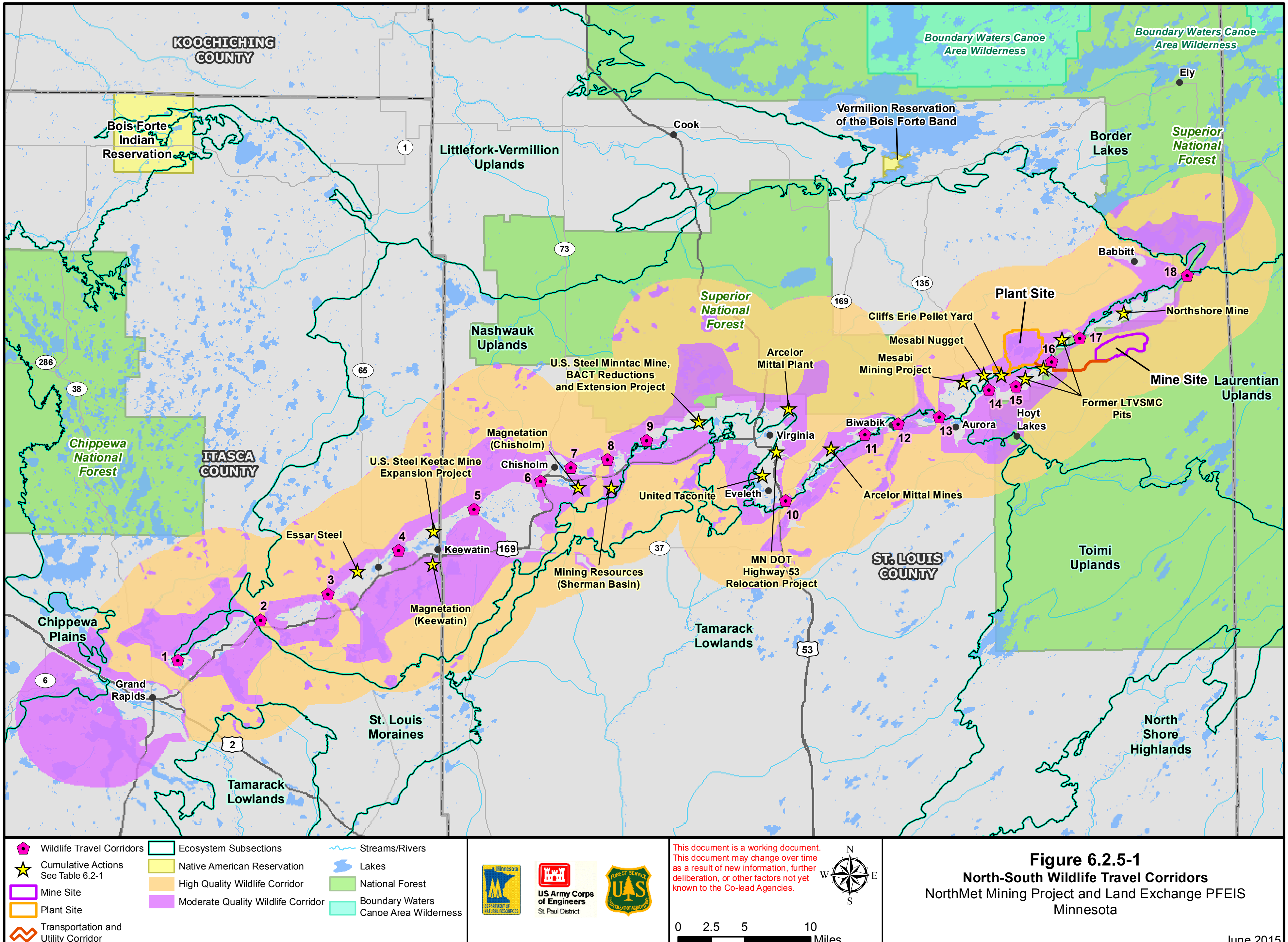

Figure 6.2.5-1
North-South Wildlife Travel Corridors
NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

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Of the 13 large mammal wildlife crossing corridors identified by Emmons & Olivier, two are in the vicinity of the Mine Site or Plant Site. The first is located approximately 1 mile southeast of the existing Plant Site (see Figure 6.2.5-1). Though small, this corridor has been identified as important (Emmons and Oliver 2006) and of moderate quality (Barr 2009a). The existing LTVSMC Tailings Basin is located within the corridor, but does not obstruct the entire width of it. The Tailings Basin provides poor habitat and is not likely to be heavily used by wildlife. Because current use is already limited, increased activity at the Tailings Basin is not likely to adversely affect wildlife movement through the corridor.

The second corridor is located approximately 0.5 mile northwest of the Mine Site. It has been identified as important (Emmons and Oliver 2006) and contains high quality habitat (Barr 2009a). Operations at the Mine Site would indirectly affect the corridor by reducing its size and acting as a source of noise and activity near the large habitat block southeast of the corridor. Though the Transportation and Utility Corridor is outside the wildlife corridors identified by Emmons & Olivier, it runs parallel and perpendicular to the corridors and would potentially affect wildlife use.

The other reasonably foreseeable projects may also affect the 18 wildlife travel corridors mapped by Emmons & Olivier and Barr (see Table 6.2.5-1 and Figure 6.2.5-1) (Emmons & Olivier 2006; Barr 2009a). These effects may include blocking or encroachment into the mapped wildlife corridors, which affects adjacent habitat that may make the corridor less valuable to wildlife, and increasing traffic along new or existing roads through the corridor. The effects on these corridors include complete loss (depending upon final extent of activities), habitat isolation, fragmentation, and/or minimal effect.

Table 6.2.5-1 Cumulative Effects on Wildlife Travel Corridors in the Mesabi Iron Range

Wildlife Travel Corridor	Project	Type of Effect
1	Urban Development, Highway Traffic	Minimal habitat isolation; may restrict wildlife travel through corridor due to roads, railroads, and potential expansion of the City of Grand Rapids.
2	Highway Traffic	Habitat isolation; may restrict wildlife travel through corridor due to highway traffic (US 169), which may increase over time.
3	Urban Development, Essar Steel	Direct loss of travel corridor; wildlife travel through the western half of the corridor is currently restricted by historical mining effects, eastern half of corridor would be directly affected by the Essar Steel project, resulting in overall loss of the corridor.
4	Highway Traffic, Essar Steel Mine, U.S. Steel Keetac Mine	Habitat isolation; may restrict wildlife travel through the corridor due to the Keetac Expansion project, which would be south of the corridor, and the Essar Steel project, which would be west of the corridor.
5	U.S. Steel Keetac Mine	Direct loss of travel corridor; wildlife travel through this corridor would be restricted by the U.S. Steel Keetac Mine and existing Hibbing Taconite, resulting in a direct loss of this low-quality corridor.

Wildlife Travel Corridor	Project	Type of Effect
6	Highway Traffic, Urban Development, U.S. Steel Keetac Mine	Fragmentation and direct loss of travel corridor; wildlife travel through this corridor is restricted by Hibbing Taconite to the west of the corridor, highway traffic on State Highway 73, and fragmentation of travel corridor habitat may occur due to urban development of Chisholm (on the northern end of the corridor) and Hibbing (on the southern end of the corridor).
7	Urban Development, Magnetation (Chisholm)	Habitat isolation; eastward expansion of Chisholm may restrict wildlife travel through this corridor. Scram mining operations south of the corridor may further restrict travel.
8	Highway Traffic, U.S. Steel Minntac, Mining Resources (Sherman Basin)	Habitat isolation; may restrict wildlife travel through corridor due to highway traffic (US 169) south of the corridor, U.S. Steel Minntac may affect habitat to the northeast of the corridor, while Mining Resources' scram mining activities may affect habitat to the south of the corridor.
9	U.S. Steel Minntac	Direct loss of travel corridor; the U.S. Steel Minntac mine pit expansion would eliminate eastern end of corridor.
10	Urban Development	Minimal effect; wildlife travel through this corridor may be restricted by expansion of Eveleth or Gilbert and associated roads.
11	ArcelorMittal Deposits	Habitat isolation and direct loss; wildlife travel through this corridor may be restricted by ArcelorMittal's Project, which would prevent access between northern and southern blocks of the corridor.
12	Urban Development	Minimal effect; wildlife travel through this corridor may be restricted by expansion of the City of Biwabik.
13	Mesabi Nugget, Mesabi Mining Project, Urban Development	Minimal effect; wildlife travel through this corridor may be restricted by westward expansion of the City of Aurora, and likely increase in traffic/noise due to the Mesabi Nugget Project.
14	Mesabi Nugget and Mesabi Mining Projects	Minimal effect; wildlife travel through this corridor may be restricted by the Mesabi Nugget Project, which would reduce the corridor width, but not eliminate use.
15	Mesabi Nugget and Mesabi Mining Projects	Minimal effect; wildlife travel through this corridor may be restricted by the Mesabi Nugget Project, which would reduce the corridor width, but not eliminate use.
16	NorthMet Project Proposed Action	Minimal effect; wildlife travel through this corridor may be restricted by noise and activities at the NorthMet Project Proposed Action Plant Site, which would be located northwest of the corridor.
17	NorthMet Project Proposed Action and Northshore Mine	Direct loss and fragmentation; the NorthMet Project Proposed Action would reduce habitat to southeast of the corridor. The NorthMet Project Proposed Action would not physically encroach into the corridor, but noise and activities at the NorthMet and Northshore mine operations could discourage use during mine operations.
18	Northshore Mine	Direct loss and fragmentation; possible expansion of Northshore mine eastward may block or fragment this corridor.

Sources: Emmons & Olivier 2006; Barr 2009a.

6.2.5.4.3 Special Status Species

In addition to habitat fragmentation and loss and effects on wildlife crossing corridors, wildlife species of concern in the Nashwauk Uplands and Laurentian Uplands ecological subsections are subject to other stressors that could result in cumulative effects. Traffic and activity related to mining projects, urban development, forestry, tourism, and road expansions all increase the risk for special status wildlife species and, as such, could result in cumulative effects. See Section 5.2.5.2.3 for a discussion on studies regarding wildlife corridor mitigation options.

The Canada lynx is listed as a threatened species by the federal government, and is listed as a species of special concern in Minnesota. The NorthMet Project Proposed Action and other cumulative actions would result in additional habitat fragmentation, and may increase pressures from loss of habitat and disruptions in travel corridors for Canada lynx. Forest management would contribute the largest acreage effect for lynx, but this effect would be offset by the regeneration of forest stands over time. Additional human activity due to the NorthMet Project Proposed Action and other cumulative actions would likely result in additional vehicle and rail traffic and the potential for collisions with lynx.

The northern long-eared bat is proposed to be listed as a threatened species by the federal government, and is listed as a species of special concern in Minnesota. The NorthMet Project Proposed Action and other cumulative actions, including community growth and forest management, could affect northern long-eared bats through removal of summer roosting habitat and additional habitat fragmentation from timber harvests and road construction. The interim 4(d) rule specifies that forest clearing activities may not occur within the summer maternity roosting season within one quarter mile of known occupied roost trees or a known occupied hibernacula.

The gray wolf has been re-listed as threatened by the federal government, but it was removed from the Minnesota ETSC species list in 2013. The wolf had rebounded sufficiently that the state held a limited hunting season in 2012 through 2014. A 2014 winter survey by the MDNR (Erb et. al 2014) estimated that 2,423 gray wolves were present in Minnesota, which, along with the 2012-2014 hunts, indicates that populations have stabilized to the point that the wolf in Minnesota is viable. The NorthMet Project Proposed Action and other cumulative actions may increase pressures from loss of habitat and disruptions in travel corridors which may affect the total numbers of animals in the future.

6.2.5.4.4 Effects from Acid (NO_2/SO_2) and Mercury Deposition

Acid depositions from sulfate (from SO_2 emissions) and nitrate (from NO_2 emissions) can have an adverse effect on terrestrial ecosystems, including forested wildlife habitat. These pollutants may travel long distances and contribute to complex chemical and physical reactions within a variety of habitats. These reactions could contribute to increased vulnerability of sensitive wildlife species and their habitats. Additionally, these pollutants can be carried by precipitation into nearby lakes and rivers, which wildlife species rely upon for food and water.

As described in Section 6.2.7.5, emissions from the NorthMet Project Proposed Action, in combination with other projects, would emit increased amounts of SO_2 and NO_2 emissions, resulting in a potential increase in acid deposition that may be too small to measure. However, the projects would not likely cause a cumulative effect on the ecosystems due to the NorthMet Project Proposed Action having relatively low emissions of SO_2 and NO_2 and potential deposition of sulfate and nitrate that are below both the Minnesota standard threshold value and the federal Class I threshold values, in combination with the overall reduction in sulfate and nitrate-producing emissions cumulatively since 2008.

The MPCA estimated that over 90 percent of the mercury deposition within Minnesota is a result of other states and countries (MPCA 2013e). However, as described in Section 5.2.7.2.5, the Plant Site would be expected to contribute essentially all of the NorthMet Project Proposed Action-related mercury air emissions of 4.6 lbs/year, as the Mine Site only contributes potential emissions of less than 1.0 lb/yr (Barr 2011g). Based on the results of the MMREM evaluation summarized in cumulative effects Section 6.2.6.3.3, the potential additional mercury load that might be added to the Embarrass River and the Partridge River from air emissions is not expected to adversely affect these ecosystems when compared to the variability in background mercury concentrations. Similarly, the mercury deposition on terrestrial environments is not expected to adversely affect these ecosystems when compared to variability in background mercury concentrations. Additional information on the cumulative analysis of acid and mercury deposition associated with air emissions is summarized in Section 6.2.6.3.3 and 6.2.7.5.

6.2.6 Aquatic Species

The NorthMet Proposed Project Action could affect aquatic physical habitat and species via changes in flow and water quality in the Partridge River and Embarrass River. The analysis found the NorthMet Project Proposed Action would meet or not cause or contribute to exceedances of water quality evaluation criteria with the exception of aluminum (Section 5.2.2). For aluminum, ambient water quality already exceeds the Class 2B standard in both the Partridge River and Embarrass River, but would increase in several tributaries to the Embarrass River as a result of the NorthMet Project Proposed Action because of a decrease in Tailings Basin seepage with low aluminum concentrations and a proportional increase in natural runoff with higher aluminum concentrations (Section 5.2.2.3.2 and Section 5.2.2.3.3). Although all other solutes are predicted to meet Class 2B water quality standards, the aggregate of these solutes, primarily metals, has the potential to impact aquatic biota.

Although there is historic and current mining in the area, the water quality of these watersheds is generally good, with some exceptions. One exception involves portions of the Embarrass River that are included on the 303(d) list as impaired for "Fishes Bioassessment" (non-supportive of aquatic life and indicative of habitat stressors that limit aquatic life). Another exception relates to some lakes through which the Partridge River and Embarrass River flow that are on the 303(d) list of impaired waters for "mercury in fish tissue." The MDH has issued fish consumption advisories for the "mercury in fish tissue" impaired waters to provide site-specific consumption guidance on the quantity and frequency of fish species consumed. The following sections provide a quantitative and semi-quantitative analysis of the potential cumulative effects of the NorthMet Project Proposed Action and other activities in the Partridge River and Embarrass River watersheds.

Both the Partridge River and Embarrass River are tributaries to the St. Louis River, which flows through the Fond du Lac Indian Reservation and empties into Lake Superior near Duluth. A qualitative assessment of the cumulative effects to aquatic resources in St. Louis River has been included.

The St. Louis River is not included within the spatial scale of the NorthMet Project's cumulative effects analysis for these reasons:

- The NorthMet Project Proposed Action would not have any direct effects (i.e., habitat disturbance) on the St. Louis River, or even perennial waterbodies within the Partridge River and Embarrass River watersheds.
- The NorthMet Project Proposed Action would not pose any obstructions to fish movement between the St. Louis River and the Partridge River or Embarrass River.
- The NorthMet Project Proposed Action would result in about a 2 percent (about 6 cfs) reduction in average annual flow in the St. Louis River at the confluence with the Embarrass River during operations, and less than 1 percent reduction during closure. The NorthMet Project Proposed Action effects would be even less during low flows because of flow augmentation from Whitewater Reservoir once water levels in Colby Lake fall below 1,439 ft, which equates to a flow of approximately 13 cfs).

- With the proposed design modifications and engineering controls, the water quality model predicted that the NorthMet Project Proposed Action would not cause any significant water quality impacts because: 1) exceedances of the P90 threshold did not occur, 2) the NorthMet Project Proposed Action concentrations were no higher than concentrations predicted for the Continuation of Existing Conditions (CEC) Scenario, or 3) the frequency of exceedances for NorthMet Project Proposed Action conditions was within an acceptable range or not attributable to NorthMet Project Proposed Action discharges or both.
- The NorthMet Project Proposed Action would result in a net decrease in overall mercury loadings (1.0 grams per year) with no detectable change in mercury concentrations to the St. Louis River.
- Therefore, the NorthMet Project Proposed Action would not have any direct effects on aquatic habitat in the St. Louis River and would not have any measureable indirect effects on fish or aquatic invertebrates as a result in changes in flow or water quality, and, therefore, it would not contribute any measureable cumulative effects to the St. Louis River.
- The NorthMet Proposed Project Action could affect aquatic physical habitat and species via changes in flow and water quality in the Partridge River and Embarrass River. The analysis found that changes in water chemistry would not exceed water quality evaluation criteria.

6.2.6.1 Temporal

The evaluation focused on the potential cumulative effects of the NorthMet Project Proposed Action, in combination with other existing and reasonably foreseeable projects, on aquatic habitat. The NorthMet Project would have little direct effect on perennial streams and aquatic habitat within the vicinity of the NorthMet Project Proposed Action. Effects would likely be limited to changes in the seasonal hydrograph of the upper reaches of the Partridge and Embarrass Rivers, with no direct effect on aquatic habitat for other downstream areas within the CEAA.

6.2.6.2 Contributing Past, Present, and Reasonably Foreseeable Future Actions

The assessment discusses potential cumulative effects on surface water habitats and aquatic species associated with the following current and future actions listed below in conjunction with the NorthMet Project Proposed Action:

- LTV Steel Mining Company Former LTVSMC Pits;
- Mesabi Mining Project;
- Mesabi Nugget Project;
- Northshore Mine;
- U.S. Steel Minntac; and
- U.S. Steel Minntac Mine Extension Project.

These activities, along with the NorthMet Project area, are located within or adjacent to the CEAA. The aquatic habitats and species associated with the Embarrass River and Partridge River watersheds should be very similar in that they both contain headwaters (first-order streams which develop, downstream, into larger second- and third-order streams, as determined by the Strahler

Stream Order classification). Section 4.2.6 indicates that baseline studies performed within these watersheds exhibited species typical for this region and these species can be assumed to occur within the streams and rivers affected by the NorthMet Project Proposed Action.

6.2.6.3 Cumulative Effects Assessment

6.2.6.3.1 Water Quality Effects

As described in Section 5.2. 2, with the proposed design modifications and engineering controls, the water quality model predicted that the NorthMet Project Proposed Action would not cause any significant water quality impacts because: 1) exceedances of the P90 threshold did not occur, 2) the NorthMet Project Proposed Action concentrations were no higher than concentrations predicted for the Continuation of Existing Conditions (CEC) Scenario, or 3) the frequency of exceedances for NorthMet Project Proposed Action conditions was within an acceptable range or not attributable to NorthMet Project Proposed Action discharges or both.. Nevertheless, while the NorthMet Project Proposed Action would not cause or contribute to exceedances of water quality evaluation criteria, it could combine with other past, present and reasonably foreseeable future activities to create cumulative effects within the CEAA. The analysis below describes these combined effects to arrive at a finding that the NorthMet Proposed Action would not cause cumulative effects on aquatic resources within the CEAA. However, there is potential for cumulative effects on aquatic biota due to changes in water quality, especially in impaired waters for the Embarrass River, and in the Upper Partridge River from cessation of Northshore Mine dewatering post-closure.

The Class 2B standards were developed to be protective of aquatic life and to promote the “propagation and maintenance of a healthy community of cool or warm water sport or commercial fish and associated aquatic life, and their habitats” (*Minnesota Rules*, part 7050.0222). The chronic standards are restrictive standards and reflect “the highest water concentration of a toxicant to which organisms can be exposed indefinitely without causing chronic toxicity” (*Minnesota Rules*, part 7050.0218, subpart 3, item I).

The NorthMet Project Proposed Action, in combination with other reasonably foreseeable projects, could increase solute concentrations for many constituents in the Partridge River and Embarrass River. This change in existing water quality and the interactions between effects from a number of projects in the area, natural conditions, and current and future hydrology could be addressed as part of the non-degradation analysis for the NorthMet Project Proposed Action in permitting. The NorthMet Project Proposed Action, in particular, but to some extent in combination with other existing and reasonably foreseeable projects, would shift maintenance of water quality in the Partridge River and Embarrass River from natural systems (i.e., essentially an ecosystem service) to mechanical systems (e.g., the NorthMet Project Proposed Action WWTF and WWTP). Given that with the proposed design modifications and engineering controls, the water quality model predicted that the NorthMet Project Proposed Action would not cause any significant water quality impacts, impacts due to changes in water quality from NorthMet Project Proposed Action, in combination with other reasonably foreseeable projects, to aquatic species are not anticipated.

6.2.6.3.2 Physical Habitat Effects

Hydrologic changes are often one of the major sources of effects on fish and macroinvertebrate habitat. While many aspects of the hydrologic regime can be important to the maintenance of fish and macroinvertebrate assemblages, reduction in baseflow (the portion of streamflow from groundwater) is particularly relevant because it represents a change or even a loss of habitat.

Section 5.2.6.2 concluded that the NorthMet Project Proposed Action would reduce flow upstream of Colby Lake and in the Embarrass River by very small amounts from the current baseline habitat conditions. Alterations due to multiple projects in the Second Creek Watershed within the Partridge River Watershed along with the planned flow augmentation of Second Creek due to the NorthMet Project Proposed Action may contribute to small cumulative effects on aquatic habitat if flows fluctuate by more than 20 percent, but fluctuations of this magnitude are not expected (see Section 6.2.2). Changes in average annual flow of less than 20 percent would fall into the range of annual natural variability in terms of precipitation and would have minimal impacts to ecosystem function and aquatic species within the Embarrass River Watershed.

After 2070, when Northshore Mine dewatering discharge is predicted to end, there may be effects on the headwater Partridge River instream habitat due to loss of flow. The NorthMet Project Proposed Action, however, would not be expected to contribute measurably to this cumulative effect, but instead would reduce the effect by discharging treated water in mine year 52.

6.2.6.3.3 Effects from Mercury

Estimated Mercury Deposition

The NorthMet Project Proposed Action, along with other reasonably foreseeable projects have the potential for adverse effects from mercury deposition on nearby lakes, including the Heikkila, Colby, Sabin, Wynne, and Whitewater lakes, the Partridge River and Embarrass River watersheds, and the aquatic biota within these waterbodies.

The cumulative effects of mercury from the NorthMet Project Proposed Action and other cumulative actions on risks to fish consumption were analyzed using the MMREM. As described in Section 5.2.7.2.5, the MMREM assessed the potential changes in fish mercury concentrations in the following nearby lakes (Barr 2015f):

- Heikkila Lake;
- Colby Lake;
- Sabin Lake;
- Wynne Lake; and
- Whitewater Lake.

The five lakes are located within 12 km, about 7 miles, of the Plant Site. Heikkila Lake, Sabin Lake, and Wynne Lake are included in the Embarrass River watershed, while Colby Lake and Whitewater Lake are closest to the Plant Site and are part of the Partridge River watershed. The closer a lake is to the Plant Site, the greater the potential for more effects from deposition related to Plant Site operations.

The MMREM method relies on empirical fish contamination data (Barr 2012b), combined with the principle of proportionality between mercury in fish and atmospheric deposition (MPCA 2006a). As other cumulative analyses have identified that local impacts from mercury deposition are small and likely not measureable in terms of fish mercury concentration within 10 kilometers of a single project, it is expected that projects located further away would have fewer impacts. Consequently, it has been determined that the maximum extent of the quantitative cumulative impact assessments using the MMREM is about 25 kilometers (about 16 miles) from the specific project of interest (Barr 2015f). The analysis considered deposition from the NorthMet Project Proposed Action and the Mesabi Nugget emissions over existing risks. The Mesabi Nugget Large Scale Demonstration Plant was assessed because it is the only “reasonably foreseeable” project within 25 km of the NorthMet Project Proposed Action.

Because of uncertainty in speciation of emissions of the NorthMet Project Proposed Action, two speciation scenarios were used for assessing potential effects for the NorthMet Project (Barr 2015f), while only one scenario was used to evaluate the Mesabi Nugget Large Scale Demonstration Plant emissions since there was no uncertainty in the speciation of the emissions from this action. The first scenario for the NorthMet Project Proposed Action represents a conservative overestimation of oxidized mercury (25 percent elemental mercury, 50 percent oxidized mercury, and 25 percent particle bound mercury), while the second scenario is a more conservative and more likely speciation for air emissions (80 percent elemental mercury, 10 percent oxidized mercury, and 10 percent particle bound mercury) that is considered to provide a worst-case emissions scenario for the NorthMet Project Proposed Action. The scenario for the Mesabi Nugget Large Scale Demonstration plant evaluates 99.3 percent elemental mercury (see Section 5.2.7.2.5).

The current MPCA-estimated mercury atmospheric deposition rate is 12.5 $\mu g/m^2/yr$ for northeast Minnesota (MPCA 2007), which translates into about 250 pounds of mercury currently being deposited onto the St. Louis River Watershed (3,600 square miles) every year due to background deposition. The potential total annual deposition in the watershed from the NorthMet Project Proposed Action is estimated to be about 0.17 pounds per year (Barr 2012b), which is less than 0.1 percent of the estimated 250 pounds per year of mercury already being deposited to the St. Louis River watershed due to background deposition.

The cumulative analysis assessment showed that projected increase in mercury concentrations from the two reasonably foreseeable cumulative sources in the fish for the five lakes ranges from 0.3 to 1.8 percent (when considering both speciation scenarios), of which the increased percentage from the NorthMet Project Proposed Action alone ranges from 0.2 to 1.6 percent. Therefore, although the NorthMet Project Proposed Action would account for the majority of the increase, the total added mercury to the lakes is small compared to background conditions. The highest impact in fish concentration from the NorthMet Project Proposed Action alone was at Wynne Lake where the estimated incremental increase to fish tissue mercury concentration is 0.016 ppm. This estimated incremental change in fish mercury concentration is small compared to the background fish tissue mercury concentrations in Wynne Lake range, which range from 0.35 to 2.06 ppm. The increase to fish tissue mercury concentrations at the remaining four lakes was at or below 0.012 ppm (Barr 2013c) with the background fish tissue mercury concentrations in these lakes ranging from 0.12 ppm in Whitewater Lake to 2.06 ppm in Heikkila Lake (Barr

2015f). These potential increases would not be expected to have an appreciable effect on fish tissue mercury concentrations in the Embarrass River or Partridge River and would not have any effect on the current fish consumption advisories for the respective lakes.

Hazard Quotient

The Hazard Quotient is the ratio of the mercury concentration in fish to a health-based target of 0.2 ppm; a Hazard Quotient greater than 1 exceeds the health-based target. To estimate the potential incremental Hazard Quotient, the incremental methylmercury exposure in mg/kg body weight per day and the reference dose are accounted for in the calculation. The incremental Hazard Quotient calculation in the MMREM Spreadsheet uses the following methodology:

- Incremental daily mercury consumed (mg) = estimated incremental increase in fish mercury due to the Project (mg/kg) x the amount of fish consumed (e.g. 0.142 kg for a subsistence fisher);
- Incremental methylmercury exposure (mg/kg body weight per day) = Incremental daily mercury consumed x 1.07945 / adult body weight (70 kg); and then
- Incremental Hazard Quotient = incremental methylmercury exposure (mg/kg body weight per day) / Reference Dose of 1.00E-04 mg methylmercury/kg body weight per day (i.e., the ratio of the incremental methylmercury exposure divided by the reference dose in the same units).

The maximum incremental cumulative Hazard Quotient from the two reasonably foreseeable cumulative projects over existing fish mercury concentrations is 0.08 for recreational anglers, 0.61 for subsistence/tribal anglers, and 0.54 for subsistence fishers. This is only about a 0.3 to 1.8 percent increase over the existing incremental risk levels, for recreational, subsistence/tribal and subsistence anglers. Of this, the NorthMet Project Proposed Action would contribute approximately 59 to 92 percent of the incremental cumulative Hazard Quotient. Note that the current fish tissue concentration in the five lakes results in Hazard Quotients that exceed 1, leading to the need for the fish consumption advisories currently in effect (see Table 6.2.6-1).

Table 6.2.6-1 Analysis of Existing Hazard Quotients of Cumulative Impacts from Mercury Deposition for Five Lakes following Three Fish-Consumption Scenarios

Lake	MDNR #	Speciation Scenario	Recreational Angler[1]		Subsistence/Tribal Angler[2]		Subsistence Fisher[3]	
			Existing HQ	**Incremental Cumulative HQ**	**Existing HQ**	**Incremental Cumulative HQ**	**Existing HQ**	**Incremental Cumulative HQ**
Colby Lake	69024900	Scenario 1	4.3	0.05	32	0.4	28.4	0.35
		Scenario 2		0.02		0.1		0.10
Heikkila Lake	69025300	Scenario 1	3	0.05	22.3	0.4	19.8	0.35
		Scenario 2		0.01		0.1		0.09
Sabin Lake	69043401	Scenario 1	4.7	0.06	35.1	0.5	31.2	0.41
		Scenario 2		0.02		0.1		0.11
Whitewater Lake	69037600	Scenario 1	1.6	0.01	11.9	0.1	10.6	0.09
		Scenario 2		0.01		0.0		0.03
Wynne Lake	69043402	Scenario 1	6.2	0.08	46.2	0.6	41	0.54
		Scenario 2		0.02		0.2		0.15

Source: Barr 2012b.

Notes:
[1] Consumption rate assumed to be 30 grams/ day.
[2] Consumption rate assumed to be 224 grams/ day and approximates the allowed take of fish by a Tribal member (~180 pounds per year of fish).
[3] Consumption rate assumed to be 199 grams/day.

Water Mercury Mass Balance

In addition to atmospheric mercury deposition, water discharges from the NorthMet Project area would affect the mercury load in the Embarrass and Partridge rivers (and ultimately on downstream portions of the St. Louis River). As discussed in Section 5.2.2.3.4, a water mass balance was performed to assess mercury load from NorthMet Project Proposed Action. The mass balance indicated that overall, the NorthMet Project Proposed Action is predicted to result in a net decrease in mercury loading to the St. Louis River watershed and is not likely to result in an appreciable change in the mercury concentration in fish in waterbodies of the St. Louis River watershed, including the Embarrass River or Partridge River, or in the St. Louis River itself (Barr 2015f). Potential mercury increases from air deposition discussed above would not be expected to have any appreciable effect on inputs into the water quality mass loading calculations.

Statewide Mercury TMDL and Mitigation Measures

The MPCA Statewide Mercury TMDL is intended to provide the long-term framework to reduce mercury in fish within Minnesota lakes, including the five lakes targeted in this assessment. The MPCA and industries emitting mercury into the atmosphere are working to reduce Minnesota sources' contribution to fish contamination. Minnesota is relying on actions by other states and the USEPA to address deposition from long-range sources.

In the period of time between completion of the cumulative effects analysis background study for Minnesota Steel and the development of this FEIS, Minnesota stakeholders created an implementation plan for Minnesota's mercury TMDL (MPCA 2009). Within the implementation plan, there is a process for assessing new and expanding sources of mercury in Minnesota. It is important to assess sources so that while existing sources reduce emissions, new sources do not interfere or confound the state's progress in reducing mercury emissions overall. At the recommendation of the Minnesota stakeholders, MPCA has developed guidance for new and modified sources of mercury in Minnesota (MPCA 2013d). The guidance requires sources to: employ best controls to reduce mercury emissions and apply emissions limits to permit conditions. MPCA has conducted a review of the NorthMet Project Proposed Action mercury emissions and has determined that it would not impede the reduction goals (MPCA 2013c). Thus, no minimization and mitigation plan would be required for the NorthMet Project Proposed Action (see Section 5.2.7.2.5). Mercury mitigation measures are summarized in Section 5.2.2.3.5 (water) and in Section 5.2.7.4 (air).

6.2.7 Air Quality

Several components of the NorthMet Project Proposed Action would combine with other past, present, and reasonably foreseeable proposed actions to cause cumulative effects on air quality. Of particular concern are the effects on Class I and Class II areas, especially with respect to acid deposition, particulates, and visibility impairment. Both direct and indirect effects of the NorthMet Project Proposed Action were used to calculate its effects in combination with those of other emission sources. Given the public's concern over air quality in the BWCAW and Voyageurs National Park, the analysis modeled how emissions from the NorthMet Project Proposed Action and other projects in the airshed would affect air quality and visibility in these areas.

6.2.7.1 Approach

Cumulative effects have been evaluated to assess the potential effects from other foreseeable projects that have been approved by regulatory agencies, but have not been implemented or accounted for in existing air quality conditions. The assessments of these projects, in combination with the NorthMet Project Proposed Action, were conducted to evaluate the overall effects on the NAAQS/MAAQS, the USEPA PSD Class I and Class II standards, and the USEPA Class I Visibility and Regional Haze criteria.

6.2.7.2 Cumulative Effects Assessment Area

6.2.7.2.1 Spatial

The CEAA for air quality is defined as those areas that are beyond the boundaries of the Plant Site, Mine Site, the Mesabi Nugget Ambient Air Boundary, and the Northshore Mine (labeled as St. Louis County Tax Records) identified on Figure 6.2.7-1. The cumulative receptors on the figure (in blue) provide spatial projection of the closest receptors used in the modeling that are at or beyond the four boundary areas identified above.

6.2.7.2.2 Temporal

Based on the approved model's limitations, this evaluation used a qualitative baseline of industrial growth within the Arrowhead Regional Airshed as indicative of the historical and more recent effects on air quality resulting in the current ambient conditions.

6.2.7.3 Past, Present, and Reasonably Foreseeable Future Actions

The air quality modeling used existing background to represent the cumulative effects from all past, present, and reasonably foreseeable future actions that affect air quality in the region.

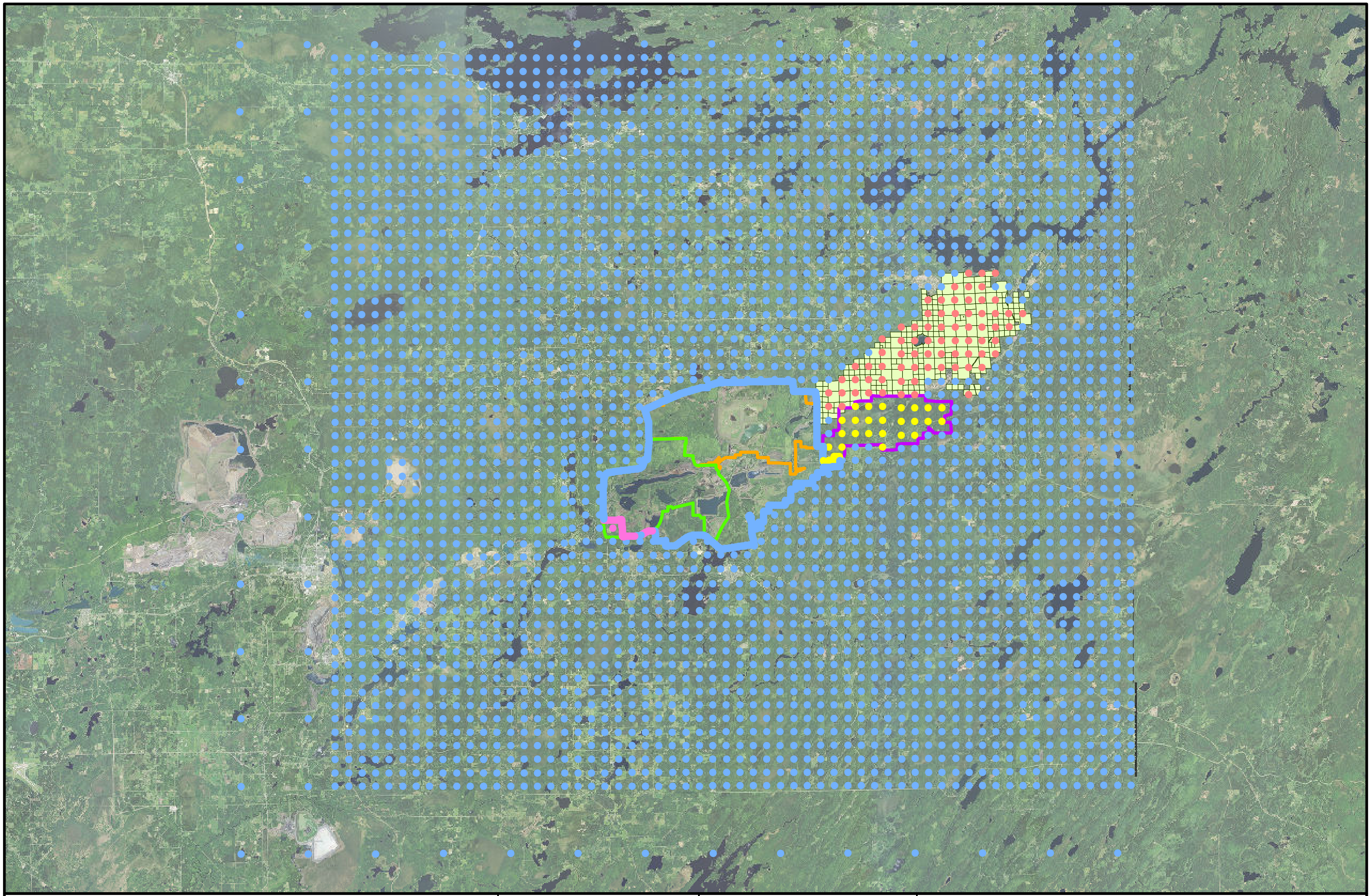
6.2.7.4 Cumulative Effects Assessment

Air quality modeling analyses were conducted to assess cumulative effects on NAAQS, MAAQS, PSD Class II Increments, and Class I Increments using a similar modeling approach discussed in Section 5.2.7.2.1. However, relative to NAAQS, MAAQS, and PSD Class II Increments, the receptor locations were restricted to areas at and beyond the former LTVSMC ambient air boundary as defined in the Final SDD. However, the Class II modeling report for the

Plant Site included a more detailed and up-to-date assessment of combined effects at the Plant Site. For PSD Class I Increments, the cumulative analysis was conducted by adding the maximum effects from the NorthMet Project Proposed Action to the maximum effects from the cumulative analysis prepared for the Minnesota Steel EIS (MDNR and USACE 2007), in order to assess overall cumulative effects. The following sections describe the results of these assessments.

6.2.7.4.1 Cumulative Ambient Air Quality Effects (NAAQS/MAAQS)

As stated earlier, an assessment of the Plant Site was conducted using the same modeling approach as presented in Section 5.2.7, except that receptor locations were limited to the Plant Site's boundary combined with the shared properties of the Mesabi Nugget and Cliffs Erie Pellet Yard (using the former LTVSMC processing plant boundary) as the ambient air boundary. It should be noted that the NorthMet Project Proposed Action emissions were evaluated on both Mesabi Nugget and Cliffs Erie property. Figure 6.2.7-1 shows the ambient air boundary for the former LTVSMC processing plant. The cumulative analysis included potential emissions for all NorthMet Project Proposed Action sources, nearby sources as defined in the Final SDD, and additional sources agreed upon with the MPCA, as identified above.



- Cumulative Receptors
- Mesabi Nugget
- NorthMet Project Mine Site
- NorthShore Mine
- Mesabi Nugget Ambient Air Boundary
- Mine Site Ambient Air Boundary
- Plant Site Ambient Air Boundary
- St Louis County Tax Records

US Army Corps of Engineers
St. Paul District

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0 1.5 3 6 Miles

Figure 6.2.7-1

Ambient Air Boundary - EIS Cumulative NAAQS/Increment Receptor Grid NorthMet Plant Site EIS Class II Modeling Report

NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

56

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Table 6.2.7-1 summarizes the results of the cumulative NAAQS/MAAQS model analysis. Except for the cumulative 1-hour SO_2 and 1-hour NO_2 effects, all other maximum cumulative effects were below the respective NAAQS and MAAQS, ranging from 24 percent to 97 percent of their respective standards. In order to compare with the applicable standards, the following calculated maximum concentrations were defined, as defined in Section 5.2.7, by the "highest nth high" concentration (HnH) as follows:

- 24-hour PM_{10} – H6H;
- 24-hour $PM_{2.5}$ and 1-hour NO_2 – H8H;
- 1-hour SO_2 – H4H;
- 3-hour and 24-hour SO_2 – H2H; and
- All annual – maximum.

Ambient air background concentrations were added to modeled concentrations to determine compliance with NAAQS and MAAQS. Background concentrations represent the 2008 to 2010 values from the Blaine-Anoka Airport Monitor (the nearest monitoring station available for model input), Rosemont Monitor, and Virginia Monitoring Stations for NO_2, SO_2, and PM_{10}/$PM_{2.5}$, respectively.

The maximum predicted ambient 1-hour NO_2 concentration was 292 μg/m^3, which was predicted to occur to the southwest portion of the ambient air quality boundary, and exceeded the 1-hour NO_2 NAAQS (188 μg/m^3). The Plant Site modeled contribution at the location of maximum effect was 0.002 μg/m^3. Other receptors where concentrations were lower than the maximum but exceeded the 1-hour NO_2 NAAQS were predicted primarily on the western half of the receptor grid and were due to the nearby sources (see Figure 6.2.7-2). For all receptors that exceeded the 1-hour NO_2 NAAQS, the contributions from the Plant Site sources were less than the 1-hour NO_2 Significance Threshold of 7.5 μg/m^3 and are considered to have no significant contribution to the predicted exceedances.

Similarly, the maximum 1-hour SO_2 ambient concentration was predicted at the southwestern border of the ambient boundary with a value of 893 μg/m^3 and exceeded the 1-hour SO_2 NAAQS of 196 μg/m^3 (see Figure 6.2.7-3). The Plant Site maximum modeled contribution to this maximum was 0.002 μg/m^3, well below the 1-hour SO_2 SIL threshold of 7.8 μg/m^3. For all receptors that exceeded the 1-hour SO_2 NAAQS, the contributions from the Plant Site sources were less than the 1-hour SO_2 Significance Threshold, thus having no cumulative effect on any predicted exceedances.

It should be noted that modeled NAAQS exceedances do not mean that the region is in non-attainment for these standards. NAAQS attainment is determined by measuring the actual concentration of pollutants in the air by monitoring. There is no monitoring data in the region that indicates that NAAQS standards are not being met. The NAAQS model results represent the maximum allowable emissions from NorthMet and all of the nearby sources, not the actual emission rates or actual pollutant concentrations, which are lower. In addition, the model results represent worst case meteorological conditions and background pollutant concentrations. Because the NorthMet Project Proposed Action is considered a synthetic minor PSD source and is not culpable for the modeled exceedances, per EPA guidance, permits can be issued for the project without addressing the modeled exceedances.

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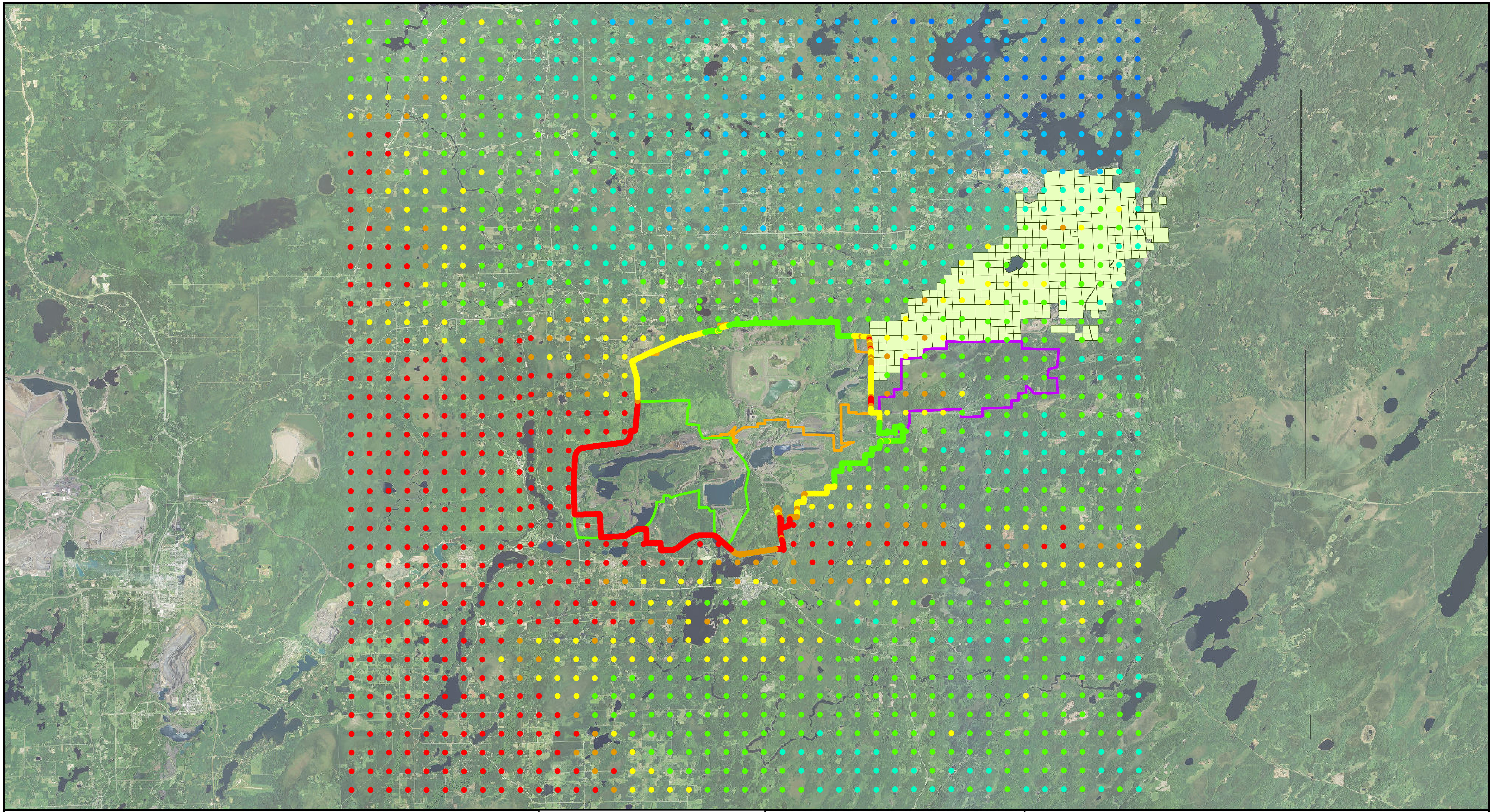

H8H Concentration ug/m

- 142 - 149
- 150 - 159
- 160 - 169
- 170 - 179
- 180 - 185
- 186 - 188
- 189 - 292

- Mesabi Nugget Ambient Air Boundary
- Mine Site Ambient Air Boundary
- Plant Site Ambient Air Boundary
- St Louis County Tax Records

Minnesota DEPARTMENT OF NATURAL RESOURCES

US Army Corps of Engineers
St. Paul District

FOREST SERVICE U S DEPARTMENT OF AGRICULTURE

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N W E S

0 1 2 4 6 Miles

Figure 6.2.7-2

1-Hour NO_2 Cumulative Effect NAAQS Results

NorthMet Mining Project and Land Exchange PFEIS
Minnesota

June 2015

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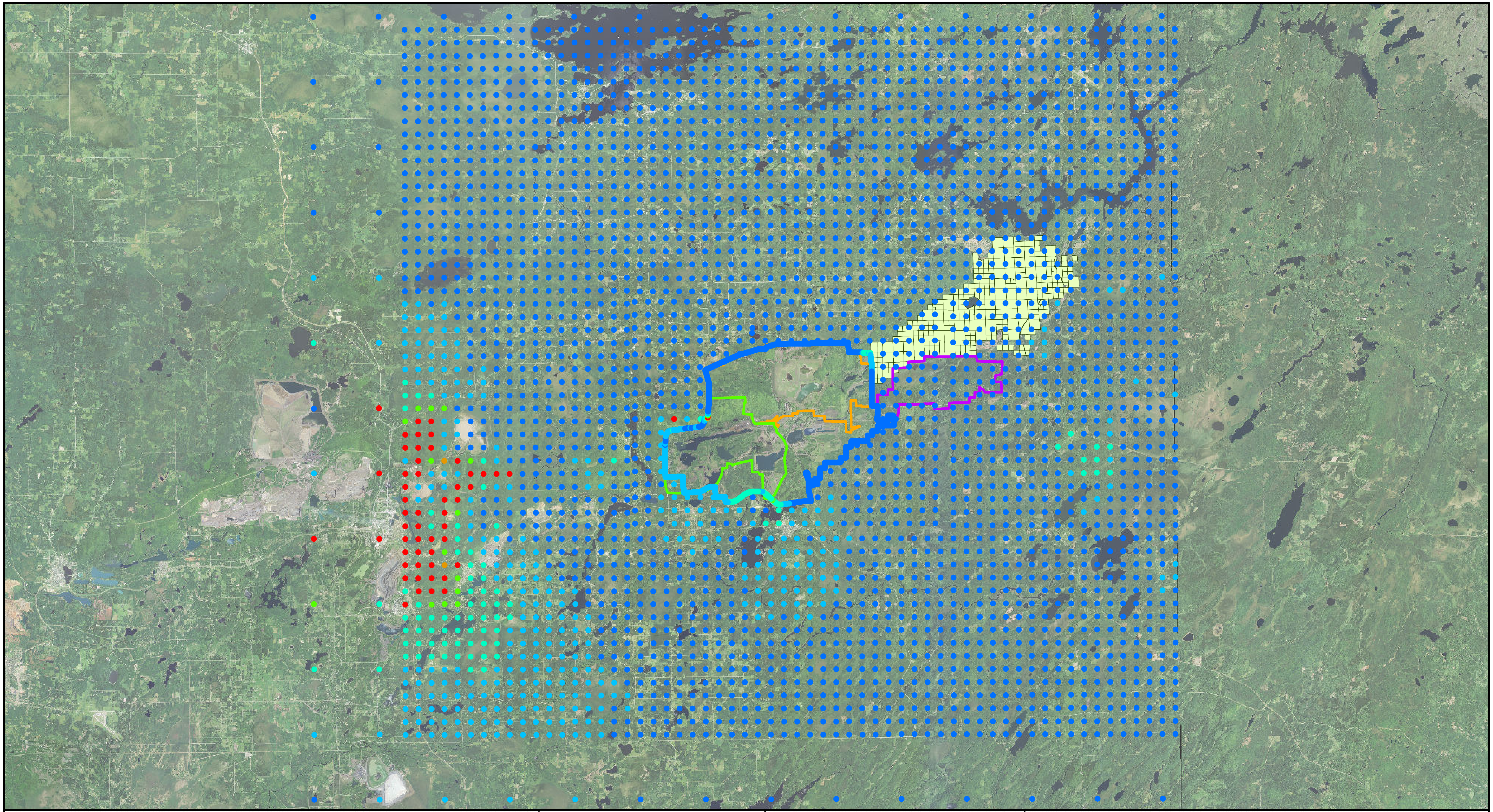

H4H Concentration ug/m³

- 61 - 100
- 101 - 130
- 131 - 160
- 161 - 180
- 181 - 190
- 191 - 196
- 197 - 925
- Mesabi Nugget Ambient Air Boundary
- Mine Site Ambient Air Boundary
- Plant Site Ambient Air Boundary
- St Louis County Tax Records

Minnesota Department of Natural Resources

US Army Corps of Engineers St. Paul District

Forest Service U.S. Department of Agriculture

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N W E S

0 2 4 8 Miles

Figure 6.2.7-3

1-Hour SO_2 Cumulative Effect NAAQS Results

NorthMet Mining Project and Land Exchange PFEIS

Minnesota

June 2015

103 -Page Intentionally Left Blank-

The MPCA is, however, taking actions to reduce emissions from taconite facilities with a goal to evolve controls at these facilities. Specifically, the Long Term Strategy contained in Minnesota's Regional Haze State Implementation Plan to protect visibility in National Parks and Wilderness Areas relies on demonstration of compliance with the 1-hour NOx and 1-hour SO_2 NAAQS at the nearby taconite facilities. The MPCA has issued administrative orders to the existing taconite facilities requiring modeling that demonstrates compliance with the NO_2 and SO_2 one-hour standards, submittal of proposed emission limits that show they no longer contribute to modeled noncompliance, and submittal of a description of any emission controls that would be needed. It is likely that additional actions may be needed to reduce pollutants from other large emitters in the region, including power plants, to address any modeled noncompliance.

Table 6.2.7-1 Results of Cumulative Class II NAAQS Modeling

Pollutant	Averaging Time	Maximum Modeled Concentration (µg/m^3)	Background (µg/m^3)	Total (µg/m^3)	NAAQS/ MAAQS (µg/m^3)
SO_2	1-hour	887	6	**893**	196/1300
	3-hour	772	12	784	NA/915
	24-hour	249	6	255	NA/365
	Annual	24	1	25	NA/40
PM_{10}	24-hour	41	36	77	150/150
	Annual	5	14	19	NA/50
$PM_{2.5}$	24-hour	17	17	34	35/65
	Annual	4	6	10	15/15
NO_2	1-hour	202	90	**292**	188/NA
	Annual	6	18	24	100/100

Note: Concentrations in **Bold** indicate exceedance with standard.

6.2.7.4.2 Cumulative Class II Increment Effects

Cumulative Class II Increment analysis was completed for PM_{10}, NO_X, and SO_2 for all increment consuming NorthMet sources at both the Mine Site and Plant Site. The modeling included all sources at maximum emission rates plus all nearby increment-consuming (and expanding) emissions sources identified above. Increment consuming (or expanding) sources are all sources with emission increases (or decreases) after the PSD Major Source baseline date for that pollutant. The results of the increment analyses are shown in Table 6.2.7-2, along with a comparison to the allowable Class II PSD increments.

The data in Table 6.2.7-2 summarize the PSD Class II Increment modeling results and demonstrate that the NorthMet Project Proposed Action, in conjunction with all other neighboring PSD sources, would satisfy all state and federal increment limits.

Table 6.2.7-2 Results of Cumulative Class II PSD Increment Analysis

Pollutant	Averaging Time	Cumulative Modeled Concentrations (µg/m3)	PSD Increment Limits (µg/m3)
SO_2	3-hour	11	512
	24-hour	1.9	91
	Annual	0.2	20
PM_{10}	24-hour	18	30
	Annual	3	17
NO_X	Annual	0.9	25

6.2.7.4.3 Cumulative Class I Increment Effects

Based upon the analysis presented in Section 5.2.7, the only modeling analysis with results above the acceptable screening thresholds was the 24-Hour Class I SIL for PM_{10} at BWCAW, which triggers a cumulative modeling assessment. The PM_{10} maximum modeled effect was below the SIL at Voyagers National Park, but Voyagers National Park receptors were included at the request of MPCA. The NorthMet Project Proposed Action is not a major source; however, a cumulative assessment was prepared following the same methodology that is used for assessing effects from major sources. A cumulative assessment requires modeling of all PSD increment consuming and expanding facilities within 300 km of BWCAW. The cumulative emission inventory, containing increment consuming and expanding sources, was obtained from MPCA. No other major sources within the region have submitted permit applications since the inventory was prepared. Recently permitted new sources, which have not begun operation or have recently begun operation, are also included in the inventory, as are certain minor sources near the Class I areas selected by MPCA.

The April 2006 FLM guidance suggests that area and mobile sources may be included in the cumulative effect assessment. However, PM_{10} emissions from these sources is small in the region due to its rural nature; furthermore, total population in the nearby counties has decreased since the minor source baseline trigger date. Therefore, no increase in area and mobile sources emissions are expected to have occurred, and these emissions are not included in the increment assessment.

Modeling was conducted to assess the 24-hour average PM_{10} concentrations within the Class I areas from the cumulative source inventory, and compared to effects from the NorthMet Project Proposed Action alone. The maximum concentration from project emissions was added to the maximum 24-hour PM_{10} concentration from the comprehensive cumulative analysis. This is a conservative approach, since the maximum modeled concentration due to the project sources is not at the same location and time as the maximum from the comprehensive assessment. Table 6.2.7-3 summarizes the results of the analysis, showing that the cumulative Class I 24-hour PM_{10} is below the Class I PSD increment, indicating that the full increment has not been consumed. Furthermore, sufficient increment remains in the area to allow for future growth.

Table 6.2.7-3 Results of Cumulative Class I PSD PM_{10} Increment Analysis

Class I Area	Averaging Time	Maximum Modeled Air Concentration For NorthMet Modeled Emissions (µg/m^3)	Maximum Modeled Air Concentration For Cumulative Modeled Emissions (MPCA Inventory[1]) (µg/m^3)	Total Cumulative Modeled Air Concentration (µg/m^3)[2]	PSD Increment Limit (µg/m^3)
BWCAW	24-hour	0.33	1.76	2.09	8
Voyageurs National Park	24-hour	0.13	0.22	0.35	8

Notes:
[1] The MPCA inventory includes the NorthMet Project Proposed Action, but not the same emission data that were modeled for the SDEIS.
[2] The value is conservative because the NorthMet Project Proposed Action is included in both the MPCA inventory and the modeling done for the NorthMet Project Proposed Action alone for the SDEIS.

6.2.7.5 Cumulative Effects of Acid Deposition on Ecosystems

The potential for cumulative effects of acid deposition on ecosystems was evaluated in terms of the potential increased acidification on the terrestrial and aquatic systems within a six county area (Carlton, Itasca, St. Louis, Koochiching, Lake, and Cook counties) from 1980 to 2015, as defined in the Final SDD (MDNR 2005). The pollutants of consideration included both wet and dry deposition due to sulfate depositions from SO_2 emissions to the air and nitrate deposition from NO_2 emissions to the air. Both of these pollutants can be exposed to long-range transport and are subject to complex chemical and physical reactions prior to being washed out by precipitation into lakes and rivers. MPCA has estimated that over 90 percent of the acid deposition within Minnesota is a result of out-of-state emissions from long-range transport (State of Minnesota 1985). Findings from other states and NAPAP (Mahoney et al. 1998) led the USEPA to develop the federal Acid Deposition Control Program.

Based upon the most recent information available at the time this cumulative analysis was conducted by PolyMet in January 2012, there are approximately 11 new projects for the six-county area, including the NorthMet Project Proposed Action. Collectively, without accounting for recent past reductions or expected future reductions, these sources could emit up to an additional 6,635 tons per year NO_x and 2,807 tons per year SO_2, if all were constructed and operated (Barr 2012o). This represents approximately a 12 percent and 7 percent increase, respectively, in the estimated emissions for the two pollutants in the six county “zone of interest” through 2009 (Carlton, Itasca, St. Louis, Koochiching, Lake, and Cook counties). However, due to the projected decreases in emissions from the Minnesota Power Arrowhead Regional Emission Abatement proposal in combination with various federal programs, including the implementation of the taconite and electric utility Maximum Achievable Control Technologies (MACTs), Best Achievable Retrofit Technology (BART) on Regional Haze Program and Clean Fuels Regulations, the overall emissions would be reduced by 5,503 tpy and 3,292 tpy for NO_2 and SO_2 respectively, since 2009 (Barr 2012o). In addition, supplemental decreases in emissions from the two pollutants are expected to occur due to other reasonably foreseeable actions.

As such, the emissions from the NorthMet Project Proposed Action, in combination with other projects, would emit increased amounts of SO_2 and NO_2 emissions, resulting in a potential increase in acid deposition that may be too small to measure. However, due to the NorthMet Project Proposed Action having relatively low emissions of SO_2 and NO_2 and potential deposition of sulfate and nitrate are below both the Minnesota standard threshold value and the federal Class I threshold values, in combination with the overall reduction in sulfate and nitrate-producing emissions cumulatively since 2008, the projects would not likely cause a cumulative effect on the ecosystems.

6.2.7.6 Cumulative Visibility Effects

A cumulative effects analysis assessing the potential visibility effects on Federal Class I areas was performed to provide information for the DEIS (Barr 2006h). Also, in addition to the quantitative assessment of cumulative PM_{10} increment consumption in the BWCAW described in Section 6.2.7.4.3, a semi-quantitative assessment of potential cumulative PM_{10} air concentrations and the potential effect on increment consumption in Minnesota Class I areas was also completed (Barr 2012o).

6.2.7.7 Cumulative Effects Analysis – Class I Visibility

To help determine the potential effects on visibility impairment in the Class I areas in Minnesota from the NorthMet Project Proposed Action when combined with all other concurrent projects, a cumulative effects analysis for visibility was performed by PolyMet. The semi-quantitative analysis took into account the NorthMet Project Proposed Action along with other projects that were recently permitted or are currently in the permitting or environmental review process. The results of the analysis were described in a technical report – *Cumulative Impacts Analysis Minnesota Iron Range Industrial Development Projects; Assessment of Potential Visibility Impacts in Federal Class I Areas in Minnesota* (hereafter called the '2006 Visibility Class I Study' [Barr 2006h]). An updated report was also submitted in 2012 (Barr 2012o). The 2006 Visibility Class I Study addresses the effects of the NorthMet Project Proposed Action and all other past and "reasonably foreseeable" proposed projects consistent with the SDD. This analysis focused on a four-county project area (Itasca, St. Louis, Lake, and Cook counties).

The analysis presented here represents an update to the study previously prepared for the DEIS (Barr 2006h). The updated analysis includes a six-county project area (two additional counties added: Koochiching and Carlton), additional projects, and updated information on some projects included in the 2006 study (Barr 2012o). These updates were incorporated to make the analysis consistent with the work done in Minnesota to address the federal Regional Haze Rule since the 2006 Visibility Class I Study was submitted to the state agencies.

6.2.7.8 Background on the Regional Haze Rule

The USEPA published regulations in July 1999 intended to improve visibility in the nation's Class I areas. On June 15, 2005, the USEPA issued final amendments to the July 1999 rule. This rule and amendments are referred to as the Regional Haze Rule. Minnesota has two Class I areas—the BWCAW and Voyageurs National Park. In addition, emissions from Minnesota contribute to visibility impairment to Michigan's Isle Royale National Park Class I area. The rule requires that by year 2064, visibility in the Class I areas reflect no man-made impairment and also requires the installation of BART emission controls that reduce visibility impairment, for certain industrial facilities emitting air pollutants. The MPCA submitted a SIP to the USEPA in 2009, updated in 2012, that describes a 2018 visibility goal that makes reasonable progress towards the ultimate 2064 goal. Minnesota's Regional Haze SIP outlines the 2018 visibility goal and includes a target for 30 percent reduction in combined NOx and SO_2 emissions by 2018 from 2002 levels from point sources in Northeast Minnesota that emit over 100 tons per year of either NOx and SO_2 (MPCA 2009a).

Minnesota has been included in the Cross-State Air Pollution Rule (CSAPR), as described in 40 CFR 52.1240-1241. In 2011, the USEPA proposed that the emissions reductions in CSAPR achieved greater reasonable progress than source-specific BART determinations for power plants. As such, Minnesota has submitted a Regional Haze SIP Supplement (MPCA 2012g) to substitute CSAPR for BART for power plants. On June 12, 2012, the USEPA partially approved the SIP supplement. The partial approval allowed the substitution of CSAPR for BART of power plants; however, it failed to approve the BART emission limits for the taconite facilities. The partially approved plan also includes the identification of Class I areas, calculating baseline and natural visibility, establishing reasonable progress goals, adopting a long-term strategy for progress toward visibility goals, providing a monitoring strategy, and consulting with other states and FLMs prior to development of a regional haze plan. On August 21, 2012, the U.S. Circuit Court vacated the CSAPR. As such, unless the Supreme Court reverses the lower court decision, MPCA would be required to make source-by-source BART determinations for the power plants. On February 6, 2013, the USEPA issued a Federal Implementation Plan to set emissions standards for the six taconite facilities in Minnesota (and one in Michigan) that is designed to reduce NO_x emissions by 22,000 tpy and SO_2 by 2,000 tpy.

6.2.7.8.1 Summary of the 2006 Visibility Class I Study Scope (Updated in 2011) – Background

<u>Regional Haze and Visibility Impairment</u>

The USEPA defines "regional haze" as visibility impairment caused by the cumulative air pollutant emissions from numerous sources over a wide geographic area (USEPA 2003). The primary pollutants that are contributing to regional haze in Minnesota's Class I areas are anthropogenic emissions of fine particulate matter ($PM_{2.5}$). $PM_{2.5}$ includes ammonium sulfate, ammonium nitrate, and organic carbon matter (MPCA 2009a). Each of these components can be naturally occurring or can be the result of human activity. The natural levels of these species result in some level of visibility impairment in the absence of any human influences, and would vary with season, daily meteorology, and geography (USEPA 2003).

There are two categories of fine particulates: primary and secondary. Fine particulates, 2.5 microns or less in diameter, that are placed directly into the atmosphere are called primary particulates. Secondary particulates are formed as a secondary pollutant by the chemical transformation of NOx, SO_2, or VOC. Secondary particulates are the main contributor to regional haze. Both categories of fine particulates (primary and secondary) can be transported long distances.

Coarse particles between 2.5 and 10 microns in diameter do contribute to light extinction. However, these particles tend to settle out from the air more rapidly than fine particles and can be found relatively close to their emission sources (USEPA 2004, MPCA 2005), so emissions from the NorthMet Project Proposed Action in this size range are not likely to impact Class I areas.

Measuring Visibility

Visibility is characterized by the light extinction coefficient and haze index. Additional description on these two measures of visibility is provided below.

Light Extinction Coefficient

The light extinction coefficient is the sum of the atmospheric concentration of each species of interest multiplied by a corresponding coefficient. The light extinction coefficient is referred to as b_{ext} and has units of 10^{-6} m^{-1} or $(10^6 m)^{-1}$, or as typically labeled, inverse megameters (Mm^{-1}). Data from the Interagency Monitoring of Protected Visual Environments (IMPROVE) network is used to calculate light extinction coefficients for those Class I areas where monitoring is conducted.

Haze Index (Deciview)

The haze index or deciview (dv) was developed to address the issue that light extinction coefficients are non-linear with respect to human perception of visual changes. The dv is derived from calculated light extinction, and is designed such that uniform changes in haze correspond approximately to uniform incremental changes in perception, across the entire range of conditions, from pristine to highly impaired (40 CFR Part 51.301).

Visibility Impairment "Cumulative Impact" Approach

The scope of the updated cumulative effects on visibility for the NorthMet Project Proposed Action was completed in essentially four general steps:

- Assess the IMPROVE data for Voyageurs National Park and the BWCAW to provide the current status of particulate air concentrations and haze index including a trends analysis where there is sufficient data. PM_{10} concentrations are used to assess particulate concentration trends.
- Assess available information from the Regional Haze State SIP that identifies emission sources and/or emission source regions as significant contributors to ambient air concentrations in the Class I areas located in Minnesota.
- Evaluate local, statewide, and national SO_2, NOx, and PM_{10} emissions and trends using existing emission inventory data.
- Evaluate the cumulative effects from the proposed projects based on the potential increases in SO_2, NOx, and PM_{10} emissions and concurrent reductions from current and reasonably foreseeable projects and the expected decrease in state and national emissions.

Analysis Boundaries

The following boundaries were identified to define the extent of the analysis for the visibility cumulative effects study:

- The timeframe for the trends analysis, both past and future.

- The timeframe for this analysis is 1990 to 2035.
- Other “reasonably foreseeable” actions to be assessed in addition to the NorthMet Project Proposed Action.

The following projects and actions are considered to be underway or “reasonably foreseeable”:

- Proposed Projects:
  - Excelsior Energy, Mesaba Energy Project, Coal Gasification Power Plant;
  - Essar Steel Minnesota LLC (formerly Minnesota Steel Industries), Mining/Taconite/DRI/Steel Plant;
  - Essar Steel Minnesota LLC, Project Modifications;
  - Mesabi Nugget, Large Scale Demonstration Plant;
  - Mesabi Mining Project;
  - Northshore Mining Company, Furnace 5 Reactivation Project;
  - NorthMet Mining Project;
  - Sappi Cloquet Plant Expansion;
  - UPM/Blandin Paper Mill Expansion, Project Thunderhawk;
  - U.S. Steel Keetac Expansion Project; and
  - United Taconite Green Production Project.
- Emission Reduction Projects:
  - Hill Wood Products major modification amendment;
  - Minnesota Power Taconite Harbor Energy Center Unit 2, Emission Control Modifications;
  - Minnesota Power Laskin Energy Center Unit 2, NOx Reductions;
  - Minnesota Power Boswell Energy Center Unit 3;
  - Northshore Mining Company: BART Reductions;
  - U.S. Steel Minntac BACT Reductions; and
  - United Taconite BART Reductions.
- Regulatory and other actions:
  - Implementation of the CSAPR (40 CFR parts 52.1240-1241); and
  - Implementation of the Regional Haze Rule and BART Rule.
- On-road mobile source programs:
  - Fuel blending standards; and
  - Tier II/Low-sulfur gasoline.

- Non-road mobile source programs:
  - Control of emissions from unregulated non-road engines;
  - Locomotive/marine engine reductions;
  - Non-road diesel rule; and
  - Updates and additions to the NAAQS for SO_2, NO_2, PM/$PM_{2.5}$, and ozone, including 1-hour NO_2 and SO_2 standards.

Geographic Area that May be Affected ("Zone of Impact")

The "zone of impact" is defined as the area of concern to be evaluated for potential cumulative effects due to the above-listed actions. Based on the scope defined in the SDD for the NorthMet Project Proposed Action, the selected zone of impact is defined as Voyageurs National Park and the BWCAW. Voyageurs National Park is primarily located in St. Louis County, while the BWCAW encompasses parts of St. Louis, Lake, and Cook counties.

Assessment of Existing Conditions

An assessment of the baseline visibility conditions for Minnesota's Class I areas is based on monitoring data from the IMPROVE program. Monitor sites from both the BWCAW (monitor ID: BOWA1) and Voyageurs National Park (monitor ID: VOYA2) were included in the analysis. The IMPROVE website (http://vista.cira.colostate.edu/improve/Default/htm) along with the Visibility Information Exchange Web System (VIEWS) (http://vista.cira.colostate.edu/ views/Web/Data/DataWizard.aspx), provide ambient air concentrations for particulate speciated by chemical and relative humidity data. Although another site collected data at Voyagers National Park (VOYA1), it was not used in the trend analysis due to a lack of continuous measurements and change in monitoring location, a comparison with VOYA2 was made. The VIEWS website provides the total light extinction coefficient from aerosol measurements and relative humidity.

The data for the BOWA1 location indicates a downward trend for haze index (visibility improvement) from 1992 to 2009 for the 20 percent best days, 20 percent worst days, and the median days. The data for VOYA2, representing a shorter time period from 2000 to 2009, showed a lesser visibility improvement trend in the haze index for the 20 percent best days, 20 percent worst days, and median days (-14 percent, +1 percent, -9 percent, respectively) in the rolling 5-year average data, primarily due to 2009 levels. It should be noted that the comparison of the average HI median concentration dvs between VOYA1 (1988-1993) and VOYA2 (2000-2009) showed a 17 percent decrease in dvs between the two sites.

Natural, local, state, national, and international emission sources contribute to visibility impairment in Minnesota's Class I areas. Minnesota's Regional Haze SIP recognizes that international pollution is a contributor to visibility impairment in Minnesota's Class I areas.

The Regional Haze SIP includes a modeling analysis of the potential contributions to light extinction for ammonium sulfate and ammonium nitrate on the 20 percent worst days by Minnesota and surrounding states for the projection year 2018 for BWCAW and Voyageurs National Park. The analysis indicates that Minnesota is the single largest contributor to visibility impairment at approximately 30 percent. The remaining 70 percent of the estimated contribution is from surrounding states such as Iowa, Illinois, and Wisconsin, as well as other distant areas. Northeast Minnesota sources make up approximately 50 percent of the contribution of visibility impairment coming from Minnesota (MPCA 2009a) or about 15 percent of the total from all sources.

6.2.7.9 Summary of Emission Trends

Table 6.2.7-4 shows the estimated potential emissions of SO_2, NOx, and PM_{10} from each of the proposed projects included in this analysis. Concurrent emission reductions are provided for comparison to the emissions estimated for the proposed projects. Proposed projects were included only if they were not operating for most of 2009. This cutoff date was chosen since the monitoring and emission inventory data used to assess the past or existing conditions includes information up to 2009. Any sources not operating during most of 2009 were not included in the analysis of the existing conditions and therefore need to be considered in the assessment of future cumulative effects.

Emissions of both NO_x and SO_2 have been reduced in northeast Minnesota by reductions from power generation facilities. However, both power generation facilities and the mining facilities contribute to visibility impairment in the area. As discussed in the *Background on Regional Haze* section above, the MPCA currently has a Regional Haze SIP goal to reduce combined NO_x and SO_2 emissions from northeast Minnesota from 2002 levels by 30 percent by 2018. Current MPCA estimates indicate that emission reductions at power generation facilities and additional reasonably foreseeable projects in northeast Minnesota are not enough to meet the current Regional Haze SIP goal; however, they are on track to meeting the reduction goal. Therefore, additional mitigation or reductions may be necessary.

Even though there is a net increase in PM_{10} for all the proposed projects combined, direct PM_{10} emissions are not considered to be a concern for visibility impairment in the BWCAW or Voyageurs National Park as described in Minnesota's Regional Haze SIP (MPCA 2009a).

Table 6.2.7-4 Maximum Potential SO_2, NO_x, and Particulate Emissions from the Proposed Projects in the Six-County Project Area CEAA in Comparison to Emission Reductions

Project	City/County	SO_2 (tpy)	NO_x (tpy)	PM_{10}[(18)] (tpy)	BACT/ MACT[18]
Increases					
Excelsior Energy, Mesaba Energy Project[1]	Taconite or Hoyt Lakes, St. Louis or Itasca County	1,390	2,872	532	Yes
Mesabi Nugget LSDP[2]	Hoyt Lakes, St. Louis County	417	955	587	Yes
Mesabi Mining Project[3]	Hoyt Lakes, St. Louis County	7	298	1,260	Yes
Essar Steel Minnesota LLC (formerly Minnesota Steel)[4]	Nashwauk, Itasca County	421	1,505	1,354	Yes
Essar Steel Minnesota LLC Project Modifications[5]	Nashwauk, Itasca County	146	-69	-90	Yes
Northshore Mining Company, Furnace 5 Reactivation[6]	Silver Bay, Lake County	56	200	149	Yes
PolyMet Mining, NorthMet	Hoyt Lakes, St.	40	473	1,186	No

Project	City/County	SO_2 (tpy)	NO_x (tpy)	PM_{10}[(18)] (tpy)	BACT/ MACT[18]
Project[7]	Louis County				
Sappi Cloquet[12]	Cloquet, Carlton County	1	162	29	Yes
UPM/Blandin Paper Mill Expansion, Project Thunderhawk[8]	Grand Rapids, Itasca County	213	169	-7	Yes
U. S. Steel Keewatin, Keetac, Expansion[9]	Keewatin, Itasca and St. Louis County	81	35	1,284	Yes
United Taconite Green Production Project[13]	Forbes, St. Louis County	35	35	-10	No[13]
Total Increases		2,807	6,635	6,274	--
Reductions					
Minnesota Power Taconite Harbor Energy Center Unit 2, Emission Control Modifications for SO_2, NO_x, and Mercury[11]	Schroeder, Cook County	-1,549	-423	--	--
Minnesota Power Laskin Energy Center Unit 2, NO_x Reductions[10,11]	Hoyt Lakes, St. Louis County	0	0	--	--
Minnesota Power Boswell Energy Center Unit 3[(11)]	Cohasset, Itasca County	-4,224	-6,372	--	--
U. S. Steel Minntac BACT Reductions[15]	Mtn. Iron, St. Louis County	--	-1,973	--	--
Hill Wood Products[14]	Cook, St. Louis County	--	--	-14	--
Northshore Mining Company: BART Reductions[11,17]	Silver Bay, Lake County	-583	-1,159	--	--
United Taconite BART Reductions[11,17]	Forbes, St. Louis County	-1,954	--	--	--
Total Reductions		-8,310	-9,927	-14	--
Net Reductions/Increase		**-5,503**	**-3,292**	**6,260**	--

Notes:

[1] Emission estimates (Phase I and Phase II) based on emissions used in the air quality analysis in the draft EIS (USDOE and MDC 2007), website: http://nepa.energy.gov/documents/EIS-0382_Mesaba_FEIS_Vol_1.pdf. Accessed on May 5, 2011.

[2] Mesabi Nugget's Proposed Large Scale Demonstration Plant (LSDP): No crushing/grinding at the site; receive concentrate from offsite. Technical Support Document for MPCA permit 13700318-003. Included in Northeast Minnesota Plan Project Tracking for MPCA SIP, version 1-20-2011.

[3] Preliminary emission estimates Barr Engineering, as of 1/29/2011.

[4] Baseline emission from Potential to emit from Technical Support Document for Minnesota Steel (MPCA permit #06100067-002).

[5] Project modifications preliminary emission estimates Barr Engineering, emission estimate from EI Spreadsheet submitted to MPCA on 4/5/2011.

[6] Northshore Mining's Furnace 5 Project: reactivating two crushing lines, nine concentrating lines, one pellet furnace (Furnace 5); new sources emissions only (MPCA permit #07500003-003). Although construction for the project was completed prior to the January 1, 2009 cut-off date for this analysis, due to plant turnaround and current demand, the furnace has not yet operated at a capacity reflecting the expected increase and is therefore included in this evaluation.

[7] PolyMet Mining's Proposed Facility: crushing/grinding of ore, reagent and materials handling, flotation, hydrometallurgical processing, mobile emissions. Emission estimates from Barr 2012r (RS57).

[8] Net Emission Increase from Blandin Project Thunderhawk MPCA permit #06100001-009. No change in emissions for -010 or -011. Note that this project was not built.

[9] U.S. Steel Keetac Mine, and Keetac (Keewatin) mine expansion and restart of taconite processing line – preliminary emission calculations, Barr Engineering. Submitted to MPCA in May 2011 permit application. NOx emission increase is from the baseline actual emissions used to determine PSD applicability. Although there would be a small increase in actual emissions, there would be a decrease in the allowable emissions.

[10] Minnesota Power completed installation of the Low NOx burner system project in Spring 2010. Although actual 2009 emissions already show reductions in excess of the anticipated reductions from 2002 levels, additional reductions are expected to result from the use of the low NOx burners in 2010 and future years. A reduction of zero is used in this analysis because the actual future restrictions are unknown.

[11] Emission estimates provided by the MPCA from the "Northeast Minnesota Plan Emission Tracking Spreadsheet" 1-20-2011. Reductions are the estimated reduction from 2002 emissions minus any reduction in actual emissions that has occurred between 2002 and 2009.

[12] Net emission change estimates from final EAW dated 5/1/2009. Plant expansion, new paper machine, new boiler.

[13] United Taconite Green Production Project – Involves fuel changes and improvements to concentrator and the Line 1 pellet plant to increase pellet production and was a PSD minor project. Because it was a PSD minor project, specific considerations for BACT/MACT were not required. However, the Line 1 pellet plant has an existing wet scrubber to control particulate and SO_2 emission, Emissions estimates are taken from the Technical Support Document of Permit Number 13700113-005 authorizing the project on August 19, 2010.

[14] Net emissions increase from TSD of Air Emission Permit No. 13700030-003.

[15] Reductions calculated based on data in "US Steel Minntac Line 7 Low NOx Main Burner Final Testing Report", May 13, 2011 of 3,990 ton per year goal for NOx emissions and the 2009 actual emissions provided in the MPCA "Northeast Minnesota Plan Emissions Tracking Spreadsheet" 1-20-2011.

[16] PM_{10} emissions estimates include stationary and fugitive emissions for all sources at a facility.

[17] The MPCA RH SIP is still being reviewed by the USEPA for approval including the recommended BART determinations for affected facilities. Actual BART requirements are pending discussions with the MPCA and have not yet been implemented.

[18] Abbreviations: tpy = tons per year
BACT = Best Available Control Technology
MACT = Maximum Achievable Control Technology
SO_2 = sulfur dioxide
PM_{10} = particulate matter less than 10 micrometers in size
NO_x = nitrogen oxides
NA = not applicable

6.2.7.9.1 Summary of Visibility Cumulative Effects Analysis

The following items outline the results and environmental consequences of the 2011 Visibility Class I Study and newly released IMPROVE data:

1. **Class I Area Visibility Gradually Improving or Showing No Trend.** Between 1992 and 2010, visibility in the BWCAW on the 20 percent worst days showed a downward trend in haze index (improvement in visibility), based on a rolling 5-year average. The trend since 2000 is also of interest because this reflects the timeframe of the regional haze requirements. This trend was assessed based on latest IMPROVE data through 2010. The annual 20 percent best and 20 percent worst haze index values for the BWCAW shows an improved visibility trend from 2005 to 2010. The 5-year averages from 2006 to 2010 are also lower than the baseline averages from 2000 to 2004. The National Park Service has concluded that through 2005, there was not a trend either improving or declining for Voyageurs National Park. Based on the latest IMPROVE data, there is no clear trend for Voyageurs National Park. Although visibility on the 20 percent worst days is improved from 2005 to 2010 (6-year period) for Voyageurs National Park, the 2006 to 2010 rolling 5-year average for the 20 percent worst days is higher than the baseline average (indicating greater visibility impairment for this timeframe). However, for the 20 percent best days, the 2006 to 2010 5-year rolling average shows improvement.

2. **Sulfate and Nitrate Particles Are Largest Contributor to Visibility Impairment.** Ammonium sulfate, ammonium nitrate, and organic carbon matter particulates are the largest contributors to visibility impairment in both Class I areas. The ammonium sulfate and nitrate are due to emissions of SO_2 and NO_x, respectively. Each of these components can be naturally occurring or the result of human activity.

3. **Overall Emissions Decreases in Pollutants that are Precursors to Sulfate and Nitrate Particulates.** When the emissions from the proposed projects in northeast Minnesota are viewed together with the concurrent emission reduction projects of SO_2 and NO_x from power generation facilities in northeast Minnesota, there is a net decrease in emissions of both pollutants in the six-county area of northeast Minnesota. As noted in the Environmental Consequences section above, current MPCA estimates indicate that emission reductions at power generation facilities and additional "reasonably foreseeable" projects in northeast Minnesota are not enough to meet the current Regional Haze SIP goal. Therefore, additional mitigation or reductions may be necessary to reach the 2018 goal.

4. **15 Percent of 2018 Visibility Impairment Projected to be Due to Northeast Minnesota Emissions, 15 Percent Due to Minnesota Emissions from Other Areas (In-State, but Outside Northeast Minnesota), and 70 Percent of Visibility Impairment Due to Out-of-State Emissions.** Predictive modeling done in support of the Minnesota Regional Haze SIP shows that Minnesota sources are expected to contribute approximately 30 percent of the visibility impairment at Minnesota's Class I areas and approximately 14 percent of the visibility impairment at Isle Royale (MPCA 2009a). Of the visibility impairment in the Minnesota Class I Areas, Northeast Minnesota sources contribute about half of the total from Minnesota sources or 15 percent overall. The remainder is likely due to sources in other states and Canada. Emissions from Minnesota are the single largest contributor to regional haze at its own Class I areas; however, most of the visibility impairment in these areas is due to out-of-state emissions.

5. **Net Effect from Proposed Projects.** The net effect from the proposed projects, the voluntary reductions of power generation facilities, and the foreseeable regulatory actions shown in Table 6.2.7-2 would likely reduce emissions of SO_2 and NO_x in Minnesota. However, as addressed above, the MPCA has developed Regional Haze SIP goals to reduce combined NO_x and SO_2 from 2002 levels. The reduction is 20 percent by 2012 and 30 percent by 2018. Based on current projections including the NorthMet Project Proposed Action, the reductions addressed in this section are not projected to be enough to meet the 2018 goal. The reductions would be enough to meet the 2012 goal.

In the event that additional emission reduction measures are required by the MPCA to meet Regional Haze SIP goals, emissions from the NorthMet Project Proposed Action may be included for reduction consideration through the MPCA's Regional Haze Rule and permitting programs.

6.2.7.10 Climate Change

As noted in Section 5.2.7, and in this cumulative effects assessment, the construction and operation of the NorthMet Proposed Action would emit gases known to contribute to global climate change. For an in-depth discussion of global climate change, please refer to the Keetac Project EIS published in 2010 (MDNR and USACE 2010). That EIS's cumulative effects assessment provided an exhaustive discussion of the state of scientific knowledge and policy framework regarding global climate change and has been incorporated by reference to this EIS as background information provided by the CEQ regulations (40 CFR 1502.21.).

The Keetac EIS found the following:

- global GHG emissions increased by about 19.6 percent between 1990 and 2004;
- U.S. GHG emissions increased by about 17 percent between 1990 and 2007; and
- Minnesota GHG emissions (for all economic sectors) increased by about 16.2 percent between 1990 and 2006.

It should be noted that for the global figure, a portion of the increase in GHG emissions can be attributed to deforestation and biomass decay. Nevertheless, these numbers show a definite increasing trend in anthropogenic sources of GHGs, which the IPCC has determined is contributing to an increase in global temperatures (MDNR and USACE 2010).

As noted in Section 5.2.7, the NorthMet Proposed Action would directly produce approximately 196,342 mtpy of GHG. Table 6.2.7-5 shows the amount of GHG that the NorthMet Proposed Action would produce in comparison to global, national, and Minnesota GHG emissions. It shows that the NorthMet Proposed Action's direct GHG emissions would be several orders of magnitude lower than total global, national, and even statewide GHG emissions.

Table 6.2.7-5 Greenhouse Gas Emissions

	Total GHG Emissions (million mtpy)	Proposed Action GHG Emissions as a Proportion of Total
Global	49,000	0.00038%
National	7,282	0.0026%
Minnesota	159.4	0.12%
NorthMet	0.1963	

Source: Barr 2012l.

Given the minor GHG contribution of the NorthMet Proposed Action to global GHG emissions, it is impossible to predict how much the NorthMet Proposed Action would factor into climate change, as noted in the Keetac EIS on Page 5-35. In general, increased GHG emissions from the NorthMet Project Proposed Action contribute to a cumulative adverse effect on the earth's climate. Based on the science available, there is the potential that climate change could have a significant effect on terrestrial and aquatic systems and economies worldwide. However, determining the significance of any single project is beyond the capabilities of current science.

6.2.7.11 Potential Cumulative Inhalation Risk Assessment

A cumulative risk assessment was conducted to assess the estimated potential cumulative inhalation risk to a potential resident receptor which included background, non-Project air emissions. Potential projects considered for inclusion in the cumulative risk analysis were those within about 10 kilometers (about 6 miles) of the NorthMet Project Proposed Action and included the Mesabi Mining Project for particulate metals and NO_2 and the Minnesota Power Laskin Plant for NO_x.

A summary of the maximum estimated potential cumulative inhalation risk to a potential resident receptor from background exposure (calculated by the MPCA from ambient air monitoring data), non-NorthMet Project Proposed Action air emissions (Mesabi Mining Project and the existing Minnesota Power Laskin Plant), and NorthMet Project Proposed Action air emissions (the incremental risk estimated from the Mine Site and the Plant Site) are summarized in

Table 6.2.7-6. The estimated cumulative risk is compared to the incremental risk guideline values for a single facility or project, since there are no guideline values for cumulative risk, and is intended to provide a broad context for reviewing the results.

The potential incremental risk from the NorthMet Mine Site and Plant Site together contribute about 57 percent of the estimated potential cumulative acute risk. Total cumulative inhalation acute risk does not exceed the incremental acute risk guideline value of one. Potential incremental risk from the NorthMet Mine Site and Plant Site accounts for only 7 percent of the estimated potential total cumulative chronic noncancer risk. Potential cumulative noncancer chronic risks do not exceed the incremental chronic noncancer guideline value of one and are predominately from risks based on monitored background air concentrations. Potential incremental risk from the NorthMet Mine Site and Plant Site accounts for only 9 percent of the estimated potential total cumulative cancer risk (4E-05). Cancer risk from monitored background air concentrations (3E-05) is greater than the incremental cancer risk guideline value of 1E-05, thus cumulative risk is also above this value.

Table 6.2.7-6 Summary of Cumulative Inhalation Risks

Estimated Potential Inhalation Risk[1]	Cancer	Noncancer Chronic	Noncancer Acute
Background[2]			
Ambient Air (calculated by MPCA)	3E-05	1	0.4
Laskin Energy Center	NA	NA	0.01
Total Background	3E-05	1	0.4
Incremental[3]			
Mine Site and Plant Site	3E-06	0.1	0.6
Mesabi Mining Project	NA	0.1	0.03
Total Incremental	3E-06	0.2	0.6
Cumulative[4]			
Total Cumulative Inhalation Risk	4E-05	1	1
Report Calculated Values as Percentages	9	7	57

Source: Supplemental Air Emission Risk Analysis – Plant Site (Barr 2013j).

Notes:
[1] The maximum potential cumulative risk represents the highest risk from the four receptors evaluated in the supplemental analysis for the Plant Site (Barr 2013j).
[2] Background risks were calculated by the MPCA based on MPCA 2008-2010 monitoring data from Virginia, Ely and Cloquet.
[3] As per USEPA (2005) HHRAP guidance, all reported risk values are rounded to one significant digit. Totals, however, are calculated from unrounded values (i.e., two or more significant figures) and may differ from the value obtained by adding the rounded values shown in the table.
[4] LSDP = Large-Scale Demonstration Plant (Mesabi Nugget).

6.2.8 Noise and Vibration

As described in Section 5.2.8, there would be a long-term increase in the levels and duration of noise above ambient levels throughout the construction, operation, and reclamation period in the vicinity (approximately half-mile radius) of the Mine Site (approximately 11,456 acres affected) and Plant Site (approximately 568 acres affected). The total noise modeling results presented in Table 5.2.8-7 include sources from the Mine Site and Plant Site (NorthMet Project Proposed Action) plus baseline noise levels in the region, which includes existing noise sources from past and present actions near the NorthMet Project area such as Northshore Mine and Mesabi Nugget Plant (formerly Mesabi Nugget Phase I).

There are no other past, present, or reasonably foreseeable actions within the half-mile radius of the Mine Site and Plant Site that would interact in such a way as to have a cumulative effect on the receptors identified in Sections 4.2.8 and 5.2.8. Therefore, adverse cumulative noise and vibration effects are not expected on nearby sensitive receptors (residences/dwelling places, recreational sites, cultural sites) due to the distance of the NorthMet Project Proposed Action from the closest reasonable foreseeable action, Mesabi Mining Project (formerly Mesabi Nugget Phase II) (approximately 2 miles west of the Plant Site and 10 miles west of the Mine Site). Other reasonable foreseeable projects in the region are 25 to 55 miles away from the NorthMet Project Proposed Action and, as such, would have no cumulative effect on nearest receptors (see Figure 6.1.1-1 and Table 6.1.1-1). As indicated above, other past and present actions are already accounted for in the baseline or ambient levels. Actual noise and vibration source terms from future projects such as the Mesabi Mining Project were not publicly available, and contour maps for such future projects were not provided. It should be noted that even if noise and vibration source terms for the Mesabi Mining Project were available, such contour maps would not be expected to overlap with the NorthMet Project noise and vibration contours due to the distance between both projects (i.e., considering the rapid decay of sound with increased distance [6 decibel decrease per doubling of distance] and attenuation from individual mine pit walls [i.e., as the pits become deeper] and dense foliage [Superior National Forest]).

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6.2.9 Cultural Resources

The cumulative effects analysis for cultural resources focuses on past, present, and reasonably foreseeable future effects on historic properties and 1854 Treaty resources. This section provides a qualitative analysis of cumulative effects on historic properties eligible for listing on the NRHP, as well as 1854 Treaty resources. The approach to the analysis of cumulative effects on historic properties and 1854 Treaty resources has been informed through discussions and consultation between the Co-lead Agencies and the Bands.

6.2.9.1 Approach

Cumulative effects on cultural resources were assessed by evaluating the effects of the NorthMet Project Proposed Action in conjunction with other past, present, and reasonably foreseeable future federal, state, and private actions within the CEAA for cultural resources. The cumulative effects on cultural resources are described below in Section 6.2.9.2. The baseline conditions of cultural resources, as directly and indirectly affected by past actions, are described in Section 4.2.9, and direct and indirect effects from the NorthMet Project Proposed Action are described in Section 5.2.9.

Assessment of effects on cultural resources is done specific to the cultural resources identified within the CEAA. Although cultural resources surveys have been conducted within the Project area, no cultural resource surveys for the entire CEAA have been completed (cultural resource surveys are conducted on a project-by-project basis reflective of an individual project area. For cumulative effects analysis areas, generally the areas are too large and expansive to warrant a Section 106 equivalent cultural resources field survey. In such cases, therefore, a cumulative effects analysis is performed using a qualitative analysis of the cumulative effects analysis area for comparison purposes.). Section 4.2.9 provides background information on existing conditions as a result of field surveys and investigations within the APE of the NorthMet Project Proposed Action; however, there is no similar level of data specific to the entire CEAA to allow an impact assessment comparable to the one found in Section 5.2.9. Instead, data on cultural resources located within the CEAA that were previously recorded at the SHPO and the USFS were gathered and compiled in Section 6.2.9.4.1. These data, along with the data presented in Section 4.2.9, were used to determine what cultural resource types are typically found within the CEAA. In turn the cumulative effects on cultural resources were analyzed qualitatively according to the cultural resource types typically found within the CEAA.

Cultural resources may be destroyed by erosion, construction, excavation, data collection, and looting; through the removal of artifacts from their surrounding contexts, moving the material such that it loses context; or through the removal or redeposition of artifacts and their surrounding context to another location. Cultural properties—including camps, structures, hunting and fishing sites, graves, and areas of particular religious or traditional importance—lose their integrity, and thus their potential eligibility for the NRHP, when they become degraded as a result of natural or human disturbance processes, or when the groups, such as the Ojibwe Bands, who value these places, can no longer access them, thus losing their cultural connection to the site or place over time.

The determination of effects for cultural resources is based on a resource's eligibility for inclusion on the NRHP. It should be noted that the NRHP status of some cultural resources within the CEAA remain undetermined, and surveys would be required to determine if these resources would be eligible for inclusion in the NRHP. Effects on cultural resources listed in the NRHP, considered to be eligible for listing in the NRHP, or identified but unevaluated would be avoided or mitigated to the degree practicable as required by Section 106 of the NHPA of 1966 during implementation of federal undertakings. For all cultural resources listed in the NRHP, considered to be eligible for listing in the NRHP, or unevaluated, avoidance would continue to be the preferred mitigation strategy. For any historic properties unavoidably and adversely affected by a proposed project, mitigation measures would be developed as part of a Treatment Plan for that project.

In determining how the Bands have traditionally conducted their usufructuary rights on or near the NorthMet Project area, interviews of individual Band members of Bois Forte, Fond du Lac, and Grand Portage were conducted. Only the results of interviews with Bois Forte were made available. There is little specific information concerning the use of natural resources by the Bands in the NorthMet Project area. This likely reflects limited subsistence gathering in the NorthMet Project area due to general inaccessibility. This lack of data also precludes the quantitative analysis of how Band members would be affected socioeconomically by effects on 1854 Treaty resources, as discussed in Section 5.2.10. The primary source of data for assessing effects from the NorthMet Project Proposed Action on 1854 Treaty resources is from the analysis of the environment discussed in detail in Section 4.2.9 of this EIS.

6.2.9.2 Cumulative Effects Assessment Area

The NorthMet Project Proposed Action's CEAA for cultural resources is described below, both spatially and temporally.

6.2.9.2.1 Spatial

The CEAA for cultural resources is defined as the area of the Mesabi Iron Range that is within the 1854 Ceded Territory (see Figures 6.1.1-1 and 1.1-1). The area has been limited to the Mesabi Iron Range as it is a definable region encompassing the region's mining, which represents the largest and most influential land use within a reasonable distance from the NorthMet Project area. Additionally, the area is further limited to the 1854 Ceded Territory as it is an area of cultural importance to the Bands.

At various times during consultation for the NorthMet Project Proposed Action, the Bands have proposed using an expanded area for analysis of cumulative effects on cultural resources and natural resources of significance to the Bands, including use of the 1854 Ceded Territory as the CEAA. The Co-lead Agencies believe that the use of the 1854 Ceded Territory as the CEAA for cultural resources would actually diminish the significance of any cumulative effect. By evaluating the effects of the NorthMet Project Proposed Action along with other past, present, and reasonably foreseeable future projects in the context of a much larger area with a much larger number of resources similar to those affected by the NorthMet Project Proposed Action, the effect of the NorthMet Project Proposed Action on those resources is diminished. The cumulative effects analysis focuses on the specific resources, or types of resources, affected by the NorthMet Project Proposed Action within an area that is geographically meaningful considering the resource and project under review. For these reasons, the Co-lead Agencies believe that the CEAA used in this section is appropriate for this analysis.

6.2.9.2.2 Temporal

This evaluation includes a qualitative discussion of land use and public resource management developments within the 1854 Ceded Territory since the development and use of timber/mineral resources began as a result of European settlement in the area, from roughly the 1850s on.

6.2.9.3 Cumulative Actions

This assessment includes direct and indirect cumulative effects on cultural resources associated with current and foreseeable actions listed below. The following reasonably foreseeable projects, described in Section 6.1.1.2, are included in the cumulative effects assessment for cultural resources:

- ArcelorMittal Deposits (Laurentian and East Reserve Deposits);
- ArcelorMittal Mines Push-Back Project;
- Community growth and development;
- Forestry practices (regional);
- LTV Steel Mining Company Former LTVSMC Pits;
- Mesaba Energy Project – West Range Site;
- Mesabi Mining Project;
- Mesabi Nugget;
- Mining Resources (Austin Powder Basin, Corsica Basin, Skubic Basin, and Sherman Basin);
- Minnesota Department of Transportation Highway 53 Relocation;
- Northshore Mine;
- Northshore Mine Ultimate Pit Progression Project;
- U.S. Steel Minntac Mine and Processing; and
- U.S. Steel Minntac Mine Extension Project.

6.2.9.4 Cumulative Effects Assessment

The NorthMet Project Proposed Action would result in both direct and indirect effects on historic properties and culturally important resources. Some of the historic properties affected by the NorthMet Project Proposed Action are part of a thematically related group of properties associated with Ojibwe land use patterns, while others could be thematically grouped by their relation to historic mining and development in Northern Minnesota. Cumulative effects on natural resources of cultural significance to the Bands are addressed in more detail in the specific natural resources sections and are only summarized in this section.

Cumulative effects on historic properties may be both direct and indirect and result in the physical loss of properties or changes to location, setting, design, materials, craftsmanship, feeling, or associations. Similar to the analysis of the direct and indirect effects of the NorthMet Project Proposed Action, analysis was conducted for the cumulative effects on historic properties and natural resources of significance to the Bands. Cumulative effects were assessed by evaluating the effects of the NorthMet Project Proposed Action with other past, present, and reasonably foreseeable future federal, state, tribal, and private actions.

6.2.9.4.1 Cultural Resources Previously Recorded within the CEAA

There have not been comprehensive cultural resource surveys of the defined CEAA. However, data on cultural resources located within the CEAA that were previously recorded at the SHPO and the USFS were gathered and compiled below. These data, along with the data presented in Section 4.2.9, were used to determine what cultural resource types are typically found within the CEAA. In turn, the cumulative effects on cultural resources were analyzed qualitatively according to the cultural resource types typically found within the CEAA. Also considered was the nature of some of the properties affected (i.e., thematic groups of properties), and the geographically extensive nature of some specific properties affected.

Archaeological Resources

Two archaeological sites have been previously recorded outside the NorthMet Project Proposed Action APE, but within the CEAA.

Site 21SL0457, the Jackson Site, consists of a sparse pre-contact-period lithic scatter identified on the surface of a ridgetop just west of US Highway 53 between Eveleth and Midway, Minnesota. The lithic material identified at the site appeared to be some form of taconite. Subsurface investigation of the site was not carried out as part of the 1995 site documentation. The site has not been evaluated for inclusion in the NRHP.

Site 21SL1128, the Staff Family Farmstead Site, consists of a cellar depression, two outbuilding foundations, a milk house, an isolated concrete pad, a root cellar, a stone-bordered depression, a well house depression, a surface dump, and an artifact scatter. The early 20th century farmstead is located within a general upland in Nichols Township, Minnesota. The site was recommended to be potentially eligible for listing in the NRHP per the *Historic Context Study of Minnesota Farmsteads, 1820-1960* for its association with the agricultural development of the Cutover Region of Minnesota and under Criterion D for its potential to yield important information regarding the agricultural development of St. Louis County.

Architectural Resources

Research indicates that 174 architectural properties and two historic districts have been previously inventoried outside the NorthMet Project Proposed Action APE, but within the CEAA.

The NRHP-Eligible Mountain Iron Mining Landscape Historic District comprises 10 properties and sites representing a system of open-pit natural ore mines, rail corridors, and other features associated with the early development of the Mesabi iron range between 1892 and 1909. The Mountain Iron Mining Landscape Historic District is located within the incorporated limits of the City of Mountain Iron.

The NRHP-Listed Virginia Commercial Historic District consists of 103 buildings, three vacant lots, and a clock tower. The district is located adjacent to Chestnut Street between 1st Avenue and 6th Avenue in the City of Virginia and reflects the city's main historical industries—mining and logging.

The majority of the architectural properties previously inventoried within the CEAA consists of residential structures, commercial and industrial buildings, mining-related developments, government facilities, and infrastructure-related improvements such as bridges and railroads. Of the 174 architectural properties previously identified within the CEAA, 31 are listed or eligible for listing in the NRHP. An additional 57 architectural properties, which have not been evaluated for listing in the NRHP or have been designated not eligible for listing in the NRHP, have been deemed locally significant.

6.2.9.4.2 Past Actions

The Ojibwe called the hills *Missabe*, the "sleeping giant"—land that lay undisturbed for millennia until the demand for iron drew prospectors to the area in the 1800s. On the Mesabi Range, stretching 100 miles from Grand Rapids to Babbitt, soft ore lay close to the surface, where it could be scooped from open pit mines. Prospectors came to Lake Vermilion in the 1860s to search for gold (Lamppa 2004). It was the discovery of iron ore on the Vermilion Range, however, that led vast tracts of land to be purchased (Risjord 2005). Explorations in 1890 by the Merritt brothers of Duluth—known as the "Seven Iron Men"—laid the groundwork for their Mountain Iron Mine, which marked the opening of the great Mesabi Range. Their second mine, opened at Biwabik in 1891, secured the Mesabi Range's future legacy in rich hematite ore. The Merritt brothers' railroad, the Duluth, Mesabi & Northern, carried its first carload of ore in 1892 to ore docks in Superior, Wisconsin, across the bay from Duluth, itself a major shipping port (Minnesota Historical Society 2008). A decade later, the Mesabi Range boasted over 100 open pit mines. From 1900 to 1980, the Mesabi Range contributed about 60 percent of the country's total iron ore output. Production peaked in the 1940s, when about 600,000,000 tons were shipped to serve the nation's needs during World War II. Production remained high in the 1950s, and then began to decline. It had taken less than 100 years for industrial demand to deplete the supply of high-grade ore (Risjord 2005).

In addition to the mining industry, thick forests of pine, fir, spruce, cedar, birch, and aspen covered much of what is now the Mesabi Range when the first Europeans arrived in Northern Minnesota. In the early 1860s, sawmills in Duluth, Superior City (modern-day Superior), and Beaver Bay found a growing market for timber, shipping lumber to other towns on the Lake and beyond. By 1870, there were 207 saw mills in Minnesota. In 1877, a law allowing sale of timber off state lands further opened the state for logging. The logging boom had tapered off by the early 1900s (Risjord 2005).

Both the mining and logging industries would forever change the relatively pristine environment that existed at the time of contact between Native Americans and Europeans in the mid-1600s. The historic effects of these industries, prior to the development of historic preservation legislation in the 1960s (i.e., prior to NHPA), occurred with little analysis of cultural resource effects. Areas logged (such as past forestry practices), mined (such as the LTVSMC), roaded (such as past road construction and expansion projects), or otherwise subjected to extensive ground disturbance (such as past community growth and development) resulted in undocumented and unregulated effects on cultural resources. Cultural properties tend to degrade over time due to natural forces; however, many survive for hundreds or thousands of years. Modern human activity tends to exacerbate the damage and as a consequence cultural resources are being damaged and disappearing at an increasing rate. Many of the recorded cultural resources in the CEAA exhibit effects as a result from modern use of the land. Cultural resources are likely to have sustained damage from previous mining, logging, road construction, recreation, wildfires and erosion resulting from these activities. Although difficult to quantify, the paucity of artifacts at some sites may be due to removal by artifact collectors.

Many specific use areas exist, or have existed, along the *Mesabe Widjiu*. Throughout the length of the Mesabi Iron Range, which includes a large portion of the *Mesabe Widjiu*, the setting and associated use areas have been affected by alterations to the landscape brought about by mining, community growth, road construction, and logging. Use of the *Mesabe Widjiu* and surrounding areas has changed as past development mines expanded and consumed areas once used by the Ojibwe. The setting of the *Mesabe Widjiu* and the association of the use areas and trails with the *Mesabe Widjiu* contribute to its significance.

An interconnected system of trails along the *Mesabe Widjiu* exists, as discussed in Section 4.2.9. Some of the trails are documented in the GLO surveys and some have no specific information available, but are shown on historic maps. Past mining operations have directly affected this trail system and are visible along parts of these trails. Past mining operations, therefore, have affected the setting that was otherwise largely unchanged at the time of contact between Native Americans and Europeans in the mid-1600s.

The specifics of cumulative effects on historic properties of traditional religious and cultural significance to the Ojibwe Bands are relatively unknown throughout the CEAA. However, historic documentation and oral history, as demonstrated through the Band member interviews conducted for the NorthMet Project Proposed Action, document Ojibwe occupation and use of the area throughout the CEAA. The Bands have ancestral ties to the CEAA and the Trygg Maps document a trail system and occupation sites at the time of the United States GLO surveys in the mid- to late 1800s. Landscapes such as the *Mesabe Widjiu* are part of Ojibwe oral history and traditional practices. From the signing of treaties in the 19th century to the expansion of mining operations today, mining activities in the Mesabi Iron Range likely have had substantial cumulative effect on historic properties of traditional religious and cultural significance to the Ojibwe Bands; however, the details concerning these effects are not well understood.

To address cumulative effects related to historic properties associated with taconite mining, the period that is most relevant to cumulative effects runs from 1957 (Initiation of Erie activities within the CEAA) to the present day. The concentrator building, railroads, and the majority of contributing structures were built in present form between 1957 and 1958. These structures and transportation features continued to be used in the industrial taconite process through 2001, when LTV idled activities at the Mine Site. The properties remained relatively unaltered throughout this period of use; however, there were regular periodic upgrades, maintenance, and engineering system improvements. Given the dynamic and evolving nature of mining landscapes, certain features were created, utilized, and subsequently abandoned throughout the 50-odd years of taconite mining. Mine Area No. 2, for example, was opened in 1957, but eventually merged with Mine Area No. 3 sometime after 1970. Concurrent with this evolving landscape is the movement of transportation infrastructure such as railroads and access roads, which typically have a dynamic and shifting use-life. The Erie/LTVSMC Tailings Basin is another mining feature that evolved extensively from 1957 through 2001. The spatial massing, height, and footprint of this particular feature changed regularly while mining was occurring, and its current form is vastly different than that during the period of significance for Erie. Following LTVSMC's bankruptcy in 2001 and idling of the mine site, the vast majority of the structures were deactivated, and the system railroads were not used. Cliffs Erie continued to provide site security, but maintenance activities were not known to have occurred. PolyMet acquired options to the Plant Site through Cliffs Erie in 2005/2006. Outside of general maintenance to the Administration Building, PolyMet has not initiated any notable maintenance or rehabilitation projects in the APE. The pelletizer building was demolished in 2007, though it is the only structure from Erie's period of significance that has been removed.

6.2.9.4.3 Current and Future Actions

Known or newly identified cultural resources, as part of current and future projects, are evaluated for their eligibility for listing on the NRHP based on their integrity at the time of documentation and evaluation. The combination of the implementation of an Unanticipated Discovery Plan (minimizing effects on unknown cultural resources that may be inadvertently encountered), as well as associated mitigation measures, and/or a Treatment Plan would mitigate cumulative effects on cultural resources. As discussed in Sections 4.2.9 and 5.2.9, identified cultural resources would be evaluated and avoided or minimized to the degree practicable as required by Section 106 of the NHPA during implementation of the NorthMet Project Proposed Action. Although continued current development could affect cultural resources, considerations such as these conducted through the NEPA and NHPA processes would help to mitigate many of the effects caused by currently proposed projects. However, cumulative effects on cultural resources could include reasonably foreseeable incremental effects in the form of unauthorized artifact collection and inadvertent disturbance in the CEAA caused by increased human activity.

Potential current and future effects from projects, such as the ArcelorMittal Mines, Essar Steel Project, Mesabi Nugget and Mesabi Mining Project, Northshore Mine, and U.S. Steel Minntac Project, would largely be grouped by similar types of direct and indirect impacts. Generally, these types of large mining and energy projects are going to have similar direct and indirect effects, although how they affect the significance of that property (i.e., the reason for their potential eligibility in the NRHP) could be different. It is important to note that, while the Mesaba Energy projects are outside of the CEAA, they are located immediately adjacent to it. Because many historic properties of traditional religious and cultural significance are not as readily documented for the cultural resources practitioner and the physical boundaries of properties, such as *Mesabe Widjiu*, for example, generally consist of a subjective boundary-based social, cultural, or traditional perceptions or perspectives of the property, these projects were included within the CEAA for analysis purposes. Larger categories of current and future regional projects, such as forestry practices, road construction and expansion projects, and community growth and development would not generally be expected to have unmitigated adverse impacts to historic properties due to the requirements of Section 106 of the NHPA for federal undertakings and various other local and state historic preservation requirements. There could be effects to historic properties, however, due to projects occurring on private lands where no local, state, or federal permits are required.

Landscape properties can be exposed to a number of potential direct and indirect effects. Not all effects to a landscape property, such as *Mesabe Widjiu*, would result in an adverse effect. For instance, larger landscape properties may allow for changes in landscape to a non-contributing portion of the property or minor changes to the landscape or setting. Factors to consider would include the scale of the landscape, the prominence of the affected elements, the magnitude of the proposed project, and the permanency of the change.

For large-scale natural landscapes, such as the *Mesabe Widjiu*, the relationship of landscape characteristics and integrity is complex, as discussed in Section 4.2.9 and 5.2.9. As is the case in Northern Minnesota, the compatibility of the *Mesabe Widjiu* and historic and modern mining presents change, an inescapable part of any landscape. In the case of the *Mesabe Widjiu,* direct impacts can come from new construction or incompatible land uses, such as modern logging, mining, growth or development of commercial or residential areas, transportation construction, or other activities that reshape the land or disturb significant aspects of the landscape.

For the *Mesabe Widjiu*, setting is an essential component of its use by Band members. Once pristine in nature, peacefulness and solitude contribute to its cultural significance as a traditional and sacred location. Indirect effects outside the *Mesabe Widjiu's* boundaries can constitute intrusions when such changes introduce incompatible visible, audible, or atmospheric elements. Ultimately, such effects could result in an interruption in the continuity of its historic integrity or use. More directly, changes in land ownership or segregation of the landscape or a specific use area could result in inaccessibility for Band members to experience the property for the very factors that made it eligible.

In the case of Native American trails, anticipated direct and indirect effects would come in the form of continuing segmentation and disassociation of once-related sites and resources. In particular, changes to the trail system due to expanded mining operations, would also have residual effects on this and potentially other cultural resources. Visual effects on these trails would also continue indefinitely and are considered to be cumulative, as well. There would also be continued cumulative visual intrusions (shape of the landscape) and noise effects on this type of cultural resource, as the NorthMet Project Proposed Action and other current and future projects are visible along the trails.

Direct and indirect effects on the Spring Mine Lake Sugarbush and other more finite historic properties of traditional religious and cultural significance would be similar to those described above for the *Mesabe Widjiu* and Native American trails. In addition to those mentioned above, effects could result from increases in human access leading to subsequent disturbance (e.g., looting, vandalism, and trampling) of historic properties and features. These effects could result from the establishment of corridors or facilities in otherwise intact and inaccessible areas, or increased human access. Additionally, historic properties with natural resources components, such as the Spring Mine Lake Sugarbush, could be exposed to other indirect effects such as those related to water, air, and invasive species.

Additionally, within the CEAA, there are significant historic mining properties that have both archaeological and structural components. Reuse of the Erie Mining Company Concentrator Building and Railroad as part of the NorthMet Project Proposed Action are examples of known mining properties that exist and would be affected within the CEAA. A mining landscape still being worked may retain integrity if modern extraction methods and character are similar to those practiced historically, important physical elements remain, and comparable properties are less intact. Continued use of a property also may destroy it, such as modern mining, which obliterates all traces of earlier mining activity. Continued mining on the Mesabi Iron Range has and would continue to eliminate, or alter, the landscape or structures resulting from prior mining activity, which may qualify for the NRHP. This is a cumulative effect of mining on historic mining properties that is inherent in the mining industry itself.

The NorthMet Project Proposed Action has essentially provided a temporary reprieve in demolition and site reclamation activities required by *Minnesota Rule* 6132.3200, which calls, among other remediation activities, for the removal of mining equipment, facilities, railroad tracks and ties (not required by common carriers), and structures. This administrative rule is applicable to the other Erie infrastructure, and is cited here for review purposes:

> *Minnesota Rules*, part 6132.3200 CLOSURE AND POSTCLOSURE MAINTENANCE, Subpart 2, E(4). Within three years after closure begins, or within a longer period if approved by the commissioner, the following shall be accomplished:
>
> (b) permittee-owned power plants and associated facilities except public utilities, transmission lines, pipelines, docks and associated facilities, and railroads except common carrier transportation facilities shall be removed or provisions made for continued subsequent use; and
>
> (c) all other equipment, facilities, and structures shall be removed and foundations razed and covered with a minimum of two feet of surface overburden.

PolyMet would be required to implement a closure and remediation plan for the Mine Site in the event of permitting. Specific language regarding the removal of structures and features is available in Section 3.2.2.3.12. Given the requirements for closure pursuant to *Minnesota Rule* 6132.3200, it is reasonable to assume that all buildings and structures not approved for potential future use within the APE of the NorthMet Project Proposed Action that are considered to be contributing to the overall Erie Mining Landscape Historic District would be demolished and reclaimed after the 20-year mining period.

6.2.9.4.4 1854 Treaty Resources

Given the broad range of resources under the term "1854 Treaty resources," the reader should reference the appropriate natural resource sections for detail regarding cumulative effects on specific natural resources of concern.

As discussed in Section 5.2.9.2.2, the NorthMet Project Proposed Action could have effects on 1854 Treaty resources, that is, those plant and animal species that are traditionally or culturally important to the Bands. Band members' use of the NorthMet Project area, and the entire CEAA, is not well-defined through research, and did not emerge through interviews. Construction and operation of the NorthMet Project Proposed Action and other past, present, and reasonably foreseeable future projects are not likely to reduce overall availability of 1854 Treaty resources that are typically part of subsistence activities in the 1854 Ceded Territory. However, noise and other consequences of operations could affect migration or other animal species behavior.

Additionally, the NorthMet Project Proposed Action could affect the availability of 1854 Treaty resources for some Band members through increased bioaccumulation of mercury in fish tissue, including species associated with subsistence. Effects on the environment, including those from increased mercury, are all expected to meet the standards and regulations set forth by the appropriate state or federal agency or program. These laws are intended to protect important natural and cultural resources and include but are not limited to the ESA, the CWA, and the CAA. Effects on 1854 Treaty resources are difficult to quantify when the effects are within environmental standards yet above current baseline conditions. As such, cultural effects on the Bands would be difficult to quantify in regards to such incremental increases below standards or effects on species where appropriate mitigation is used.

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6.2.10 Socioeconomics

Socioeconomics includes demographic characteristics of population, employment, income, market composition, public finance, housing, public services, and the economic characteristics of subsistence activities. The cultural aspects of subsistence, specifically for Native American populations, are discussed in the Cultural Resources section of Chapter 5. Individual subsistence products (e.g., wild rice, game animals, etc.) are discussed in appropriate resource-specific sections.

The assessment found that, while the NorthMet Project Proposed Action and other past, present, and reasonably foreseeable future actions would generate economic activity within the CEAA, the combined actions would not cause cumulative socioeconomic effects.

6.2.10.1 Approach

As discussed in Chapter 5, many of the socioeconomic effects of the NorthMet Project Proposed Action—such as increased population, housing demand, and effects on public facilities and services—are functions of the jobs and revenue that the NorthMet Project Proposed Action would create, as modeled using IMPLAN. Conclusions in this analysis were drawn using readily available data for the cumulative actions under consideration and IMPLAN estimations for the NorthMet Project Proposed Action.

Evaluation of socioeconomic cumulative effects is based largely on the number of new full-time (or full-time equivalent) jobs created by operation of the cumulative actions. While specific factors may vary, other socioeconomic effects (earnings, value added, demand for housing and community services, etc.) are presumed to vary proportionally with employment changes.

6.2.10.2 Cumulative Effects Assessment Area

6.2.10.2.1 Spatial

The CEAA for socioeconomics includes effects associated with the NorthMet Project Proposed Action, combined with other industrial (including mining) projects located within the portion of the Mesabi Iron Range encompassed by St. Louis, Lake, and Cook counties (see Figure 6.2.10-1). As with the NorthMet Project Proposed Action (see Section 5.2.10), iron, taconite, and precious metal mining in the Mesabi Iron Range have helped to define the region's socioeconomic conditions for decades. While mining activity has decreased greatly from its peak in the middle of the 20th century, it remains an important economic factor.

Tourism and other economic activity associated with the region's high-quality recreation and natural areas (such as BWCAW) are also important economic and land use drivers. These economic contributions are based largely on socioeconomic preferences (e.g., retirees choosing to live in the region to be close to recreational resources), rather than definable projects or activities. The CEAA for socioeconomics includes many of the largest and most important recreational and tourist resources in northeastern Minnesota.

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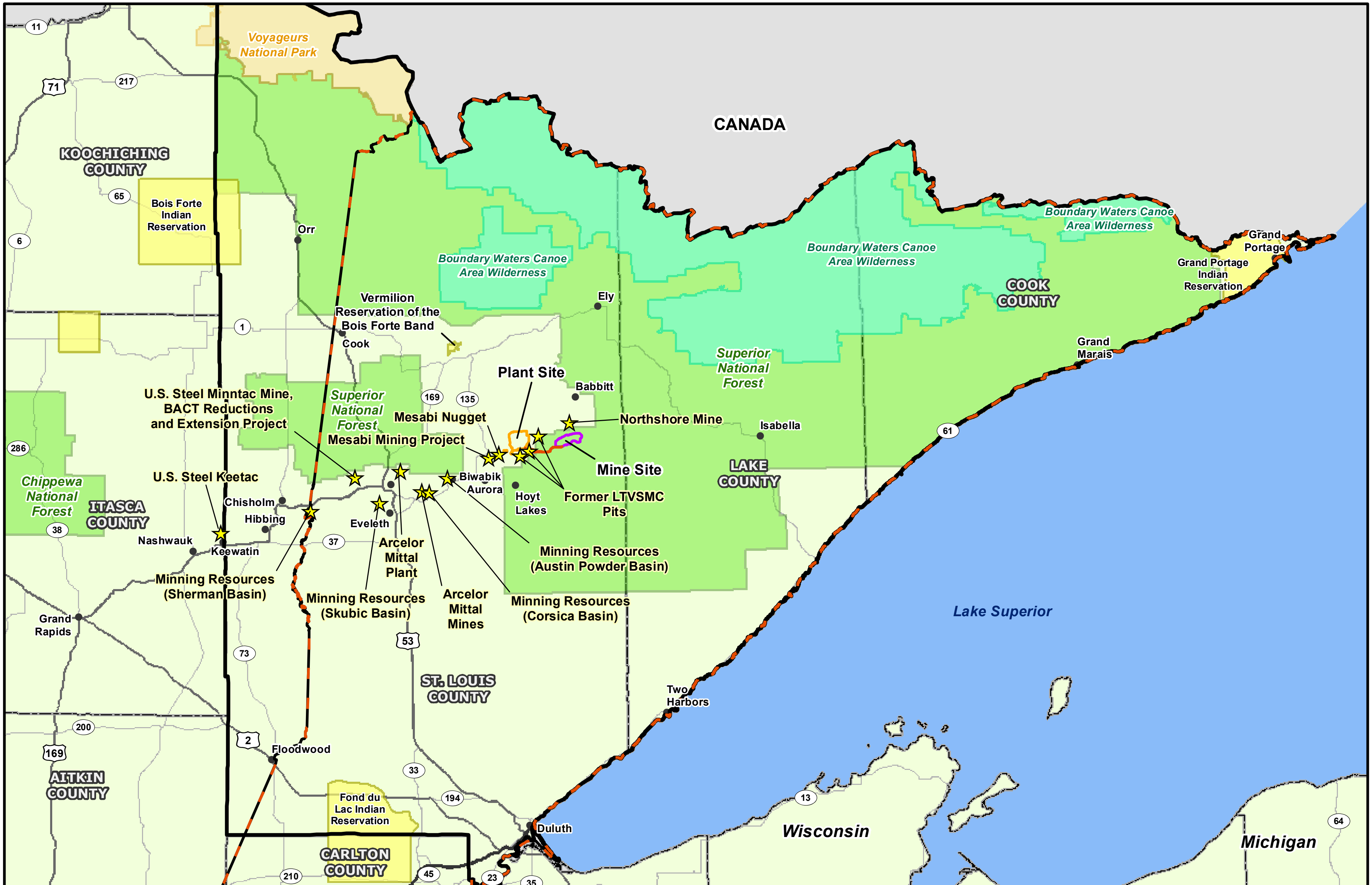

Assessment Area

Mine Site

Plant Site

Transportation and Utility Corridor

Cumulative Projects and Actions See Table 6.2-1

1854 Ceded Territory

Native American Reservation

Boundary Waters Canoe Area Wilderness

National Forest

National Park

This document is a working document. This document may change over time as a result of new information, further deliberation, or other factors not yet known to the Co-lead Agencies.

0 5 10 20 Miles

US Army Corps of Engineers St. Paul District

Figure 6.2.10-1

Socioeconomics Cumulative Effects Assessment Area

NorthMet Mining Project and Land Exchange PFEIS

Minnesota

June 2015

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6.2.10.2.2 Temporal

This evaluation focused on the existing and anticipated future use of the CEAA. Because mining and public resource management (including recreation and natural resource tourism) have been the primary drivers defining regional socioeconomic development within the CEAA for over 100 years, existing conditions are considered indicative and representative of historical mining and resource management activities.

6.2.10.3 Past, Present, and Reasonably Foreseeable Future Actions

For the purposes of this assessment, cumulative actions are those current and permitted mine projects located in the portion of the Mesabi Iron Range within St. Louis, Lake, and Cook counties. The socioeconomic effects of the region's recreation and tourism resources are discussed in Section 5.2.10, and no specific cumulative actions or activities related to these resources have been identified. These projects, described in Section 6.1.1.2, are listed below.

- ArcelorMittal Deposits (Laurentian and East Reserve Deposits);
- ArcelorMittal Deposit Push-Back;
- LTV Steel Mining Company Former LTVSMC Pits;
- Mesabi Mining Project;
- Mesabi Nugget;
- Mining Resources, (Austin Powder Basin, Corsica Basin, Skubic Basin, and Sherman Basin;
- Northshore Mine;
- Northshore Mine Ultimate Pit Progression Project;
- U.S. Steel Keetac Mine (Keewatin);
- U.S. Steel Minntac Mine;
- U.S. Steel Minntac Extension Project; and
- United Taconite Mine expansions.

The locations of these actions relative to the NorthMet Project Proposed Action are shown on Figure 6.2.10-1.

6.2.10.4 Cumulative Effects Assessment

Table 6.2.10-1 summarizes the anticipated cumulative effects of the NorthMet Project Proposed Action and cumulative actions. Existing studies, approved NEPA documents, and other information about the cumulative actions did not include detailed economic modeling—such as the IMPLAN model conducted for the Proposed Action. As shown in Table 6.2.10-1, these existing documents do estimate direct employment from some of the cumulative actions, but there are no substantive data or estimates of output and value added (as defined in Section 5.2.10.1). As a result, much of the analysis in this section is largely qualitative in nature.

Table 6.2.10-1 Summary of Socioeconomic Cumulative Effects

Project	Temporal Scale	New Direct Employment	
		Construction	Operation
NorthMet Project Proposed Action[1]	Future	764	360
ArcelorMittal Mines (Laurentian and East Reserve Deposits)	Present	0	0
ArcelorMittal Deposit Push Back	Reasonably Foreseeable	Undetermined	Undetermined
Mesabi Nugget	Present	Undetermined	Undetermined
Mesabi Mining Project[3]	Reasonably Foreseeable	250	220
Mining Resources, Austin Powder Basin	Reasonably Foreseeable	Undetermined	Undetermined
Mining Resources, Corsica Basin	Reasonably Foreseeable	Undetermined	Undetermined
Mining Resources, Skubic Basin	Reasonably Foreseeable	Undetermined	Undetermined
Mining Resources, Sherman Basin	Reasonably Foreseeable	Undetermined	Undetermined
Northshore Mine	Present	0	0
Northshore Mine Ultimate Pit Progression Project	Reasonably Foreseeable	Undetermined	Undetermined
U.S. Steel Keetac Mine (Keewatin)[4]	Present	500	170
U.S. Steel Minntac Mine[2]	Present,	Undetermined	0
U.S. Steel Minntac Mine, Extension Project[2]	Reasonably Foreseeable	Undetermined	0
United Taconite Mine expansions	Reasonably Foreseeable	Undetermined	Undetermined
Total, Cumulative Projects Only		**750**	**390**

Notes:
[1] Operations employment reflects typical year of operations.
[2] U.S. Steel announced in March that it will temporarily idle these operations due to low iron ore prices (Coyle 2015). Analysis assumes they are in full operation.
[3] Indicates the maximum typical construction employment.
[4] Reflects peak of 4-year construction period.

Construction of the above-mentioned projects would generate approximately 750 new jobs directly in the CEAA (in addition to jobs associated with projects whose employment needs are undetermined), one percent of the total existing study area employment. Given the timing of these projects, the effects are likely to be experienced across different geographies over time.

The operational phases of the cumulative actions would generate approximately 390 new jobs in the CEAA (in addition to jobs associated with projects whose employment needs are undetermined), less than one percent of the area's total current employment. Including indirect and induced employment, this figure could triple (based on multipliers associated with the NorthMet Project Proposed Action), resulting in approximately 1,170 total new jobs. Added to the NorthMet Project Proposed Action, cumulative effects on employment could surpass 1,934 total new jobs in the three-county study area.

Earnings and value added from the cumulative actions would likely be generated at a similar rate (per new employee) to the NorthMet Project Proposed Action. Therefore, it is estimated that the economic contribution of the cumulative actions, together, would likely match (and could exceed) that of the NorthMet Project Proposed Action.

Demand for housing and public services due to the cumulative actions would also likely match that of the NorthMet Project Proposed Action, although these demands would likely occur in cities and towns not evaluated in Section 5.2.10, such as Mountain Iron, Chisholm, and cities in other counties to the west, which would be in commuting distance to the cumulative actions, but that are not within commuting distance of the NorthMet Project Proposed Action. As of 2011, there were approximately 700 vacant, non-seasonal housing units in Itasca County (as well as 6,900 seasonal units, some of which could conceivably be converted or marketed for full-year use).

As with the NorthMet Project Proposed Action, some portion of these new employees are likely to already be residents of the CEAA, while some indirect and induced jobs may be filled by spouses or children of cumulative project employees. By comparison, St. Louis and Itasca counties have approximately 245,000 residents and 130,000 housing units (vacant and occupied) (US Census Bureau 2010b). Increases in population and housing demand to the cumulative actions would likely represent less than one percent of these figures. Such increases would not likely strain overall service capacity in the region due to existing capacity (see Section 5.2.10), but could create localized pressures on housing markets or public service agencies.

The cumulative actions would all occur in areas already affected by mining and many are, in fact, expansions of previous mining projects. These projects are largely on private land already zoned or otherwise designated for such activities. While EJ effects could occur on properly zoned land, there is no evidence that these cumulative actions would generate EJ effects associated with economic factors.

Increases of mercury in waterbodies from the NorthMet Project Proposed Action are discussed in Section 5.2.2.3.4, and cumulative increases are discussed in Section 6.2.2.4 and Section 6.2.6.3.3. Cumulative increases in mercury concentrations and the resultant increased mercury concentrations in fish tissue could constitute an EJ impact for Band members and other subsistence consumers of fish. However, the AERA assessed health effects for recreational and tribal fishermen and their families consuming fish that could potentially contain elevated bioaccumulated levels of methylmercury. A potential small change in fish mercury concentration was estimated based on modelled emissions and deposition. The potential change in methylmercury concentration is not statistically measureable given variability in background concentrations and current laboratory analytical methods (Barr 2013j). Therefore, there is no expected change in fish mercury concentrations, and no subsequent change in human health risks related to fish consumption (see Section 5.2.7.2.5). Also, this information is summarized in Section 7.3.4.4.3 of the FEIS.

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6.2.11 Recreation and Visual Resources

The NorthMet Project Proposed Action (including the Mine Site, Transportation and Utility Corridor, and Plant Site), occupies 7,650.1 acres of land near Hoyt Lakes and Babbitt, in St. Louis County, Minnesota. This includes public lands in the Superior National Forest, as well as private lands within the municipal boundaries of Hoyt Lakes and Babbitt.

6.2.11.1 Approach

The cumulative actions are evaluated to determine whether they would directly affect recreational lands or activities, or whether they would cause direct or indirect changes in recreational patterns or views on a regional scale.

6.2.11.2 Cumulative Effects Assessment Area

6.2.11.2.1 Spatial

The CEAA for recreation and visual resources includes the portion of the Mesabi Iron Range within St. Louis County (see Figure 6.1.1-1). The Mesabi Iron Range encompasses the region's mining activity, which has the greatest potential to affect recreational resources and activities.

This analysis also recognizes the Arrowhead Region's substantial existing high-quality recreational resources, such as BWCAW, Voyageurs National Park, and Superior National Forest. Changes in recreational activity associated with these sources are typically associated with socioeconomic preferences (e.g., increased population and/or changes in recreational preferences and patterns).

6.2.11.2.2 Temporal

This evaluation focused on existing and anticipated future activities that would affect recreation and visual resources within the CEAA. Existing conditions are considered indicative and representative of historical mining and resource management activities. Some additional qualitative consideration has been given to the pre-historic viewshed conditions documented by regional tribes in their cultural and religious teachings.

6.2.11.3 Contributing Past, Present, and Reasonably Foreseeable Actions

As noted previously, it is not possible to identify all past activities that may contribute to a cumulative effect. Similarly, all present activities would continue to affect the environment. The impacts of these combined activities are described in Chapter 4, Affected Environment. Activities included with the NorthMet Project Proposed Action for the assessment of cumulative effects are shown on Figure 6.1.1-1 and described in Section 6.1. Activities specifically associated with potential cumulative effects on recreation include permitted mines and other projects in portions of the Mesabi Iron Range in St. Louis County where future activities would likely be different from current activities. These projects include:

- ArcelorMittal Deposits (Laurentian and East Reserve Deposits);
- ArcelorMittal Deposit Push-Back;
- Mesabi Mining Project;

- Northshore Mine Ultimate Pit Progression Project;
- U.S. Steel Keetac Mine; and
- U.S. Steel Minntac Mine, Extension Project.

6.2.11.4 Cumulative Effects Assessment

The cumulative actions described in Section 6.2.11.3 are largely existing, expanded, or reconfigured mines on private land, totaling approximately 2,650 acres. Sources for the data regarding cumulative actions include MDNR and USACE 2007, USDOE and MDC 2007, and MDNR and USACE 2010.

6.2.11.4.1 Recreation

None of the cumulative actions would directly affect recreational lands such as local or state parks. The public's enjoyment of recreational activities in the region—such as hunting, fishing, boating, hiking, and winter sports—is tied in part to visual resources, as well as to factors such as the availability and quality of fish and other aquatic species, vegetation, and wildlife (particularly game species), noise, air quality, water quality, and wetlands. Direct and indirect effects on these resources are presented in their respective sections in Chapter 5.

The cumulative actions would all occur on or in close proximity to existing or previously mined land. Excluding effects related to noise, fisheries, air quality, and other effects described elsewhere in Chapters 5 and 6, and given the proximity of active and past mining and industrial activity to high-quality recreational activity in the Arrowhead Region (such as the BWCAW), there is no evidence that the activities associated with the NorthMet Project Proposed Action, in and of themselves, would directly affect the public's overall ability to hunt, fish, and conduct other recreational activities, or affect their overall recreational experience in the Arrowhead Region as a whole.

6.2.11.4.2 Visual Resources

Changes in visual conditions associated with the cumulative actions are expected to be comparable to those described for the NorthMet Project Proposed Action in Section 5.2.11.2.1. Whereas portions of the NorthMet Project Proposed Action would occur on previously unmined land, the mining-related cumulative actions would occur in areas where mine pits and processing facilities are already part of the visual landscape. After reclamation, the Northshore Mine Ultimate Pit Progression Project would introduce new visual elements to the mining area including: the construction of islands for bird habitat, areas for fish spawning, public access to the lake (post-closure) and flooding organic debris to aid in the initiation of biological productivity (MDNR 2014f).

6.2.12 Wilderness and Other Special Designation Areas

6.2.12.1 Approach

The Mine Site, Plant Site, and surrounding federal lands are not located within or adjacent to any wilderness areas, nor are there any special designation areas within or adjacent to the NorthMet Project area. For the purposes of analysis, the study area is an approximate 25-mile radius from the NorthMet Project area, as described below (see Figure 4.2.12-1).

For the purposes of this analysis, the term "wilderness" is defined by the Wilderness Act of 1964 (Public Law 88-577) (16 USC §1131–1136). Other special-designated areas (listed below) are identified by Presidential Designation, Congressional Designation, or Administrative Designation, and define lands that are considered to have remarkable ecological, paleontological, historic, scenic, recreational, geologic, or fish and wildlife value. They include wilderness areas, wilderness study areas, research natural areas, national scenic or historic trails, wild or scenic rivers, unique biological areas, national natural landmarks, national historic landmarks, and national monuments, among others. They fall under the management jurisdiction of the federal land management agencies, including the MDNR, USFS, National Park Service, and USFWS.

- Designated Wilderness Areas within the study area:
  - BWCAW – 25 miles north of the NorthMet Project area.
- National Park System Units near the study area:
  - Voyageurs National Park – 50 miles northwest of the NorthMet Project area.
- State Parks within the study area:
  - Soudan Underground Mine State Park – 18 miles west of the NorthMet Project area;
  - Lake Vermilion State Park – 16 miles northeast of the NorthMet Project area;
  - Bear Head Lake State Park – 11 miles northeast of the NorthMet Project area; and
  - Iron Range Off-Highway Vehicle State Park – 17 miles northeast of the NorthMet Project area.
- Established and Candidate Research Natural Areas (cRNAs) within the study area:
  - The Big Lake-Seven Beavers Area – 12 miles east of the NorthMet Project area;
  - Keeley Creek Natural Area – 25 miles northeast of the NorthMet Project area; and
  - Dragon Lake – 25 miles east of the NorthMet Project area.
- Unique Biological Areas (UBAs) within the study area:
  - Little Isabella River – 25 miles east of the NorthMet Project area; and
  - Harris Lake National Natural Landmark – 20 miles northeast of the NorthMet Project area.
- National Historic Landmarks within the study area:
  - Soudan Iron Mine –18 miles northwest of the NorthMet Project area.

- Scenic Byways within the study area:
  - Superior National Forest Scenic Byway – a portion of the trail is 9 miles southwest of the NorthMet Project area.
- Designated Recreation Trails within the study area:
  - Taconite State Trail – a portion of the trail is 15 to 17 miles north of the NorthMet Project area.

The cumulative actions have been evaluated against Class I air modeling to determine potential visual effects of haze from the NorthMet Project Proposed Action.

6.2.12.2 Cumulative Effects Assessment Area

6.2.12.2.1 Spatial

The CEAA for Wilderness and Other Special Designation Areas includes effects associated with the Proposed Action and combined with other industrial (including mining) or public works projects located within the portion of the Mesabi Iron Range encompassed by St. Louis County (see Figure 6.1.1-1). While no direct effects on wilderness character are anticipated, there may be measurable indirect cumulative air effects associated with the NorthMet Project Proposed Action. The CEAA for assessment of potential air effects on designated wilderness and other designated areas is the boundary of measurable air effects identified in Chapter 5.

6.2.12.2.2 Temporal

This evaluation includes a brief discussion of documented air quality degradation in the designated areas since the establishment of these wilderness or other designated areas.

6.2.12.3 Contributing Past, Present, and Reasonably Foreseeable Actions

As noted previously, it is not possible to identify all past activities that may contribute to a cumulative effect. Similarly, all present activities would continue to affect the environment. The impacts of these combined activities are described in Chapter 4, Affected Environment. Activities included with the NorthMet Project Proposed Action for the assessment of cumulative effects are shown on Figure 6.1.1-1 and described in Section 6.1.1. Activities specifically associated with potential cumulative effects on wilderness and other special designated areas include permitted mines and other projects in the portions of the Mesabi Iron Range in St. Louis County where future activities would likely be different from current activities. These projects include:

- Mesabi Mining Project;
- Mesabi Nugget;
- LTV Steel Mining Company Former LTVSMC Pits;
- Minnesota Power Laskin Energy Center;
- Minnesota Power Taconite Harbor Energy Center Unit 2, Emission control modifications;
- Northshore Mine;

- Northshore Mining Company Furnace 5 Reactivation Project;
- Northshore Mine Ultimate Pit Progression Project;
- U.S. Steel Minntac; and
- U.S. Steel Minntac Mine Extension Project.

6.2.12.4 Cumulative Effects Assessment

The cumulative actions described in Section 6.2.12.3 are largely existing, expanded, or reconfigured mines on private land.

Based on the detailed visibility analysis presented in the Air Quality Section (6.2.7), even though there would be a net increase in PM_{10} from the cumulative actions, these emissions would not impair visibility in the BWCAW or Voyageurs National Park as described in Minnesota's Regional Haze SIP (MPCA 2009a).

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6.2.13 Hazardous Materials

As described in Chapters 4 and 5, hazardous materials are a site-specific issue; however, there could be a small likelihood of cumulative effects associated with increased traffic carrying hazardous materials.

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6.2.14 Geotechnical Stability

This topic relates to the waste material storage facilities (Tailings Basin, waste rock stockpiles, and Hydrometallurgical Residue Facility). The stability of these facilities is guided by local geology and design (operation and maintenance) and would not interact with other similar facilities outside of the NorthMet Project area. Given the discrete nature of these facilities, it has been concluded that no cumulative geotechnical effects would occur as a result of the NorthMet Project Proposed Action.

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6.3 CUMULATIVE EFFECTS BY RESOURCE FOR THE LAND EXCHANGE PROPOSED ACTION

6.3.1 Land Use

The cumulative effects analysis for land use for the Land Exchange Proposed Action focused on potential changes in the land area and boundary length of the Superior National Forest; changes in land fragmentation (i.e., size of patches of federal and non-federal properties) that would occur that could affect USFS management of the forest; changes in the extent or types of designated land uses, as defined by management area designations, where known; and changes in the potential for additional lands open to public use.

6.3.1.1 Approach

This section compared the types of data presented in Sections 4.3.1 and 5.3.1, for each of the projects within the CEAA Land Exchange Proposed Action boundary. Projects within the CEAA Land Exchange Proposed Action boundary were evaluated based on the most current available Superior National Forest land ownership GIS data, as well as the other datasets used in the land use discussions in Sections 4.3.1 and 5.3.1.

6.3.1.2 Cumulative Assessment Boundary

The CEAA Land Exchange boundary for land use is described below, both spatially and temporally.

6.3.1.2.1 Spatial

The CEAA for Land Exchange effects on land use was the entire Superior National Forest.

6.3.1.2.2 Temporal

This evaluation focused on the existing and anticipated future use of the CEAA for the life of the NorthMet Project Proposed Action (approximately 40 years). This includes the approximate 15-year life of the Superior National Forest Plan, which would extend through approximately 2019. Because Superior National Forest was established in 1909, existing conditions are considered indicative and representative of historical resource management activities.

6.3.1.3 Cumulative Assessment

The cumulative assessment for the Land Exchange Proposed Action portion focused on the net increase or decrease of land ownership, boundary managed, fragmentation, and management areas. Effects were evaluated by comparing GIS shapefiles of the Superior National Forest before any exchanges or acquisitions to GIS shapefiles of the Superior National Forest after all cumulative actions and the NorthMet Project Proposed Action alternatives occur.

The cumulative actions would result in a net increase in lands within the Superior National Forest. All of the lands that would be acquired are within the 1854 Ceded Territory and would thus replace the Mine Site lands with an equal or greater number of acres available for traditional land use by the Bands. Table 6.3.1-1 shows the management area designations that would result from the cumulative actions.

Table 6.3.1-1 Potential Increase/Decrease of Management Area Allocations Occurring from the Cumulative Actions

	Existing Superior National Forest	Superior National Forest – Land Exchange Proposed Action Plus other Exchanges and Acquisitions		Superior National Forest – Land Exchange Alternative B Plus other Exchanges and Acquisitions		Superior National Forest – Land Exchange No Action Alternative but other Exchanges and Acquisitions	
Management Area[1,2]	**Acres**	**Acres**	**Net Increase (Decrease)[3]**	**Acres**	**Net Increase (Decrease)[3]**	**Acres**	**Net Increase (Decrease)[3]**
Eligible Wild, Scenic, and Recreational Rivers	32,298.8	32,339.5	40.7	32,339.5	40.7	32,339.5	40.7
General Forest	640,907.0	620,917.7	(19,989.3)	619,381.8	(21,525.2)	614,851.1	(26,055.9)
General Forest - Longer Rotation	411,825.7	400,805.7	(11,020.2)	402,052.3	(9,773.4)	406,519.2	(5,306.5)
Potential RNAs/cRNAs	19,006.8	19,296.8	290.0	19,296.8	290.0	19,006.8	(0.0)
Primitive Wilderness	300,786.3	334,046.5	33,260.2	334,046.5	33,260.2	334,046.5	33,260.2
Pristine Wilderness	114,380.0	124,370.4	9,990.4	124,370.4	9,990.4	124,370.4	9,990.4
Recreation Use in a Scenic Landscape	157,044.2	152,926.1	(4,118.1)	152,926.1	(4,118.1)	152,926.1	(4,118.1)
RNAs	3,170.1	3,170.1	0.0	3,170.1	0.0	3,170.1	0.0
Riparian Areas	17,893.5	18,081.2	187.7	17,859.8	(33.7)	17,859.8	(33.7)
Semi-primitive Motorized Recreation	68,733.6	64,595.9	(4,137.7)	64,595.9	(4,137.7)	64,595.9	(4,137.7)
Semi-primitive Motorized Wilderness	53,529.1	57,331.6	3,802.5	57,331.6	3,802.5	57,331.6	3,802.5
Semi-primitive Non-motorized Recreation	4,564.9	4,565.7	0.8	4,565.7	0.8	4,565.7	0.8
Semi-primitive Non-motorized Wilderness	343,149.2	381,092.9	37,943.7	381,092.9	37,943.7	381,092.9	37,943.7
UBAs	2,495.4	2,495.4	0.0	2,495.4	0.0	2,495.4	0.0
Unidentified	0.1	0.1	0.0	0.1	0.0	0.1	0.0
Total[4]	2,169,784.7	2,216,035.7	46,251.0	2,215,524.9	45,740.2	2,215,171.1	45,386.4

Notes:
[1] See definitions of USFS management areas in Section 4.2.3.
[2] Developed based off of Table 5.3.1-1.
[3] Calculated as (Cumulative Action) minus (Existing Superior National Forest).
[4] Totals may not match overall project area acreages due to rounding and/or due to inconsistencies in GIS data layers.

Table 6.3.1-2 summarizes the Superior National Forest boundary, acreage, and fragmentation involved in each of the cumulative actions.

Table 6.3.1-2 Potential Increase/Decrease of Superior National Forest Boundary, Acreage, and Fragmentation Occurring from the Cumulative Actions

	Existing Superior National Forest	**Superior National Forest – Land Exchange Proposed Action Plus other Exchanges and Acquisitions**		**Superior National Forest – Land Exchange Alternative B Plus other Exchanges and Acquisitions**		**Superior National Forest – Land Exchange No Action Alternative but other Exchanges and Acquisitions**	
		Acres	**Net Increase (Decrease)**	**Acres**	**Net Increase (Decrease)**	**Acres**	**Net Increase (Decrease)**
Acreage in Superior National Forest controlled by USFS	2,171,603.9	2,217,701.2	46,097.3	2,217,197.7	45,593.8	2,216,831.0	45,227.1
Boundary length (linear miles)	10,054.8	9,185.9	(868.9)	9,207.1	(847.7)	9,215.2	(839.7)
Fragmentation (linear miles per acre)	0.005	0.004	(0.001)	0.005	0.0	0.004	(0.001)

The cumulative effects of the Land Exchange Proposed Action, Land Exchange Alternative B, and the Land Exchange No Action Alternative would all result in an increase to the federal estate by adding acreage to the 2,171,603.9 acres of USFS-managed land within the Superior National Forest. Furthermore, the cumulative actions would all result in net reduction of the perimeter around the USFS-managed portions of the Superior National Forest. Two of the three cumulative actions would slightly alter the existing ratio of fragmentation in the Superior National Forest of approximately 0.005 linear mile of boundary per acre of USFS-managed Superior National Forest land (see Table 6.3.1-2).

The Land Exchange and the cumulative projects would also include the following net land use effects:

- consolidation of federal ownership of land within Superior National Forest, specifically of land abutting Fall Lake, Gunflint Lake, and Little Gunflint Lake; land on Wolf Island; and 86,000 acres of currently designated school trust lands, resulting in decreased fragmentation and easier access by Forest Service managers;
- reduced mineral, forestry, residential, and commercial development potential within Superior National Forest and decreased conflict related to split surface and subsurface ownership;
- increased opportunities for public recreational use of stream and lake shorelines and semi-primitive non-motorized activities in the Superior National Forest;
- decreased opportunities for public recreational use of scenic landscapes and semi-primitive motorized activities in the Superior National Forest;
- contribution to local land use and economic goals such as growth and development of the Town of Crane Lake and School Trust Land revenue; and

- minimal net effect on land available for tribal use under the 1854 Treaty.

Land Exchange Alternative B would have similar effects, but to a lesser degree. Under the Land Exchange No Action Alternative, none of the effects described above would occur.

6.3.2 Water Resources

6.3.2.1 Surface Water

The cumulative effects analysis for water resources for the Land Exchange Proposed Action focused on the potential increases or decreases of water resources, including lakes, streams, and wild rice beds.

6.3.2.2 Approach

The cumulative projects were evaluated against water resources including the acreages and miles of shoreline for lakes, miles of public streams, and wild rice beds. This section evaluated the cumulative effects on water resources similar to those resources included in Section 5.3.2.

This section compared the types of data presented in Sections 4.3.2 and 5.3.2, but for each of the projects within the CEAA Land Exchange Proposed Action boundary. The GIS data obtained for the sections mentioned above were compared to projects within the CEAA Land Exchange Proposed Action boundary, and effects were determined based on this proximity. Specifically, NWI GIS data was used to determine the analysis.

6.3.2.3 Cumulative Effects Assessment Area

The project's CEAA Land Exchange Proposed Action boundary for water resources is described below, both spatially and temporally.

6.3.2.3.1 Spatial

The spatial boundary includes the Superior National Forest. The net increase or decrease of waterways that result from the Land Exchange Proposed Action and other cumulative actions have been examined in the context of the entire forest in Section 6.1.2.

6.3.2.3.2 Temporal

The temporal boundary includes the present through 2024 (the end of the second decade of the Forest Plan).

6.3.2.4 Cumulative Effects Assessment

The cumulative assessment for the Land Exchange Proposed Action portion focused on the net increase or decrease of water resources (acres/miles of shoreline for lakes, acreages of wild rice beds, and miles of streams). Effects were evaluated by comparing GIS shapefiles of the Superior National Forest before any exchanges or acquisitions to the Superior National Forest after all cumulative actions and alternatives occur.

Table 6.3.2-1 summarizes the amount and type of water resources in each of the cumulative actions.

Table 6.3.2-1 Potential Increase/Decrease of Water Resources Occurring from Cumulative Actions

Water Resource Types	Existing Superior National Forest	Superior National Forest – Land Exchange Proposed Action Plus other Exchanges and Acquisitions		Superior National Forest – Land Exchange Alternative B Plus other Exchanges and Acquisitions		Superior National Forest – Land Exchange No Action Alternative but other Exchanges and Acquisitions	
		Acres	**Net Increase (Decrease)**	**Acres**	**Net Increase (Decrease)**	**Acres**	**Net Increase (Decrease)**
Public Water Lakes, Acres	73,307.8	80,562.9	7,255.10	8,0574	7,266.20	80,456.7	7,148.90
Public Water Lakes, Miles of Shoreline	5,232.2	5,627.1	394.90	5,627.3	395.10	5,624.8	392.60
Public Water Streams, Miles	2,196.0	2,243.5	47.50	2,242.4	46.40	2,236.5	40.50
Wild Rice Beds, Acres	10,452.4	11,093.3	640.90[1]	11,093.3	640.90[1]	10,964.8	512.40

Notes:
Totals may not match overall Land Exchange area acreages due to rounding and/or due to inconsistencies in GIS data layers.
[1] Excludes area of wild rice stands in Pike River. Presence of wild rice in the Pike River, which runs through Little Rice Lake, was noted in Barr's surveys (2011a; 2012a; 2013l), but the area of rice was not calculated. The net increase in wild rice due to the Land Exchange Proposed Action is approximately 125 acres.

The Land Exchange Proposed Action, Land Exchange Alternative B, and Land Exchange No Action Alternative cumulative effects would all result in an increase to water resource areas, including wild rice within the Superior National Forest.

6.3.3 Wetlands

The cumulative effects analysis for wetlands for the Land Exchange Proposed Action focused on the potential increases or decreases of wetland acres and wetland types.

6.3.3.1 Approach

The cumulative projects were evaluated against wetland acres and wetland types. This section evaluated effects on wetland resources similar to Chapter 5.

This section compared the types of data presented in Sections 4.3.3 and 5.3.3, but for each of the projects within the CEAA Land Exchange Proposed Action boundary (see Section 6.1.2 and Figure 6.1.2-1). The GIS data obtained for the sections mentioned above were compared to projects within the CEAA Land Exchange Proposed Action boundary and effects were determined based on this proximity. Specifically, NWI GIS data was used to determine the analysis. Floodplain data for the CEAA Land Exchange Proposed Action boundary was not available for all areas; therefore, an analysis was not performed.

6.3.3.2 Cumulative Effects Assessment Area

The project's CEAA Land Exchange Proposed Action boundary for wetlands is described below, both spatially and temporally.

6.3.3.2.1 Spatial

The spatial boundary included the Superior National Forest. The net increase or decrease of wetland resources that result from the Land Exchange Proposed Action and other cumulative actions has been examined in context of the entire forest.

6.3.3.2.2 Temporal

The temporal boundary included the present through 2024 (the end of the second decade of the Forest Plan).

6.3.3.3 Cumulative Effects Assessment

The cumulative assessment for the Land Exchange Proposed Action portion focused on the net increase or decrease of wetland resources (acres of wetlands and acres of wetland types). Effects were evaluated by comparing GIS shapefiles of the Superior National Forest before any exchanges or acquisitions to the Superior National Forest after all cumulative actions and the NorthMet Project Proposed Action alternatives occur.

Table 6.3.3-1 summarizes the amount and type of wetland resources in each of the Cumulative Actions.

Table 6.3.3-1 Potential Increase/Decrease of Wetland Resources Occurring from Cumulative Actions

	Existing Superior National Forest	Superior National Forest – Land Exchange Proposed Action Plus other Exchanges and Acquisitions		Superior National Forest – Land Exchange Alternative B Plus other Exchanges and Acquisitions		Superior National Forest – Land Exchange No Action Alternative but other Exchanges and Acquisitions	
	Acres	**Acres**	**Net Increase (Decrease)**	**Acres**	**Net Increase (Decrease)**	**Acres**	**Net Increase (Decrease)**
Net Change in Wetlands	532,851.2	545,633.1	12,781.9	544,976.7	12,125.5	544,461.8	11,610.6
Wetland Types							
Freshwater Emergent Wetland	35,852.6	37,480.1	1,627.5	37,469.0	1,616.4	37,450.5	1,597.9
Freshwater Forested/Shrub Wetland	427,440.8	433,733.4	6,292.6	433,074.7	5,633.9	432,697.0	5,256.2
Freshwater Pond	14,609.8	14,988.8	379.0	14,990.2	380.4	14,989.5	379.7
Lake	51,763.1	56,123.9	4,360.8	56,135.8	4,372.7	56,020.1	4,257.0
Other	38.2	38.2	0.0	38.2	0.0	38.2	0.0
Riverine	3,146.7	3,268.8	122.1	3,268.8	122.1	3,266.4	119.7

The cumulative effects of the Land Exchange Proposed Action, Land Exchange Alternative B, and Land Exchange No Action Alternative would result in an increase to wetland resource areas as well as wetland types.

6.3.4 Vegetation

The cumulative effects analysis for vegetation for the Land Exchange Proposed Action focused on potential increases or decreases of land cover types, landscape ecosystems, MBS Sites of Biodiversity Significance, and ETSC plant species. Other comparisons that cannot be fully made include MIH types, age classes, mature patches, RFSS plants, and invasive non-native species.

6.3.4.1 Approach

This section compared the types of data presented in Sections 4.3.4 and 5.3.4, but for each of the projects within the CEAA Land Exchange Proposed Action boundary. The GIS data obtained for the sections mentioned above were compared to projects within the CEAA Land Exchange Proposed Action boundary, and effects were determined based on this proximity. Specifically, GIS data were obtained from the MDNR regarding GAP land cover types and listed ETSC plant species within the NHIS database. Data were obtained from the USFS MIH types, forest stand age classes, landscape ecosystems, RFSS plants, and invasive non-native species.

6.3.4.2 Cumulative Effects Assessment Area

The CEAA Land Exchange Proposed Action boundary for vegetation is described below, both spatially and temporally.

6.3.4.2.1 Spatial

The spatial boundary includes the Superior National Forest. The net increase or decrease of vegetation categories mentioned below that result from the Land Exchange Proposed Action and other cumulative actions has been examined in context of the entire forest. For state-listed ETSC plant species and RFSS species, federal and non-federal lands proposed for exchange are also analyzed in ecological context of the subsection.

6.3.4.2.2 Temporal

The temporal boundary includes the present through 2024 (the end of the second decade of the Forest Plan). The Forest Plan establishes management objectives for the landscape ecosystems (Forest Plan pages 2-61 through 2-78) primarily for composition (forest type) and age class distribution. All of these may be subject to change in a future plan revision (post-2019), but the second decade would incorporate this timeframe.

6.3.4.3 Cumulative Effects Assessment

The cumulative assessment for the Land Exchange Proposed Action portion focused on the net increase or decrease of vegetation cover types, MIH types, age classes, mature patches, landscape ecosystems, ETSC plant species, RFSS plants, and invasive non-native species. For all analyses, effects were evaluated by comparing GIS shapefiles of the Superior National Forest before any exchanges or acquisitions to the Superior National Forest after all cumulative actions and the NorthMet Project Proposed Action alternatives occur.

6.3.4.3.1 Effect of Cumulative Actions on Gap Analysis Program Land Cover Types

Effects were based on a net increase or decrease basis of GAP land cover type acres after all cumulative actions and the Land Exchange Proposed Action alternatives occur (see Section 6.1.2.2 for details on the Land Exchange actions) (see Table 6.3.4-1).

Table 6.3.4-1 Potential Increase/Decrease of GAP Land Cover Types Occurring from Cumulative Actions

	Existing Superior National Forest	Superior National Forest – Land Exchange Proposed Action Plus other Exchanges and Acquisitions		Superior National Forest – Land Exchange Alternative B Plus other Exchanges and Acquisitions		Superior National Forest – Land Exchange No Action Alternative but other Exchanges and Acquisitions	
Cover Types	**Acres**	**Acres**	**Net Increase (Decrease)**	**Acres**	**Net Increase (Decrease)**	**Acres**	**Net Increase (Decrease)**
Aquatic environments	90,559.8	95,622.6	5,062.7	95,634.7	5,074.9	95,403.0	4,843.1
Cropland/ Grassland	8,639.8	8,205.8	(434.0)	8,210.2	(429.6)	8,187.0	(452.8)
Disturbed	3,599.5	3,203.2	(396.3)	3,252.2	(347.3)	3,286.1	(313.4)
Lowland coniferous forest	288,212.4	293,756.6	5,544.2	293,147.1	4,934.6	293,659.1	5,446.7
Lowland deciduous forest	9,303.4	9,342.2	38.8	9,336.3	32.9	9,324.3	20.9
Shrubland	239,549.4	241,123.3	1,573.9	241,151.4	1,601.9	239,870.6	321.2
Upland conifer-deciduous mixed forest	94,636.8	100,879.5	6,242.8	100,832.0	6,195.3	100,843.2	6,206.4
Upland coniferous forest	443,125.9	459,302.8	16,176.9	459,318.2	16,192.2	460,151.6	17,025.6
Upland deciduous forest	993,698.8	1,005,960.5	12,261.7	1,006,011.0	12,312.2	1,005,801.6	12,102.8
Total[1]	2,171,325.9	2,217,396.6	46,070.7	2,216,893.1	45,567.1	2,216,526.4	45,200.5

Notes:
[1] Totals may not match overall project area acreages due to rounding and/or due to inconsistencies in GIS data layers.

Under all cumulative Land Exchange scenarios (i.e., Land Exchange Proposed Action and all other exchanges and acquisitions, Land Exchange Alternative B and all other exchanges and acquisitions, and Land Exchange No Action Alternative with all other exchanges and acquisitions), there would be a decrease in disturbed areas and cropland/grassland cover types on the Superior National Forest. There would be an increase to the Superior National Forest of aquatic environments, lowland coniferous forest, lowland deciduous forest, shrubland, upland conifer-deciduous mixed forest, upland coniferous forest, and upland deciduous forest.

Generally, the effects of the Land Exchange Alternative B would be less pronounced than those of the Land Exchange Proposed Action since less land would be exchanged, but all other exchanges and acquisitions would continue.

6.3.4.3.2 Effect of Cumulative Actions on Landscape Ecosystems

Effects were based on a net increase or decrease basis of landscape ecosystem acres (see Table 6.3.4-2).

Table 6.3.4-2 Potential Increase/Decrease of Landscape Ecosystems Occurring from Cumulative Actions

Landscape Ecosystem	Existing Superior National Forest	Superior National Forest – Land Exchange Proposed Action Plus other Exchanges and Acquisitions		Superior National Forest – Land Exchange Alternative B Plus other Exchanges and Acquisitions		Superior National Forest – Land Exchange No Action Alternative but other Exchanges and Acquisitions	
	Acres	Acres	Net Increase (Decrease)	Acres	Net Increase (Decrease)	Acres	Net Increase (Decrease)
Dry-Mesic Red and White Pine	257,939.5	256,649.1	(1,290.4)	256,555.3	(1,384.2)	255,980.8	(1,958.7)
Jack Pine-Black Spruce	869,304.9	918,260.1	48,955.2	918,913.2	49,608.2	920,153.5	50,848.6
Lowland Conifer	398,395.6	407,344.1	8,948.5	406,709.7	8,314.0	406,184.2	7,788.6
Lowland Hardwood	25,754.6	25,219.0	(535.6)	25,154.2	(600.4)	25,154.2	(600.4)
Mesic Birch-Aspen-Spruce-Fir	376,587.2	369,552.4	(7,034.8)	369,239.3	(7,347.9)	369,239.3	(7,347.9)
Mesic Red and White Pine	185,392.5	183,251.9	(2,140.6)	183,233.8	(2,158.7)	182,739.5	(2,653.0)
Sugar Maple	56,390.0	55,718.9	(671.1)	55,679.4	(710.6)	55,679.4	(710.6)
Total[1]	2,169,764.4	2,215,995.6	46,231.2	2,215,484.8	45,720.4	2,215,131.0	45,366.5

Notes:
[1] Totals may not match overall project area acreages due to rounding and/or due to inconsistencies in GIS data layers.

Under all cumulative Land Exchange scenarios (i.e., Land Exchange Proposed Action and all other exchanges and acquisitions, Land Exchange Alternative B and all other exchanges and acquisitions, and Land Exchange No Action Alternative with all other exchanges and acquisitions), there would be a decrease in dry-mesic red and white pine, lowland hardwood, mesic birch-aspen-spruce-fir, mesic red and white pine, and sugar maple landscape ecosystems on the Superior National Forest. There would be an increase to the Superior National Forest of the jack pine-black spruce and lowland conifer landscape ecosystems.

6.3.4.3.3 Effect of Cumulative Actions on Minnesota Biological Survey Sites of Biodiversity Significance

Effects were based on a net increase or decrease basis of landscape ecosystem acres (see Table 6.3.4-3).

Table 6.3.4-3 Potential Increase/Decrease of MBS Sites of Biodiversity Significance Occurring from Cumulative Actions

	Existing Superior National Forest	Superior National Forest – Land Exchange Proposed Action Plus other Exchanges and Acquisitions		Superior National Forest – Land Exchange Alternative B Plus other Exchanges and Acquisitions		Superior National Forest – Land Exchange No Action Alternative but other Exchanges and Acquisitions	
MBS Sites	**Acres**	**Acres**	**Net Increase (Decrease)**	**Acres**	**Net Increase (Decrease)**	**Acres**	**Net Increase (Decrease)**
High Biodiversity Significance	127,903.3	145,448.3	17,544.9	146,846.8	18,943.4	151,106.3	23,203.0
Moderate Biodiversity Significance	111,250.4	146,528.4	35,278.0	145,771.5	34,521.1	145,771.5	34,521.1
Total	239,153.7	291,976.6	52,822.9	292,618.3	53,464.6	296,877.8	57,724.1

There would be an increase in MBS Sites of "High" and "Moderate" Biodiversity Significance on the Superior National Forest under all cumulative Land Exchange scenarios (i.e., Land Exchange Proposed Action and all other exchanges and acquisitions, Land Exchange Alternative B and all other exchanges and acquisitions, and Land Exchange No Action Alternative with all other exchanges and acquisitions). There would be greater increases in the "Moderate" sites than "High" sites under all scenarios.

6.3.4.3.4 Effect of Cumulative Actions on Management Indicator Habitat Types

Generally, the non-federal lands do not have any MIH types identified on them, as it is a federal designation. Additionally, not all federal lands have been fully mapped for MIH types. As a result, an MIH comparison cannot be made for the Superior National Forest before and after all exchanges and acquisitions. Additionally, age classes and mature patches cannot be fully analyzed since they are a subset of the MIH data.

6.3.4.3.5 Effect of Cumulative Actions on Endangered, Threatened, and Special Concern Plant Species

Effects on ETSC plant species were evaluated by comparing the MDNR NHIS database for the Superior National Forest before and after all exchanges or acquisitions would occur. Effects were based on a net increase or decrease basis of number of species to federal land holdings. No federally listed ETSC plant species would be affected by the Land Exchange Proposed Action. The Land Exchange Proposed Action and all exchanges and acquisitions would not result in the decrease or absence to the Superior National Forest of any of the 10 ETSC plant species listed for the NorthMet Project Proposed Action or 4 ETSC plant species listed for the Land Exchange Proposed Action.

Land Exchange Alternative B, and all exchanges and acquisitions, would not result in a decrease or absence to the Superior National Forest of any of the 10 ETSC plant species listed for the NorthMet Project Proposed Action or 4 ETSC plant species listed for the Land Exchange Proposed Action.

The Land Exchange No Action Alternative, and all exchanges and acquisitions, would not result in a decrease or absence to the Superior National Forest of any of the 10 ETSC plant species listed for the NorthMet Project Proposed Action or 4 ETSC plant species listed for the Land Exchange Proposed Action.

6.3.4.3.6 Effect of Cumulative Actions on Regional Foresters Sensitive Species Plants

Effects on RFSS plants were evaluated by comparing the federal RFSS GIS layer on the Superior National Forest before and after all exchanges and acquisitions. Effects were based on a net increase or decrease basis of species to the federal estate. Based on the GIS layer alone, there would be no change to RFSS plants on the Superior National Forest due to all exchanges and acquisitions. However, RFSS plants have not been identified on all federal and non-federal lands, and so a true comparison cannot be made.

6.3.4.3.7 Effect of Cumulative Actions on Invasive Non-native Species

Effects on the federal estate regarding invasive non-native plant species were evaluated by comparing the federal invasive non-native species GIS layer on the Superior National Forest before and after all exchanges and acquisitions. Based on the GIS layer alone, there would be no change to invasive non-native plant species on the Superior National Forest due to all exchanges and acquisitions. However, invasive non-native species have not been identified on all federal and non-federal lands, and so a true comparison cannot be made.

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6.3.5 Wildlife

The cumulative effects analysis for wildlife for the Land Exchange Proposed Action focuses on potential increases or decreases of habitat availability and occurrences of ETSC wildlife species.

6.3.5.1 Approach

This section evaluated effects on species similar to Chapter 5, but for the CEAA Land Exchange Proposed Action boundary. Land cover type GIS data from the MDNR, discussed in Section 6.3.4, determined available habitat for wildlife species. Federally and state-listed wildlife species were identified in the NHIS database. Data obtained from the USFS identified miles of roads and trails available for use by Canada lynx.

6.3.5.2 Cumulative Effects Assessment Area

The CEAA Land Exchange Proposed Action boundary for wildlife is described below, both spatially and temporally.

6.3.5.2.1 Spatial

The FEIS analyzed effects on the Canada lynx, gray wolf, and northern long-eared bat occurring within the federal and non-federal lands proposed for exchange.

State-listed species were analyzed on the federal and non-federal lands proposed for exchange.

6.3.5.2.2 Temporal

The temporal boundary includes the present through 2019.

6.3.5.3 Cumulative Effects Assessment

The cumulative assessment for the Land Exchange Proposed Action portion focused on the net increase or decrease of habitat types, of road and snow trail miles (for Canada lynx), and of ETSC and RFSS wildlife species occurrences.

6.3.5.3.1 Environmental Consequences of Reasonably Foreseeable Actions on Wildlife Habitat

Effects on key habitat type were evaluated by comparing GIS shapefiles of the Superior National Forest before any exchanges or acquisitions to GIS shapefiles of the Superior National Forest after all cumulative actions and the Land Exchange Proposed Action alternatives occur (see Section 6.1.2.2 for details on the Land Exchange actions). Effects were based on a net increase or decrease of habitat acres types to the federal estate (see Table 6.3.5-1).

Table 6.3.5-1 Potential Increase/Decrease of Key Habitat Types Occurring from Cumulative Actions

Increase or (Decrease) of Acres of Key Habitat Types	Existing Superior National Forest	Superior National Forest – Land Exchange Proposed Action Plus other Exchanges and Acquisitions		Superior National Forest – Land Exchange Alternative B Plus other Exchanges and Acquisitions		Superior National Forest – Land Exchange No Action Alternative but other Exchanges and Acquisitions	
	Acres	**Acres**	**Net Increase (Decrease)**	**Acres**	**Net Increase (Decrease)**	**Acres**	**Net Increase (Decrease)**
Mature Upland Forest, Continuous Upland/Lowland Forest (MIH1-13)	1,828,977.3	1,869,241.7	40,264.4	1,868,644.5	39,667.2	1,869,779.8	40,802.4
Open Ground, Bare Soils (no MIH)	3,599.5	3,203.2	(396.3)	3,252.2	(347.3)	3,286.1	(313.4)
Grassland and Brushland, Early Successional Forest (no MIH)	248,189.2	249,329.1	1,139.9	249,361.6	1,172.4	248,057.6	(131.6)
Aquatic Environments (MIH 14)	90,559.8	95,622.6	5,062.7	95,634.7	5,074.9	95,403.0	4,843.1
Total[1]	2,171,325.9	2,217,396.6	46,070.7	2,216,893.1	45,567.1	2,216,526.4	45,200.5

Notes:
[1] Totals may not match overall project area acreages due to rounding and/or due to inconsistencies in GIS data layers.

The cumulative effect of the Land Exchange Proposed Action, plus other exchanges and acquisitions, would result in an increase of wildlife habitat on the federal estate. While mature forest, grassland/ shrubland, and aquatic habitats would increase, there would be a decrease in habitat acres for disturbed areas. The cumulative effect of Land Exchange Alternative B plus other exchanges and acquisitions would result in a smaller but similar increase or decrease in wildlife habitat. The Land Exchange No Action Alternative, plus other exchanges and acquisitions, would result in an increase of wildlife habitat on the federal estate. Mature forest and aquatic habitats would increase, but there would be a decrease in acres for disturbed and grassland/shrubland habitats.

6.3.5.3.2 Environmental Consequences of Reasonably Foreseeable Actions on Special Status Wildlife Species

Effects on special status wildlife species were evaluated by comparing GIS shapefiles of the Superior National Forest before any exchanges or acquisitions to the Superior National Forest after all cumulative actions and the Land Exchange Proposed Action alternatives occur. Effects on special status wildlife species were evaluated by comparing the MDNR NHIS database for the Superior National Forest before and after all exchanges or acquisitions would occur. Effects were based on a net increase or decrease basis of species to the federal estate.

Based upon the MDNR NHIS database information, there would be a net decrease of special status wildlife species to the federal estate due to all three actions (Land Exchange Proposed Action, Land Exchange Alternative B, and Land Exchange No Action Alternative), plus other exchanges and acquisitions. According to available information, a species of special concern, the red-shouldered hawk (*Buteo lineatus*), would decrease due to one of the exchanges and acquisitions. Special status species studies that inform the NHIS database have not been completed for all federal and non-federal lands; therefore, a true comparison cannot be made.

There are 17 terrestrial wildlife species on the Superior National Forest RFSS list. These species are not legally protected and species studies have not been completed. Similar to the special status species studies mentioned above, a true comparison of the increase or decrease of RFSS species occurrences cannot be made.

6.3.5.3.3 Environmental Consequences of Reasonably Foreseeable Actions on the Federally Listed Species

<u>Canada Lynx</u>

The Superior National Forest, where the Land Exchange Proposed Action included in the CEAA is located, includes lynx habitat and habitat for lynx prey species. As discussed in Section 5.3.5.2.1, lynx habitat includes a wide variety of upland and lowland habitats and forest types/ages, shrubland, and grasslands, but excludes aquatic environments. Denning habitat is typically found in mature forest and is generally more dependent on forest age classes, with trees older than saplings and with a dbh greater than 5 inches. Snowshoe hare are the primary prey species for the Canada lynx, and hare habitat includes all types and age classes of forest and shrubland, but not aquatic environments, disturbed areas, or grassland/croplands. Unsuitable habitat includes aquatic environments and disturbed areas.

The effects on lynx habitat were evaluated by comparing GIS shapefiles of the Superior National Forest before any exchanges or acquisitions to the Superior National Forest after all cumulative actions and the Land Exchange Proposed Action alternatives occur. Effects were based on a net increase or decrease of habitat acres to the federal estate (see Table 6.3.5-2).

Table 6.3.5-2 Potential Increase/Decrease of Suitable Habitat Types for Canada Lynx and Prey Species Occurring from Cumulative Actions

Suitable Habitat for Lynx and Prey Species	Existing Superior National Forest	Superior National Forest – Land Exchange Proposed Action Plus other Exchanges and Acquisitions		Superior National Forest – Land Exchange Alternative B Plus other Exchanges and Acquisitions		Superior National Forest – Land Exchange No Action Alternative but other Exchanges and Acquisitions	
	Acres	Acres	Net Increase (Decrease)	Acres	Net Increase (Decrease)	Acres	Net Increase (Decrease)
General Suitable Lynx Habitat (acres)	2,077,166.5	2,118,570.8	41,404.3	2,118,006.1	40,839.6	2,117,837.3	40,670.8
Suitable Denning Habitat (acres)	748,762.1	552,245.4	(196,516.6)	552,586.1	(196,175.9)	555,677.1	(193,085.0)
Suitable Snowshoe Hare Forage Habitat (acres)	2,068,526.8	2,110,365.0	41,838.2	2,109,795.9	41,269.1	2,109,650.4	41,123.6
Unsuitable Lynx Habitat (acres)	94,159.4	98,825.8	4,666.4	98,887.0	4,727.6	98,689.1	4,529.7

All three actions (Land Exchange Proposed Action, Land Exchange Alternative B, and Land Exchange No Action Alternative) plus other exchanges and acquisitions would result in some increases in general suitable lynx habitat, snowshoe hare forage habitat, and unsuitable habitat. Under all three actions plus other exchanges and acquisitions, there would be a decrease in lynx denning habitat, using mature MIH forest types as a predictor.

Lynx utilize snow pack trails and roads as travel corridors. The effects on lynx travel corridors were evaluated by comparing GIS shapefiles of the Superior National Forest before any exchanges or acquisitions to GIS shapefiles of the Superior National Forest after all cumulative actions and the Land Exchange Proposed Action alternatives occur. Effects were based on a net increase or decrease of miles of snow pack trails and established roads to the federal estate (see Table 6.3.5-3).

Table 6.3.5-3 Potential Increase/Decrease of Lynx Travel Corridors on the Federal Estate Occurring from Cumulative Actions

Travel Corridor Type	Existing Superior National Forest	Superior National Forest – Land Exchange Proposed Action Plus other Exchanges and Acquisitions		Superior National Forest – Land Exchange Alternative B Plus other Exchanges and Acquisitions		Superior National Forest – Land Exchange No Action Alternative but other Exchanges and Acquisitions	
	Miles	Miles	Net Increase (Decrease)	Miles	Net Increase (Decrease)	Miles	Net Increase (Decrease)
Established Snow Pack Trails	1,818.7	1,803.5	(15.2)	1,803.0	(15.7)	1,803.0	(15.7)
Established Roads	3,167.3	2,968.2	(199.1)	2,968.3	(199.0)	2,972.1	(195.2)

All three actions (Land Exchange Proposed Action, Land Exchange Alternative B, and Land Exchange No Action Alternative), plus other exchanges and acquisitions, would result in a decrease in established road and established snow pack trails available for lynx use.

Gray Wolf

The Superior National Forest, where the Land Exchange Proposed Action included in the CEAA is located, includes gray wolf habitat and habitat for wolf prey species. As discussed in Section 5.3.5.2.1, wolf cover habitat includes a wide variety of upland and lowland habitats and forest types of immature to mature age classes. Forage habitat is typically found in young forest types. Unsuitable habitat includes aquatic environments and disturbed areas.

The effects on wolf habitat were evaluated by comparing GIS shapefiles of the Superior National Forest before any exchanges or acquisitions to the Superior National Forest after all cumulative actions and the Land Exchange Proposed Action alternatives occur. MIH types and age classes are not fully mapped on non-federal lands, and so a true comparison is impossible to make. Effects were based on a net increase or decrease of habitat acres to the federal estate (see Table 6.3.5-4).

Table 6.3.5-4 Potential Increase/Decrease of Gray Wolf Habitat on the Federal Estate Occurring from Cumulative Actions

	Existing Superior National Forest	Superior National Forest – Land Exchange Proposed Action Plus other Exchanges and Acquisitions		Superior National Forest – Land Exchange Alternative B Plus other Exchanges and Acquisitions		Superior National Forest – Land Exchange No Action Alternative but other Exchanges and Acquisitions	
Suitable Habitat for Gray Wolf	**Acres**	**Acres**	**Net Increase (Decrease)**	**Acres**	**Net Increase (Decrease)**	**Acres**	**Net Increase (Decrease)**
Forage Habitat (acres)	66,681.1	64,312.5	(2,368.6)	64,307.0	(2,374.1)	64,539.2	(2,141.9)
Cover Habitat (acres)	1,107,492.2	900,697.2	(206,795.0)	901,181.6	(206,310.6)	905,493.3	(201,998.9)

All three actions (Land Exchange Proposed Action, Land Exchange Alternative B, and Land Exchange No Action Alternative), plus other exchanges and acquisitions, would result in a decrease in forage and cover habitat available for gray wolves.

Northern Long-Eared Bat

The Superior National Forest, where the Land Exchange Proposed Action included in the CEAA is located, includes northern long-eared bat habitat. As discussed in Section 5.3.5.2.1, northern long-eared bat summer roosting habitat includes mature forest types. Forage habitat is typically found in mature forest understories or openings in such habitat types.

The effects on northern long-eared bat habitat were evaluated by comparing GIS shapefiles of the Superior National Forest before any exchanges or acquisitions to the Superior National Forest after all cumulative actions and the Land Exchange Proposed Action alternatives occur. MIH types and age classes are not fully mapped on non-federal lands, and so a true comparison is impossible to make. Effects were based on a net increase or decrease of habitat acres to the federal estate (see Table 6.3.5-5).

Table 6.3.5-5 Potential Increase/Decrease of Northern Long-Eared Bat Habitat on the Federal Estate Occurring from Cumulative Actions

Suitable Habitat for Northern Long-Eared Bat	Existing Superior National Forest	Superior National Forest – Land Exchange Proposed Action Plus other Exchanges and Acquisitions		Superior National Forest – Land Exchange Alternative B Plus other Exchanges and Acquisitions		Superior National Forest – Land Exchange No Action Alternative but other Exchanges and Acquisitions	
	Acres	**Acres**	**Net Increase (Decrease)**	**Acres**	**Net Increase (Decrease)**	**Acres**	**Net Increase (Decrease)**
Forage and Roosting Habitat (acres)	748,762.1	552,245.4	(196,516.6)	552,586.1	(196,175.9)	555,677.1	(193,085.0)

All three actions (Land Exchange Proposed Action, Land Exchange Alternative B, and Land Exchange No Action Alternative), plus other exchanges and acquisitions, would result in a decrease in forage and summer roosting habitat available for northern long-eared bats.

6.3.6 Aquatic Species

The cumulative effects analysis for aquatic species for the Land Exchange Proposed Action focused on the potential increases or decreases of surface water area and available shoreline, as these parameters are the limiting factors that determine the available aquatic species habitat.

6.3.6.1 Approach

The cumulative effects of the Land Exchange Proposed Action, in combination with other existing and reasonably foreseeable projects were evaluated against stream shoreline frontage, lake surface area, and lake shoreline frontage. This section evaluated effects on aquatic species available habitat similar to Chapter 5.

This section compared the types of data presented in Sections 4.3.6 and 5.3.6, but for each of the projects within the CEAA Land Exchange Proposed Action boundary. The GIS data obtained for the sections mentioned above were compared to projects within the CEAA Land Exchange boundary, and effects were determined based on this proximity. Specifically, DNR 24K Lakes and DNR 24K Streams GIS data were used to determine the analysis; however, a shoreline frontage index was not analyzed, as in Section 5.3.6, due to limited data availability.

The surface water features analyzed were assumed to correlate to available aquatic species habitat.

6.3.6.2 Cumulative Effects Assessment Area

The CEAA Land Exchange Proposed Action boundary for aquatic species habitat is described below, both spatially and temporally.

6.3.6.2.1 Spatial

The spatial boundary included the Superior National Forest. The net increase or decrease of surface water features or SGCN species that result from the Land Exchange Proposed Action and other cumulative actions has been examined in context of the entire Superior National Forest.

6.3.6.2.2 Temporal

The temporal boundary included the present through 2024 (the end of the second decade of the Forest Land and Resource Management Plan).

6.3.6.3 Cumulative Effects Assessment

The cumulative assessment for the Land Exchange Proposed Action portion focused on the net increase or decrease of surface water features and federal/state sensitive aquatic species (SGCN, ETSC, and RFSS species). Effects were evaluated by comparing GIS shapefiles of the Superior National Forest before any exchanges or acquisitions to GIS shapefiles of the Superior National Forest after all cumulative actions and the NorthMet Project Proposed Action alternatives occur.

6.3.6.3.1 Effect of Cumulative Actions on Net Increase/Decrease of Surface Water Features

Table 6.3.6-1 summarizes the surface water area and shoreline linear distance in each of the cumulative actions. For this qualitative assessment, it is assumed that the surface water features provide aquatic species habitat; however, the quality of that habitat could not be assessed or compared.

The effects of the cumulative actions for each scenario summarized below indicate there would be an increase in the lake area and lake shoreline distances, and a decrease in the riverine shoreline distances.

6.3.6.3.2 Environmental Effects of Cumulative Actions on Special Status Aquatic Species

Effects on special status aquatic species (federal and state ETSC, SGCN, and RFSS) were evaluated by comparing maps (derived from GIS data) of the existing Superior National Forest to the Forest if all cumulative actions and the alternatives to the Land Exchange were to occur. GIS analysis determined that no known special status aquatic species are located within the lands that would be relinquished or acquired by the Superior National Forest. However, it is likely that special status aquatic species habitat does exist on some of these lands, but the limited available data does not allow for an accurate comparison.

Table 6.3.6-1 Potential Increase/Decrease of Surface Water Resources Occurring from Cumulative Actions

	Existing Superior National Forest	Superior National Forest – Land Exchange Proposed Action Plus other Exchanges and Acquisitions		Superior National Forest – Land Exchange Alternative B Plus other Exchanges and Acquisitions		Superior National Forest – Land Exchange No Action Alternative but other Exchanges and Acquisitions	
	Total	**Total**	**Net Increase (Decrease)**	**Total**	**Net Increase (Decrease)**	**Total**	**Net Increase (Decrease)**
Lake (acres)	80,885.0	88,067.5	7,182.5	88,080.7	7,195.7	87,961.7	7,076.7
Lake (shoreline miles)	7,145.6	7,641.6	496.0	7,642.1	496.5	7,639.1	493.5
Riverine (miles)[1]	7,293.3	3,749.7	(3,543.6)	3,749.1	(3,544.2)	3,746.4	(3,546.9)

Notes:
[1] River miles calculated used both shorelines to derive total.

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6.3.7 Air Quality

This resource would not be subject to any cumulative effects as a result of the Land Exchange Proposed Action in conjunction with other past, present, or reasonably foreseeable actions.

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6.3.8 Noise and Vibration

This resource would not be subject to any cumulative effects as a result of the Land Exchange Proposed Action in conjunction with other past, present, or reasonably foreseeable actions.

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6.3.9 Cultural Resources

This resource would not be subject to any cumulative effects as a result of the Land Exchange Proposed Action in conjunction with other past, present, or reasonably foreseeable actions.

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6.3.10 Socioeconomics

The cumulative effects analysis for socioeconomics for the Land Exchange Proposed Action focused on changes to revenue streams, timber harvesting, employment related to forestry and timber activities, recreation, and amount of accessible 1854 Ceded Territory area and resources.

6.3.10.1 Approach

Criteria for evaluating the socioeconomic cumulative effects of the Land Exchange Proposed Action include:

- changes in revenue streams (taxes, payment in lieu of taxes) and assessed market value associated with transfers of land from non-federal to federal ownership;
- changes in the amount and value of land available for timber harvest and employment related to forestry and timber activities;
- changes in visitation, recreational tourism spending to the Superior National Forest; and
- changes in the amount of accessible 1854 Ceded Territory land and the availability of treaty resources (e.g., wild rice, fish, and game).

6.3.10.2 Cumulative Effects Assessment Area

The CEAA Land Exchange Proposed Action boundary for socioeconomics is described below, both spatially and temporally.

6.3.10.2.1 Spatial

The CEAA for socioeconomic effects of the Land Exchange Proposed Action is the portions of Superior National Forest in St. Louis, Lake, and Cook counties.

6.3.10.2.2 Temporal

This evaluation focuses on the existing and anticipated future use of the CEAA for the life of the NorthMet Project Proposed Action (approximately 20 years). This includes the approximate 15-year life of the Forest Plan, which would extend through approximately 2019. Because Superior National Forest was established in 1909, existing conditions are considered indicative and representative of historical resource management activities.

6.3.10.3 Cumulative Effects Assessment

The net socioeconomic effects of the Crane Lake Land Exchange would be a marginal increase in recreational activity (and thus regional tourism revenue) in the Superior National Forest, and increased economic benefit to the Town of Crane Lake due to additional development (consistent with existing plans).

The net socioeconomic effects of the Cook County Land Exchange would include increased revenue to Cook County through management activities (timber and development) on newly acquired parcels and reduced cost of federal management of the Superior National Forest and BWCAW.

The net socioeconomic effects of the School Trust Land Exchange and Land Acquisition would be a decrease in logging or mining activity (and thus timber and mineral revenue) in the Superior National Forest, and increased School Trust Land revenue due to additional development (consistent with existing plans).

The Fall Lake land acquisition and the Gunflint land acquisition would open additional areas of land to potential public use (as well as exercise of usufructuary rights under the 1854 Treaty) in an area that already experiences recreational activity (see Section 6.2.11). Any increases in economic activity associated with these expansions would be minimal. The Wolf Island Phase 2 land acquisition would also open additional areas of land to potential public and tribal use and would consolidate Forest Service ownership of Wolf Island and its documented historical resources. Any increases in economic activity associated with this acquisition would be minimal.

In summary, the Land Exchange Proposed Action and cumulative actions would consolidate federal ownership within the Superior National Forest, thus reducing costs associated with management activities. At the same time, the Land Exchange Proposed Action and cumulative actions would provide more land to federal and county governments that could generate economic activity (for those entities and for the region as a whole) through timber, development, or increased recreational use. Increased activity could result in increased employment related to timber, development, and/or recreation.

Net change in public land available under the 1854 Treaty would increase due to the NorthMet Proposed Action and Land Exchange Proposed Action; although the federal lands proposed for exchange would no longer be available. The Land Exchange Proposed Action would transfer 6,650.2 acres of USFS administered land to PolyMet for the NorthMet Project Proposed Action mine and acquire up to 6,722.5 acres of private land for administration by the USFS. The proposed land exchange is a discrete action for the sole purpose of resolving the instant conflict between surface and subsurface rights and would not spur additional conversion of land from private to public ownership.

There is no evidence that the land exchanges in question would create EJ effects.

Land Exchange Alternative B would have similar effects, although to a lesser degree.

Under the Land Exchange No Action Alternative, none of the effects described above would occur.

6.3.11 Recreation and Visual Resources

The cumulative effects analysis for recreation and visual resources for the Land Exchange Proposed Action focused on potential increases or decreases in recreation opportunities between recreation opportunity spectrum classes and in scenic integrity objective designated lands.

6.3.11.1 Approach

This section compared the types of data presented in Sections 4.3.11 and 5.3.11, for each of the projects within the CEAA Land Exchange Proposed Action boundary. Effects were determined based on GIS data for these projects, including USFS mapping of ROS classes and SIO designated lands.

ROS classes (see Section 4.2.11.1.1) were defined for the Superior National Forest by the USFS (1982). Likely ROS classes for the non-federal lands were identified by the USFS through the SDEIS process, and are generally the same as the existing mapped ROS classes on surrounding adjacent federal lands. GIS analysis was employed to determine the net change in acreage by ROS class.

SIOs (see Section 4.2.11.1.2) were defined for Superior National Forest by the USFS (1995). As with the ROS classes, likely SIO designations for the non-federal lands were identified through the SDEIS process and generally match the existing mapped SIO designations on surrounding adjacent federal lands. GIS analysis was employed to determine the net change in acreage by SIO.

6.3.11.2 Cumulative Effects Assessment Area

The CEAA Land Exchange Proposed Action boundary for recreation and visual resources is described below, both spatially and temporally.

6.3.11.2.1 Spatial

The spatial boundary for recreational resources included the Superior National Forest. The spatial boundary for visual resources included the Superior National Forest, including the viewshed of the federal tract. The net gain or loss of recreation and visual resources from the exchange and other foreseeable activities was examined in context of the entire forest.

6.3.11.2.2 Temporal

This evaluation focuses on the existing and anticipated future use of the CEAA for the life of the NorthMet Project Proposed Action (approximately 20 years). This includes the approximate 15-year life of the Forest Plan, which would extend through approximately 2019. Because Superior National Forest was established in 1909, existing conditions are considered indicative and representative of historical resource management activities.

6.3.11.3 Cumulative Effects Assessment

The cumulative assessment for the Land Exchange Proposed Action portion focused on the net increase or decrease of ROS classes and SIO-designated lands. For all analyses, effects were evaluated by comparing GIS shapefiles of the Superior National Forest before any exchanges or acquisitions to GIS shapefiles of the Superior National Forest after all cumulative actions and the NorthMet Project Proposed Action alternatives occur.

Table 6.3.11-1 summarizes the net increase or decrease of recreation opportunity spectrum classifications in each of the cumulative actions.

Table 6.3.11-1 Potential Increase/Decrease of Recreation Opportunity Spectrum Classifications Occurring from Cumulative Actions

	Existing Superior National Forest	**Superior National Forest – Land Exchange Proposed Action Plus other Exchanges and Acquisitions**		**Superior National Forest – Land Exchange Alternative B Plus other Exchanges and Acquisitions**		**Superior National Forest – Land Exchange No Action Alternative but other Exchanges and Acquisitions**	
Recreation Opportunity Spectrum	**Acres**	**Acres**	**Net Increase (Decrease)**	**Acres**	**Net Increase (Decrease)**	**Acres**	**Net Increase (Decrease)**
Primitive	**481,022.1**	**481,862.4**	**840.3**	**481,862.4**	**840.3**	**481,862.4**	**840.3**
Primitive	481,022.1	523,201.5	42,179.4	523,201.5	42,179.4	523,201.5	42,179.4
Roaded Natural	314,667.2	307,664.1	(7,003.1)	308,129.9	(6,537.3)	307,099.1	(7,568.1)
Rural	9,838.0	9,448.1	(389.9)	9,448.1	(389.9)	9,448.1	(389.9)
Semi-Primitive Motorized	954,020.3	933,211.6	(20,808.7)	932,391.0	(21,629.3)	935,194.1	(18,826.2)
Semi-Primitive Non-motorized	411,717.2	443,837.0	32,119.8	443,688.2	31,971.0	441,549.2	29,832.0
Urban	93.2	93.0	(0.2)	93.0	(0.2)	93.0	(0.2)
Total[1]	2,171,357.9	2,217,455.3	46,097.4	2,216,951.7	45,593.8	2,216,585.1	45,227.2

Notes:
[1] Totals may not match overall project area acreages due to rounding and/or due to inconsistencies in GIS data layers.

The cumulative actions from the Land Exchange Proposed Action would result in an increase to Primitive and Semi-primitive Non-motorized classes, and a decrease in Roaded Natural, Rural, Semi-primitive Motorized, and Urban classes. The Land Exchange Alternative B would result in an increase to Primitive and Semi-primitive Non-motorized classes while there would be a decrease in Roaded Natural, Rural, Semi-primitive Motorized, and Urban classes. The Land Exchange No Action Alternative would result in a decrease to Roaded Natural, Rural, Semi-primitive Motorized, and Urban classes, but an increase to Primitive and Semi-primitive Non-motorized classes.

The Cook County Land Exchange action would help consolidate federal ownership of land within BWCAW, but would not change recreational opportunities within BWCAW. The Fall Lake land acquisition action would result in federal acquisition of tracts with recreational value along Fall Lake. The properties are located on the shores of Fall Lake, across from the Fall Lake boat landing/campground and within 0.5 mile of the Fall Lake entry to the BWCAW. The Gunflint Land acquisition action would result in federal acquisition of tracts with recreational value along Gunflint and Little Gunflint Lakes at the US-Canadian border along the “Voyageurs Route”. The School Trust Land Exchange and Land acquisition action would help consolidate federal ownership of land within BWCAW and would not change recreational opportunities within the BWCAW, but would decrease opportunities for public recreational use of scenic landscapes and Semi-primitive Motorized activities in the Superior National Forest. The Wolf

Island Phase 2 land acquisition action would result in federal acquisition of the northern portion of Wolf Island, and consolidation of federal ownership of the entire island. The island has documented historical resources, and is close to the BWCAW (TPL 2012).

In summary, the cumulative actions would increase the amount of public land available and accessible for recreational activity; however, some specific recreational opportunities, such as recreational use of scenic landscapes and Semi-primitive Motorized activities in the Superior National Forest, would be diminished.

Table 6.3.11-2 summarizes the net increase or decrease of SIO classifications in each of the cumulative actions.

Table 6.3.11-2 Potential Increase/Decrease of Scenic Integrity Objectives Classifications Occurring from Cumulative Actions

	Existing Superior National Forest	**Superior National Forest – Land Exchange Proposed Action Plus other Exchanges and Acquisitions**		**Superior National Forest – Land Exchange Alternative B Plus other Exchanges and Acquisitions**		**Superior National Forest – Land Exchange No Action Alternative but other Exchanges and Acquisitions**	
SIO Classifications	**Acres**	**Acres**	**Net Increase (Decrease)**	**Acres**	**Net Increase (Decrease)**	**Acres**	**Net Increase (Decrease)**
High	344,508.1	341,220.9	(3,287.2)	341,018.8	(3,489.3)	341,000.7	(3,507.4)
Moderate	798,922.5	778,350.5	(20,572.0)	778,022.2	(20,900.3)	776,732.9	(22,189.6)
Low	158,944.9	149,235.3	(9,709.6)	148,980.6	(9,964.3)	149,907.3	(9,037.6)
Unclassified	22,177.12	21,722.9	(454.2)	21,778.9	(398.3)	21,786.8	(390.3)
Total	1,324,553.0	1,290,529.5	(34,023.5)	289,800.5	(34,752.5)	1,289,427.7	(35,125.3)

The cumulative actions from the Land Exchange Proposed Action, Land Exchange Alternative B, and Land Exchange No Action Alternative would result in a net decrease to the federal estate of acres of land with a High, Moderate, Low, and Unclassified SIO.

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6.3.12 Wilderness and Other Special Designation Areas

This resource would not be subject to any cumulative effects as a result of the Land Exchange Proposed Action in conjunction with other past, present, or reasonably foreseeable actions.

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6.3.13 Hazardous Materials

This resource would not be subject to any cumulative effects as a result of the Land Exchange Proposed Action in conjunction with other past, present, or reasonably foreseeable actions.

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6.3.14 Geotechnical Stability

This resource would not be subject to any cumulative effects as a result of the Land Exchange Proposed Action in conjunction with other past, present, or reasonably foreseeable actions.

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7.0 COMPARISON OF ALTERNATIVES AND OTHER CONSIDERATIONS

7.1 INTRODUCTION

This chapter compares the alternatives and their environmental consequences for the NorthMet Project Proposed Action and Land Exchange Proposed Action. It also addresses irretrievable and irreversible effects, short-term uses verses long-term productivity of the environment, unavoidable adverse effects, impacts on human health, and consideration of how the Land Exchange Proposed Action and alternatives meet the public interest. This chapter concludes with a statement on the federal Co-lead Agencies' preferred alternatives.

7.2 COMPARISON OF ALTERNATIVES

Alternatives to the NorthMet Project Proposed Action and Land Exchange Proposed Action were screened and analyzed relatively independently of each other because of the different nature of the actions. This section consolidates the connected actions, and summarizes the detailed analysis presented in the respective sections in Chapter 5 and 6. A description of the connected alternatives is provided below, followed by a comparison of the environmental consequences.

7.2.1 Proposed Connected Actions

The Proposed Connected Actions would involve both the NorthMet Project Proposed Action and Land Exchange Proposed Action as presented and described in Sections 3.2.2 and 3.3.2, respectively.

The NorthMet Project Proposed Action would involve three major components: a new copper-nickel-PGE Mine Site, a refurbished Plant Site at the former LTVSMC processing plant, and an existing Transportation and Utility Corridor that would connect the Mine Site and Plant Site. The NorthMet Project Proposed Action would comprise three phases. The first phase would last for approximately 18 months and would include site preparation, refurbishment of some existing buildings, and construction of new facilities and infrastructure. The second phase, which would last approximately 20 years, would include operation of the mine and processing facilities; blasting, hauling, and processing of the ore to be shipped; stockpiling of waste rock; and progressive reclamation (at the same time as mining). The third phase would occur after mining and would include infrastructure removal and final land reclamation, and post-closure maintenance.

The water quality objective of closure is to provide mechanical or non-mechanical treatment for as long as necessary to meet regulatory standards at applicable groundwater and surface water compliance points. Water quality modeling performed in support of this FEIS indicates that water treatment systems would be needed at the Mine Site and Plant Site indefinitely. The water models constructed to assess the potential effects from the NorthMet Project Proposed Action were not designed to predict the duration of treatment nor do they capture all the factors that influence the duration of treatment (e.g., potential future regulatory and technological changes). Therefore, the models cannot be used to predict when treatment would end. Actual treatment requirements would be assessed on a recurring basis throughout operations and closure based on results of ongoing discharges, performance, and water resource monitoring, ensuring continuous protection of ground and surface water quality and compliance with applicable water quality standards. This reassessment process would rely on measured monitoring results (evaluated through modeling) rather than the results of the predictive modeling included in this FEIS. Regardless of the precise duration of effects or water treatment at either the Mine Site or Plant Site, there are measures available to address impacts to natural resources. PolyMet would be held accountable for maintenance and monitoring required under the permit and would not be released until all conditions have been met. PolyMet would be required to provide financial assurance to MDNR (managed independently) for closure and maintenance costs as a contingency if PolyMet or the operating company at that time were unable to fulfill the obligations under the Permit to Mine.

The configuration of the NorthMet Project Proposed Action is shown in Figure 3.2-1 in Section 3.2.1. The development of the Mine Site is shown in Figures 3.2-4 through 3.2-9 in Section 3.2.2.1. The Transportation and Utility Corridor is shown in Figure 3.2-20 in Section 3.2.2.2, and development of the Plant Site is shown in Figure 3.2-23 and Figure 3.2-29 in Section 3.2.2.3.

The Land Exchange Proposed Action would involve exchange of a single 6,650.2-acre (GLO) tract of federal land (encompassing the activities proposed at the Mine Site) with up to 6,722.5 acres (GLO) of privately owned, non-federal lands located within five different tracts throughout the proclamation boundary of the Superior National Forest within St. Louis, Lake, and Cook counties of northeastern Minnesota. The location of the federal and non-federal lands is shown in Figure 3.3-1 in Section 3.3.2.

7.2.2 Proposed Connected Actions Alternative B

Proposed Connected Actions Alternative B would involve the NorthMet Project Proposed Action as described in Section 3.2.2 and summarized above in Section 7.2.1, and the Land Exchange Alternative B as described in Section 3.3.3.2.

Compared to the Land Exchange Proposed Action, the Land Exchange Alternative B would involve conveying fewer acres of federal lands, approximately 4,887.3 acres (GLO), for fewer acres of non-federal land, approximately 4,651.5 acres (GLO) from a single tract (Tract 1). The configuration of the smaller federal parcel is shown in Figure 3.3-2 in Section 3.3.3.2.

7.2.3 No Action Alternative

Under the No Action Alternative there would be no NorthMet Project Proposed Action or Land Exchange Proposed Action. Refer to Section 3.2.3.2 and Section 3.3.3.1 for a discussion on the No Action alternative for the respective connected actions.

At the Mine Site, PolyMet would be required under exploration approvals to reclaim surface disturbance associated with exploratory and development drilling activities. Other existing surface uses would be allowed to continue consistent with the Superior National Forest Plan. No further upgrades or new segments would be constructed along the existing power transmission line, railroad, and Dunka Road, which would continue to be used by their private owners. At the former LTVSMC processing plant and Tailings Basin, the land owner, Cliffs Erie, would be required to complete closure and reclamation activities as required under existing state permits, plans, and the Consent Decree.

The federal government would not convey federal lands to PolyMet and the USFS would continue managing these lands as has been done in the past. Furthermore, the federal government would not acquire the five tracts of non-federal lands and the lands would remain as private lands.

7.2.4 Comparison of Effects

A summarized comparison of the environmental consequences of the alternatives—as described in Sections 7.2.1, 7.2.2, and 7.2.3—is provided in Table 7.2.4-1. Refer to the respective sections in Chapter 4 for discussion on the affected environment and to Chapter 5 for more detail on the environmental consequences.

In comparison to the Proposed Connected Actions (see Section 7.2.1), the Proposed Connected Actions Alternative B (see Section 7.2.2) would have the same effects from the NorthMet Project Proposed Action, but would convey fewer lands through the Land Exchange, resulting in smaller net increases/decreases in environmental resources. The No Action Alternative would not directly affect the existing environment and management of these lands would continue in accordance with their current permits. Compared to the Proposed Connected Actions and Proposed Connected Actions Alternative B, the No Action Alternative would likely result in active but different comprehensive management of water from the existing LTVSMC Tailings Basin. There would be no other measurable effect on other resources compared to their existing conditions.

102 -Page Intentionally Left Blank-

Table 7.2.4-1 Comparison of Environmental Consequences by Alternative

Resource	Proposed Connected Actions	Proposed Connected Actions Alternative B	No Action Alternative
Land Use	• No effects on land use that would require changes in ordinances or comprehensive forest plans • Federal lands within the NorthMet Project area would be replaced with acreage of equal value through a land exchange	• Mostly similar effects as Proposed Connected Actions, with fewer federal acres exchanged	• Existing LTVSMC site would be reclaimed in accordance with the reclamation/closure plan
Water Resources	• Greater than 90 percent of groundwater and 100 percent of surface water at the Tailings Basin would be captured and treated to a concentration at or below applicable water quality evaluation criteria • The NorthMet Project Proposed Action would not cause any significant water quality impacts because: 1) exceedances of the P90 threshold would not occur; 2) the NorthMet Project Proposed Action concentrations would not be higher than concentrations predicted for the Continued Existing Conditions scenario; or 3) the frequency of exceedances for the NorthMet Project Proposed Action conditions would be within an acceptable range or not attributable to the NorthMet Project Proposed Action discharges or both • Mercury loadings to the Embarrass River would increase slightly, decrease slightly to the Partridge River, with an overall net decrease in NorthMet Project Proposed Action loadings to the downstream St. Louis River.	• Same as under Proposed Connected Actions	• Seepage water quality from the existing LTVSMC Tailings Basin would be expected to improve over time as a result of the Cliffs Erie Consent Decree, other permit requirements (e.g., Permit to Mine), and natural attenuation of contaminants

Resource	Proposed Connected Actions	Proposed Connected Actions Alternative B	No Action Alternative
	Discharges from the Plant Site WWTP and Mine Site WWTF would be at or below the Great Lakes Initiative discharge standard of 1.3 ng/L • Sulfate concentrations would remain unchanged in the Partridge River and would be significantly reduced in the Embarrass River • Plant Site WWTP effluent would be used to augment flows to tributary streams and wetlands downgradient from the Tailings Basin to offset seepage captured in the containment system and the south surface seepage management system for water quality reasons		
Wetlands and Floodplains	• 913.8 acres of wetlands in NorthMet Project area would be directly affected • 6,568.8 to 7,694.2 acres of wetlands in NorthMet Project area would be indirectly affected • 940.7 acres of directly affected and fragmented wetlands to be mitigated up front • 1,602.7 acres of compensatory off-site wetlands • Wetland mitigation plan would be implemented to offset increased CO_2 emissions to extent practicable • 505.5-acre net increase of wetlands to the federal estate (through Land Exchange Proposed Action); therefore, Land Exchange Proposed Action conforms to EO 11990 • 376.2-acre net increase of mapped floodplain but would result in a 1,226.0-acre net decrease of floodplain	• Same direct and indirect effects and compensatory mitigation at NorthMet Project area as under Proposed Connected Actions • 69.9-acre net increase of wetlands to the federal estate (through Land Exchange Alternative B); therefore, Land Exchange Alternative B conforms to EO 11990 • 376.2-acre net increase of mapped floodplain but would result in a 861.7-acre net decrease of floodplains to the federal estate (through Land Exchange Alternative B); however, no decrease in regulatory floodplains, no increase in flood damage potential, and no change in ecological function of floodplain; therefore, Land Exchange Alternative B conforms to EO 11988	• No change in wetland or floodplain acreage

Resource	Proposed Connected Actions	Proposed Connected Actions Alternative B	No Action Alternative
	area to the federal estate (through Land Exchange Proposed Action); however, no decrease in mapped floodplains, no increase in flood damage potential, and no change in ecological function of floodplain. Therefore, Land Exchange Proposed Action conforms to EO 11988		
Vegetation (includes habitat and Special Status Species)	• 4,028.5-acre decrease in vegetation in the NorthMet Project area • Special concern plant species: eight directly affected, two indirectly affected in the NorthMet Project area • 579.6-acre net increase of vegetation land cover types to federal estate (through Land Exchange Proposed Action) • Decrease of 10 plant species, increase of three different plant species to the federal estate (through Land Exchange Proposed Action)	• Same decrease of vegetation in NorthMet Project area as under Proposed Connected Actions • Same effects on plant species in the NorthMet Project area as under Proposed Connected Actions • 173.6-acre net increase of vegetation land cover types to the federal estate (through Land Exchange Alternative B)	• No effects on vegetation
Wildlife (includes Special Status Species)	• 4,028.5-acre decrease of wildlife habitat in the NorthMet Project area • Localized population decrease and fragmentation of critical habitat of the gray wolf and Canada lynx • Localized population decrease and loss of habitat for northern long-eared bat • Low potential for incidental take resulting from vehicular collisions due to increased NorthMet Project Proposed Action-related traffic • Special status species, including SGCN, RFSS, and other wildlife species (such as those considered tribally or culturally significant) may	• Same as under Proposed Connected Actions at the NorthMet Project area • 173.6-acre net increase of vegetation land cover types for wildlife habitat to the federal estate (through Land Exchange Alternative B)	• No effects on wildlife

Resource	Proposed Connected Actions	Proposed Connected Actions Alternative B	No Action Alternative
	be affected by human activity, noise and vibration, rail and vehicle traffic, and decrease of habitat • Wildlife corridors at and adjacent to the NorthMet Project area would be affected through the reduction of access to these corridors • 579.6-acre net increase of vegetation land cover types for wildlife habitat to the federal estate (through Land Exchange Proposed Action)		
Aquatic Species	• No effects from changes in stream flow, which would remain within natural variability • No decrease in the Riparian Connectivity Index • Would not directly exceed or increase existing exceedances of Class 2B water quality standards, with the exception of aluminum that is not attributable to process water from the NorthMet Project Proposed Action (i.e., is attributable to non-contact stormwater runoff • No effect on federally or state-listed aquatic species	• Same as under Proposed Connected Actions	• Water seepage from the existing LTVSMC site would be managed in accordance with the Cliffs Erie Consent Decree
Air Quality (includes Greenhouse Gases and Global Climate Change)	• Increased emissions of criteria air pollutants, but below Prevention of Significant Deterioration major source thresholds • Amphibole mineral fiber emissions minimized by installing best available particulate emission control equipment and preventing fugitive dust generation • The air quality of the BWCAW would not be adversely affected by the	• Same as under Proposed Connected Actions	• Continued air (fugitive dust) effects at LTVSMC site until remediation occurs under closure/reclamation plan

Resource	Proposed Connected Actions	Proposed Connected Actions Alternative B	No Action Alternative
	NorthMet Project Proposed Action		
Noise and Vibration	• Added noise emissions and vibration. However, in all cases, the NorthMet Project Proposed Action, during the operations phase, would comply with the applicable state standards • Noise, ground vibration, and air blast impact area/zone would be limited to 11,456, 11,334, and 11,469 acres, respectively. The BWCAW, which is 20 miles away, is outside the maximum area of audibility (247,612 acres)	• Same as under Proposed Connected Actions	• No effects
Cultural Resources & Historic Properties	• Adverse direct and indirect effects on the Mesabe Widjiu (Laurentian Divide), Spring Mine Lake Sugarbush, BBLV Trail Segment, Erie Mining Company Concentrator Building, and Erie Mining Company Landscape Historic District due to loss of sites and proximity to proposed activities • Direct effects, but no adverse effects, on the Erie Mining Company Railroad Mine and Plant Track, Main Line Segment, and Dunka Railroad Segment; Erie Mining Company Railroad Corridor Historic District; DM&IR Segment; and Erie Mining Company Administration Building due to refurbishment and new construction • Potential to affect 1854 Treaty resources by potential limitation or elimination of access to public lands within the 1854 Ceded Territory and potential loss of 1854 Treaty resources	• Same as under Proposed Connected Actions	• No effects
Socioeconomics (includes Environmental	• Up to 500 new direct jobs (maximum during construction), plus additional indirect and induced jobs	• Same as under Proposed Connected Actions	• No effects

Resource	Proposed Connected Actions	Proposed Connected Actions Alternative B	No Action Alternative
Justice)	• Millions of dollars revenue for State of Minnesota and federal taxes • Environmental Justice (Native American) populations affected by changes in subsistence uses and potential increased living costs		
Recreation and Visual Resources	• Net increase to the federal estate of recreational land on acquired tracts through Land Exchange Proposed Action • Visual effects would occur, but would not exceed USFS standards	• Fewer federal lands conveyed at NorthMet Project Mine Site under Land Exchange Alternative B • Remaining federal lands at Mine Site would not have public access • Fewer acres acquired through Land Exchange Alternative B • Same visual resources effects as under Proposed Connected Actions	• No effects
Wilderness and Special Designation Areas	• No effects on Wilderness or Special Designation Areas • The air quality of the BWCAW would not be adversely affected by the NorthMet Project Proposed Action	• Same as under Proposed Connected Actions	• No effects
Hazardous Materials	• Potential effects from spills and use of explosives during operations	• Same as under Proposed Connected Actions	• No effects
Geotechnical Stability	• Waste rock stockpiles, Tailings Basin, and Hydrometallurgical Residue Facility would be constructed in accordance with applicable State of Minnesota standards • Monitoring and adaptive management would maintain geotechnical stability	• Same as under Proposed Connected Actions	• Tailings Basin would be subject to closure and reclamation activities in accordance with MDNR requirements

7.3 OTHER CONSIDERATIONS

In addition to disclosure of direct, indirect, and cumulative effects, NEPA requires that federal agencies identify whether, and to what extent, the proposed action would cause irreversible or irretrievable commitments of resources and considers the short-term use of the environment versus maintenance and enhancement of long-term productivity (40 CFR 1502.16). Each of these considerations is explained and disclosed below and the resultant unavoidable adverse effects are described in Table 7.2.4-1.

A number of comments were received during the SDEIS public comment period requesting that human health impacts of the NorthMet Project Proposed Action be considered in the FEIS. While human health is considered in establishing the evaluation criteria used in the resource-specific analysis in Chapter 5, a summary of the potential impacts on human health is provided below.

In addition, a summary of how the Land Exchange Proposed Action addresses the public interest review and factors that the USFS will consider in the ROD is provided below.

7.3.1 Irreversible or Irretrievable Commitment of Resources

Irreversible commitments of resources are those that involve permanent loss because the affected resource cannot be returned to its previous condition (e.g., mined ore or wetlands that would be permanently converted to rock stockpile). Irretrievable commitments of resources are more temporary in nature because the environment can be returned to its previous state through reclamation and restoration activities (e.g., wetlands that would be restored or former facilities that would be removed and the land recontoured and replanted per the reclamation plan).

The construction and operation of the NorthMet Project Proposed Action would result in the irreversible loss of approximately 225 million tons of base and precious metal ore. Mining activities would remove 913.8 acres of wetlands that would be permanently lost. Off-site wetland compensatory mitigation would be eventually replaced by the restoration of 1,602.7 acres of wetlands.

Other resources could also be irreversibly lost by the NorthMet Project Proposed Action. For example, changes in the viewshed from the expansion of the existing LTVSMC Tailings Basin would permanently alter visual resources. While cultural resources may be adversely affected, irreversible commitments would be minimized through avoidance. There would be both irreversible and irretrievable loss of federally managed wildlife habitat under the NorthMet Project Proposed Action and Land Exchange Proposed Action. Some species, such as white-tailed deer, may not avoid the area throughout the mine life, although some habitat would be disturbed. Others, such as the Canada lynx, may seek other, better habitat elsewhere. Air quality effects, primarily from fugitive dust, would occur during the mine life, but air quality would return to pre-mining conditions after closure and rehabilitation and restoration of disturbed areas. Water quality would be affected as discussed in Section 5.2.2. These would be considered irretrievable commitments due to their temporary nature.

The federal lands may contain natural resources culturally important to tribal entities, including access to the land itself, which would be irreversibly lost following the Land Exchange Proposed Action and conversion of the land from public to private ownership.

7.3.2 Short-Term Uses versus Long-Term Productivity of the Environment

NEPA requires that agencies disclose how the short-term use of land or a resource may affect its long-term productivity. For example, the NorthMet Project Proposed Action and Land Exchange Proposed Action would utilize existing federal resources (i.e., at the Mine Site), which would no longer be available for other purposes, such as timber harvesting or wildlife habitat. The long-term loss of the productivity of the land for these purposes would constitute a foregone opportunity.

The construction and operation of the NorthMet Project Proposed Action would cause short-term effects on air, noise, and visual resources during the 20-year life of the mine. Additionally, there may be potential short-term effects on wetlands from time delays between the loss of existing wetland resources (at the NorthMet Project area) and the development of new, viable wetlands with similar functions (at the off-site wetland mitigation areas). During construction and operation of the mine, air pollutant concentrations would be higher throughout the study area than they are currently, but below applicable air quality standards. Once mining and reclamation are completed, the pollutant concentrations would return to pre-mining levels. The noise levels in the area, while below standards, would increase during operation of the mine. However, post-closure, the noise levels would return to pre-mining levels. The visual effects from the NorthMet Project Proposed Action would be most noticeable during year 11, when the Category 2/3 Stockpile and Category 4 Stockpile would be at their maximum heights (after which time they would be placed into the East Pit as backfill), and year 12, when the Category 1 Stockpile would reach its maximum height. Additionally, there would be short-term effects on visual resources from fugitive dust and night-lighting during operations. Long-term visual effects would be landform changes as a result of mining activities.

The Land Exchange Proposed Action would result in the permanent loss of the federal lands for mining purposes, which would be offset by the long-term increased productivity of the non-federal lands as they would be managed under the Forest Plan. As a result of the Land Exchange Proposed Action, there would be no effects as a result of short-term use of aquatic species, cultural resources, vegetation, wildlife, water resources, air resources, wetlands, or recreational and visual resources.

The NorthMet Project Proposed Action and Land Exchange Proposed Action would remove 6,650.2 acres (GLO) at the Mine Site from Forest Service administration and management under the Forest Plan. Currently, the federal lands, which include the Mine Site, are managed under the Forest Plan as General Forest – Longer Rotation (6,140.1 acres) and as General Forest (355.3 acres). If the land were exchanged, the long-term productivity of the federal lands at the Mine Site would be lost to timber production and other forest uses for the short-term use as a mine. This would represent an unquantified opportunity cost in which the lands and resources could not be used for forest purposes. The Proposed Connected Actions Alternative B would result in 4,397.3 acres lost under General Forest – Longer Rotation management and 355.3 acres under the General Forest management category. These losses would be replaced by the acquisition, through the Land Exchange Proposed Action, of land for Forest purposes.

7.3.3 Unavoidable Adverse Effects

Regardless of the inclusion of all reasonable mitigation, some effects may not be avoided. For example, the NorthMet Project Proposed Action would utilize technologies to mitigate effects on water quality, which have been demonstrated through modeling to meet applicable water quality evaluation criteria (with two exceptions, refer to Section 5.2.2). However, effects on water quality would remain after all reasonable mitigation measures have been applied.

After the implementation of mitigation measures that have been built into the design, the NorthMet Project Proposed Action would have unavoidable adverse effects on wetlands, vegetation, wildlife, air quality, noise and vibration, visual resources, cultural resources, water resources, and aquatic species. Unavoidable direct effects on surface features such as wetlands, vegetation, and wildlife resources would be offset by gains through off-site mitigation (wetlands) and through lands acquired through the Land Exchange Proposed Action. Unavoidable noise and vibration, air, and water emissions from the NorthMet Project Proposed Action would affect the existing conditions, but would not trigger new exceedances of relevant water quality evaluation criteria (with two exceptions, refer to Section 5.2.2) and would result in comparatively small increases to existing levels. The residual practical effects of the Land Exchange Proposed Action would be the loss of federal land, which would be used for the NorthMet Project Proposed Action, and the gain of non-federal lands.

7.3.4 Human Health Considerations

7.3.4.1 Introduction

This section summarizes relevant health issues and potential impacts for the NorthMet Project Proposed Action and identifies where specific health information can be found in the FEIS.

Public comments on the SDEIS identified several concerns based on potential interactions between the NorthMet Project Proposed Action and resources/receptors in the area. Public concerns identified potential health impacts as a result of the following:

- Exposure to air contaminants, particularly airborne fibers;
- Exposure to contaminants in drinking water, surface water, and food sources (e.g., wild rice, and fish);
- Increased risk of traffic accidents involving chemicals;
- Increased exposure to noise and vibration; and
- Strain on emergency response services.

7.3.4.2 Baseline Community Health

A baseline assessment of community health can be found at the County Health Rankings website (www.countyhealthrankings.org). The health rankings are based on a composite indices of health outcomes (e.g., premature death, diabetes prevalence) and health determinants (circumstances that can affect the future health of a population, such as lifestyle behaviors, health policies, and environmental quality).

Minnesota's population health status is good relative to other states in the nation (sixth out of 50; higher rankings indicate poorer health outcomes (www.americashealthrankings.org/MN). Within Minnesota, health in Cook County is above the state average as it ranks 28th out of 87 counties for health measures (County Health Rankings 2014). Health in Lake and St. Louis counties are poor relative to other counties in Minnesota at 82 and 75 out of 87, respectively. The FEIS did not analyze how or whether these counties' community health rankings would be affected by the NorthMet Project Proposed Action.

7.3.4.3 Human Health Impacts

The following sections describe how human health could be affected by exposure to airborne and waterborne chemicals from the NorthMet Project Proposed Action. This information is drawn from the relevant resource sections in Chapter 5 of the FEIS.

7.3.4.3.1 Exposure to Chemicals in Air Emissions

Industrial emissions to air have the potential to affect human health in several ways by the hazardous chemicals and dust irritants they may contain. State and federal ambient air quality standards have been established to protect human health and the FEIS analysis was conducted using these standards as threshold criteria to determine the magnitude and level of significance of the potential air quality impacts of the NorthMet Project Proposed Action. Section 5.2.7.2.3 analyzes human health risks from Mine Site and Plant Site air emissions. The quantitative analysis evaluated 11 chemicals to determine the lifetime cancer and non-cancer health risks of the NorthMet Project Proposed Action. The assessment found that Mine Site and Plant Site emissions would not exceed MDH lifetime cancer and non-cancer guidance levels.

An AERA addressing the emissions from site operations of the NorthMet Project Proposed Action was conducted and is summarized in Section 5.2.7.2.3 of the FEIS. Separate AERAs were conducted for the Mine Site and Plant Site due to the distance (approximately 6 miles) between Mine Site and Plant Site sources.

The AERA included an evaluation of the most sensitive health endpoint for each chemical, e.g., neurological morbidity from manganese, reproductive toxicity of methylmercury, and the carcinogenic potential of diesel, nickel, and arsenic. The FEIS concludes that there would be no lead emissions as a result of the NorthMet Project Proposed Action (Section 5.2.7.1.3). Toxicological information for arsenic, cobalt, diesel, nickel, manganese, mercury, and methylmercury (plus additional chemicals) was obtained from the MPCA Risk Assessment Screening Spreadsheet (RASS) and is found as an appendix to the AERA. The AERA includes an analysis of the potential health effects of those chemicals (MPCA 2013b).

Controls were incorporated to reduce airborne mercury emissions. The MPCA reviewed the NorthMet Proposed Action and determined that it would not impede State mercury reduction goals (MPCA 2013b). At the levels estimated in the FEIS, airborne mercury emissions resulting from the NorthMet Project Proposed Action were found to not be a health concern.

In summary, the FEIS conclude that the NorthMet Project Proposed Action, as designed and with the addition of mitigation measures, would meet all NAAQS (Section 5.2.7).

7.3.4.3.2 Exposure to Airborne Fibers

The NorthMet Project Proposed Action would mine ore from the Duluth Complex, which may contain amphibole mineral fibers. The potential air emissions of amphibole mineral fibers were analyzed in Section 5.2.7.5 of the FEIS. The vast majority of potential emissions of MN-fibers for the NorthMet Project Proposed Action would occur from the ore-crushing operations at the Plant Site, with minor potential emissions from the Tailings Basin and the Mine Site (Barr 2007o). Fine-particulate matter emission controls were incorporated to minimize any release of fiber emissions.

Overall, amphibole mineral fibers were found to represent a relatively small percent of the mineral fibers associated with the processing of NorthMet Deposit ore (Flotation Pilot Testing in July and August 2005), approximately 9 percent of the fibers identified from all collected samples of ore, tailings, and process water. Chrysotile mineral fibers were not found in samples of ore, tailings, or process water collected from the flotation pilot-testing. However, PolyMet's petrographic observations indicate that chrysotile minerals are about 2 percent of the minerals associated with the waste rock from the NorthMet Project Proposed Action.

The University of Minnesota conducted a research effort, known as the Minnesota Taconite Workers Health Study (University of Minnesota 2014), funded by the State of Minnesota, to better understand taconite worker health issues, including an epidemiological investigation into causes of excess rates of disease, including mesothelioma, among taconite workers. The Study did not rule out amphibole mineral fibers as a potential source of health risk or as playing some role in the incidence of disease among taconite workers. Mine workers' health is regulated by the U.S. Department of Labor, Mine Safety and Health Administration. Exposure limits for airborne contaminants, including amphibole mineral fibers, is found in 30 CFR, Ch. 1, Subc. K, Part 56, § 56.5001

The MDH considers the role of non-asbestiform amphibole fibers in the induction of health effects to be uncertain at this time. MDH concludes that amphibole mineral fibers have the potential for an undetermined toxicity and potency.

7.3.4.4 Health Impacts from Chemicals in Water

Human health impacts could occur by ingestion of water borne chemicals either directly through drinking water or through food sources. In addition, sulfates in wild rice stands could reduce productivity which may affect its availability as a subsistence food source.

7.3.4.4.1 Drinking Water

Potential arsenic and lead releases to groundwater and surface water are evaluated in Section 5.2.2.1.1 and 5.2.2.1.2, respectively. GoldSim model output indicates that the dominating chemical controls on arsenic concentrations in Colby Lake (a drinking water source) are natural surface runoff, natural groundwater baseflow, and contaminant sources contributing directly to Colby Lake, all of which are not related to the NorthMet Project Proposed Action.

For conditions where the arsenic standard would be exceeded in Colby Lake, the NorthMet Project Proposed Action would not cause higher concentrations compared to what would occur for the CEC scenario. It is therefore concluded that the NorthMet Project Proposed Action would not cause arsenic exceedances in Colby Lake above and beyond what would occur without the NorthMet Project Proposed Action.

Examination of GoldSim results show that when lead concentrations at PM-11 are predicted to exceed associated hardness-based evaluation criteria, the flow at PM-11 is dominated by WWTP discharges. In GoldSim, the WWTP effluent lead concentration is assumed to be 3 μg/L.

When effluent lead concentration is decreased to 2 μg/L the predicted frequency of lead exceedance at PM-11 (when the CEC scenario does not exceed) was reduced to 1.3 percent, which is substantially less than the 5 percent screening threshold. Given that pilot testing shows that 2 μg/L lead concentration is achievable in the WWTP effluent, it is likely that actual lead concentrations at PM-11 would have acceptably low frequencies of exceedances.

Based on the analysis, the FEIS found that no discharges of water or seepage from the NorthMet Project Proposed Action would affect off-site domestic water wells or public sources in the area.

Amphibole mineral fibers may be found in water that has come in contact with ore at the Mine Site. There is no applicable water quality standard specific to non-asbestiform amphibole mineral fibers. The USEPA has developed drinking water standards for asbestos for drinking water utilities (USEPA 2015). This standard, called an MCL, is 7 million fibers per liter. The USEPA has provided proven methods of water treatment to meet the MCL, including coagulation/filtration, direct and diatomite filtration, and corrosion control.

Water in contact with waste rock, ore, and pit walls would be treated at the WWTF during operations utilizing a greensand filter. No discharge would occur off site during operations. During post-closure, a greensand filter, pre-filters, and a RO system would be used to treat water to meet water quality standards prior to discharge. This treated water would be discharged into the Partridge River, which flows into Colby Lake, the only lake in the area used for drinking water. It is the source of drinking water for the City of Hoyt Lakes. Currently, the City utilizes sand filters, coagulation, and settling and has been in compliance with the USEPA asbestos standards. When the RO treatment system would be constructed at the Mine Site, it would operate in the same fashion as the City's treatment system. As such, the discharge from the Mine Site would be expected to be in compliance with the federal standard prior to it being treated again by the City of Hoyt Lakes.

7.3.4.4.2 Fish

The AERA assessed the health effects for recreational and tribal fishermen and their families consuming fish which may contain elevated bioaccumulated levels of methylmercury. It estimated a potential small change in fish mercury concentration based on modelled emissions and deposition. The FEIS concludes that this potential change in methylmercury concentration is not statistically measurable given the variability in background concentrations and the current laboratory analytical methods. Given that finding, no potential change in human health risks related to the fish consumption pathway is expected (Sections 5.2.2.3.4, 5.2.6.2.1, and 5.2.6.2.2).Section 6.2.6 of the FEIS contains an assessment of cumulative effects to aquatic resources. It found that the NorthMet Project Proposed Action, in combination with other reasonably foreseeable projects, could increase solute concentrations for many constituents in the Partridge River and Embarrass River, although not above water quality evaluation criteria. This change in existing water quality and the interactions between effects from a number of projects in the area, natural conditions, and current and future hydrology could be addressed as part of the non-degradation analysis for the NorthMet Project Proposed Action in permitting. The NorthMet Project Proposed Action, in particular, but to some extent in combination with other existing and reasonably foreseeable projects, would shift treatment of water discharged into the Partridge River and Embarrass River from natural systems (i.e., essentially an ecosystem service) to mechanical systems (e.g., the NorthMet Project Proposed Action WWTF and WWTP). Given that the solute concentrations for constituents in the Partridge River and Embarrass River are not expected to increase above water quality evaluation criteria, cumulative impacts to aquatic species due to changes in water quality from the NorthMet Project Proposed Action, in combination with other reasonably foreseeable projects, are not anticipated.

7.3.4.4.3 Wild Rice

Waters downstream from the NorthMet Project area are used are used as a source of wild rice by the Ojibwe people who continue to harvest it in traditional ways. Research indicates that increased sulfate levels in wild rice habitat can adversely affect its growth and productivity during certain times of its lifecycle. It is possible that Tribal member health could be indirectly affected if their diet would need to increasingly rely on less-healthy replacement foods if wild rice production were to decrease as a result of the NorthMet Project Proposed Action.

In order to protect this food source, the State has issued regulations that place limits on the allowable level of sulfate in waters used for production of wild rice (*Minnesota Rules*, part 7052.0100). Section 5.2.2.2.2 of the FEIS analyzes any sulfate released from the NorthMet Plant Site and Mine Site that could affect the production of wild rice downstream from both the Mine Site and Tailings Basin. The analysis concludes that in the Partridge River the NorthMet Project Proposed Action would not cause or contribute to exceedances of the sulfate evaluation criteria of 10 mg/L applicable at the MPCA staff recommended wild rice production waters near SW-005. In the Embarrass River, the NorthMet Project Proposed Action would decrease sulfate concentrations. In neither case would wild rice productivity be adversely affected or reduce its availability as a subsistence food source.

7.3.4.5 Health Impacts from Traffic Accidents Involving Chemicals

Section 5.2.13 discusses risks involved in the transportation, storage and use of regulated hazardous materials used in mining and ore processing. These materials are regulated by state and federal rules, which limit the potential risks of off-site effects, especially if large quantities were transported to and from the NorthMet Project area. The hazardous materials analysis also included a risk assessment of large scale events which could affect populations along the transportation routes. This analysis found that given overall design and operational commitments of the NorthMet Project Proposed Action, there would not be any significant adverse effects from the proposed transportation of hazardous wastes.

7.3.4.6 Health Impacts from Noise and Vibration

Impacts of noise and ground vibration from the NorthMet Project Proposed Action are discussed in Section 5.2.8. While health effects were not explicitly discussed, modelling shows that the NorthMet Project Proposed Action would meet State of Minnesota noise and vibration limits and would not, therefore, result in health concerns.

7.3.4.7 Health Impacts from Strain on Emergency Response Services

Section 5.2.10.2 of the FEIS discusses changes in the local area's work force (local versus population influx), and demands on available services, including the medical infrastructure. A sudden increase in population can place strain on local health resources including emergency management services, primary care, and acute health care services. Similarly, a large-scale emergency event can put a strain on emergency resources. The FEIS found that the NorthMet Project Proposed Action would result in minimal population and employment changes. Hence, it is not expected that the NorthMet Project Proposed Action would place a strain on existing emergency and health care services in the area.

As a requirement of the permit to mine, the operator of the NorthMet Mining Project would be required to prepare an Emergency Response Plan, which would require them to coordinate their emergency response planning with local agencies, as described in Section 5.2.13.2.4.

7.3.5 Land Exchange Public Interest Consideration

In accordance with CEQ regulations (40 CFR 1502.14), the ROD from the USFS will contain the rationale for the selected alternative and how the public interest is served under 36 CFR 254.3(b). As stated in Section 1.4.3 of this FEIS, factors that must be considered include the opportunity to: achieve better management of federal lands and resources to meet the needs of state and local residents and their economies and secure important objectives, including but not limited to protection of fish and wildlife habitats, cultural resources, watersheds, and wilderness and aesthetic values; enhancement of recreation opportunities and public access; consolidation of lands and/or interests in lands, such as mineral and timber interests, for more logical and efficient management and development; consolidation of split estates; expansion of communities; accommodation of existing or planned land use authorizations; promotion of multiple-use values; implementations of applicable Forest Land and Resource Management Plans; and fulfillment of public needs (see 36 CFR 254.3(b) and 254.4(c)(4)). The ROD will also incorporate the finding of these factors and how the factors relate to how the public interest would be served by the Land Exchange Proposed Action, Land Exchange Alternative B, and the Land Exchange No Action Alternative. Table 7.3.5-1 below presents a comparison of how the alternatives address these factors.

Table 7.3.5-1 Public Interest Factors That Must be Considered for the Land Exchange Proposed Action

Factors		EIS Section Citation	Land Exchange Proposed Action	Land Exchange Alternative B	Land Exchange No Action Alternative
Opportunity to achieve better management of federal lands and resources to meet the needs of state and local residents and their economies	Boundary (Perimeter) Managed	5.3.1	33.2-mile net reduction in Forest boundary to be managed	8.6-mile net reduction in Forest boundary to be managed	No change
	Fragmentation (ratio of boundary to area)	5.3.1	No change	No change	No change
	Net Federal Estate Acreage	5.3.1	385.1 acres net increase to the federal estate	38.7 acres net increase to the federal estate	No change
Secure important objectives, including but not limited to:	Protection of fish and wildlife habitats	5.3.4/5.3.5/ 5.3.6/7.2.4	• See Wildlife and Aquatic Species in Table 7.2.4-1 for a summary of potential effects to fish and wildlife resources from NorthMet Project Proposed Action • 579.6-acre net increase of vegetation land cover types to the federal estate • 1,364.5-acre, 248.3-acre, 226.7-acre net increase of MIH-1, MIH-9, and MIH-14, respectively; 1,172.5-acre net decrease of MIH-5 • 6,025.8-acre net decrease in high MBS Sites; 767.9-acre net increase in medium MBS Sites • Decrease of 10 plant species, increase of three different plant species to the federal estate • Net increase in acreage of landscape ecosystems (dry-mesic red and white pine, lowland conifer, lowland hardwood, mesic birch-aspen-spruce fir, mesic red and white pine, and sugar maple) with a net decrease to jack pine-black spruce to the federal estate • Forested habitat would decrease; shrubland/grassland and aquatic habitats would increase • Increase to the federal estate of overall suitable habitat for lynx and for snowshoe hare (prey species); however the amount of unsuitable lynx habitat would also increase • Decrease to the federal estate of denning habitat and of federal lands within designated LAU • Critical lynx habitat would not change • Decrease of 29.1 acres to the federal estate of cover habitat; increase to the federal estate of forage habitat of 507.1 acres for the gray wolf • Increase of SGCN habitat to the federal estate • Net increase of surface water resources (MIH 14) to the federal estate thereby increase aquatic habitat • 99.1-acre of lake, 3.8-mile of river, and 8.1 miles of third-order stream net increase to the federal estate • 34.0-shoreline/acre unit for lakes and streams (frontage index) net increase to federal estate • Increase in watershed riparian connectivity, which indicates that the streams on both the federal and non-federal lands are located within watersheds with existing high-quality riparian connectivity • Acquiring streams located in watersheds with better aquatic connectivity values	• See Wildlife and Aquatic Species in Table 7.2.4-1 for a summary of potential effects to fish and wildlife resources from NorthMet Project Proposed Action • 173.6-acre net increase of vegetation land cover types to the federal estate • 1,411.8-acre and 206.2-acre net increase of MIH-1, MIH-14, respectively; 1,084.6-acre and 261.1 net decrease of MIH-5 and MIH-9, respectively • 4,573.1-acres and 0.3-acre net decrease in high and medium MBS Sites, respectively • Decrease of 10 plant species to the federal estate, increase of 1 different plant species to the federal estate • Net increase in acreage of landscape ecosystems (dry-mesic red and white pine, lowland conifer, lowland hardwood, mesic birch-aspen-spruce fir, mesic red and white pine, and sugar maple) with a net decrease to jack pine-black spruce to the federal estate • Forested habitat would decrease; shrubland/grassland and aquatic habitats would increase • Decrease to the federal estate of overall suitable habitat for lynx and denning habitat; however, increase of suitable snowshoe hare habitat • Decrease of federal lands within designated LAUs • Critical lynx habitat would not change • Increase of 262.7 acres of forage habitat; however, decrease of 192.9 acres of cover habitat on the federal estate for gray wolf • Increase of SGCN habitat to the federal estate • Net increase of surface water resources (MIH 14) to the federal estate thereby increase aquatic habitat • 120.7-acre of lake, 2.8-mile of river, and 8.1 miles of third-order stream net increase to the federal estate • 3.2 and 3.5-shoreline/acre unit for lakes and streams, respectively, (frontage index) net increase to federal estate • Increase in watershed riparian connectivity, which indicates that the streams on both the federal and non-federal lands are located within watersheds with existing high-quality riparian connectivity • Acquiring streams located in watersheds with better aquatic connectivity values	• See Wildlife and Aquatic Species in Table 7.2.4-1 for a summary of potential effects to fish and wildlife resources from NorthMet Project Proposed Action • Would not change the USFS' responsibility for managing wildlife and aquatic resources and would result in no change in anticipated effects on existing wildlife and aquatic species

Factors		EIS Section Citation	Land Exchange Proposed Action	Land Exchange Alternative B	Land Exchange No Action Alternative
			• The USFS determined, through a Biological Evaluation, that the project would have no beneficial impact to RFSS species, and would not likely impact individuals or result in a trend to federal listing or loss of viability for the RFSS species	• The USFS determined, through a Biological Evaluation, that the project would have no beneficial impact to RFSS species, and would not likely impact individuals or result in a trend to federal listing or loss of viability for the RFSS species	
	Cultural resources	5.3.9/7.2.4	• See Cultural Resources & Historic Properties in Table 7.2.4-1 for a summary of potential effects to cultural resources from NorthMet Project Proposed Action • For federal lands the exchange could result in lack of access to those areas and species that are traditionally or culturally important to the Bands. Band members use of the Land Exchange area is not well-defined • No known cultural resources on the non-federal lands, however, cultural resources located on private lands being transferred to federal ownership would be considered to have greater preservation protection under federal law	• See Cultural Resources & Historic Properties in Table 7.2.4-1 for a summary of potential effects to cultural resources from NorthMet Project Proposed Action • For federal lands the exchange could result in lack of access to those areas and species that are traditionally or culturally important to the Bands. Band members use of the Land Exchange area is not well-defined • No known cultural resources on the non-federal lands, however, cultural resources located on private lands being transferred to federal ownership would be considered to have greater preservation protection under federal law	• No change
	Watersheds	5.3.2/5.3.3/ 7.2.4	• See Water Resources Wetlands & Floodplains in Table 7.2.4-1 for a summary of potential effects to water resources from NorthMet Project Proposed Action • No substantive difference in the quality of groundwater resources between the federal and non-federal tracts • 4.6-mile net increase of public water streams to the federal estate • 95.2-acre net increase of public water lakes to the federal estate • 2.1-mile net increase of shoreline to the federal estate • 125.7-acre net increase of wild rice beds to the federal estate • 505.5-acre net increase of wetlands to the federal estate; therefore conforms to EO 11990 • 376.2-acre net increase of mapped floodplain but would result in a 1,226.0-acre net decrease of floodplains to the federal estate; however, no decrease in regulatory floodplains, no increase in flood damage potential, and no change in ecological function of floodplain. Therefore, conforms to EO 11988 • 99.1-acre net increase of lakes and 3.8-mile net increase of rivers to federal estate	• See Water Resources and Wetlands & Floodplains in Table 7.2.4-1 for a summary of potential effects to water resources from NorthMet Project Proposed Action • No substantive difference in the quality of groundwater resources between the federal and non-federal tracts • 3.6-mile net increase of public water streams to the federal estate • 116.8-acre net increase of public water lakes to the federal estate • 2.6-mile net increase of shoreline to the federal estate • 125.7-acre net increase of wild rice beds to the federal estate • 69.9-acre net increase of wetlands to the federal estate; therefore conforms to EO 11990 • 376.2-acre net increase of mapped floodplain but would result in an 861.7-acre net decrease of floodplains to the federal estate; however, no decrease in regulatory floodplains, no increase in flood damage potential, and no change in ecological function of floodplain. Therefore, conforms to EO 11988 • 120.7-acre net increase of lakes and 2.8-mile net increase of rivers to federal estate	• Would not change the USFS' responsibility for managing water and wetland resources and would result in no change in anticipated effects on existing water and wetland resources • See Water Resources and Wetlands & Floodplains in Table 7.2.4-1 for a summary of potential effects to water resources from NorthMet Project Proposed Action
	Wilderness	5.3.12/7.2.4	• No change • See Wilderness & Special Designation Areas in Table 7.2.4-1 for a summary of potential effects to cultural resources from NorthMet Project Proposed Action	• No change • See Wilderness & Special Designation Areas in Table 7.2.4-1 for a summary of potential effects to cultural resources from NorthMet Project Proposed Action	• No change • See Wilderness & Special Designation Areas in Table 7.2.4-1 for a summary of potential effects to cultural resources from NorthMet Project Proposed Action
	Aesthetic values	5.3.11/7.2.4	• See Recreation and Visual Resources in Table 7.2.4-1 for a summary of potential effects to visual resources from NorthMet Project Proposed Action • Change in the composition of the visual character of the Superior National Forest, affecting less than one-quarter of one percent of the total area of the forest, has	• See Recreation and Visual Resources in Table 7.2.4-1 for a summary of potential effects to visual resources from NorthMet Project Proposed Action • Change in the composition of the visual character of the Superior National Forest, affecting less than one-tenth of one percent of the total area of the forest, has	• See Recreation and Visual Resources in Table 7.2.4-1 for a summary of potential effects to visual resources from NorthMet Project Proposed Action • Visual appearance of the federal and non-federal lands would remain unchanged

Factors		EIS Section Citation	Land Exchange Proposed Action	Land Exchange Alternative B	Land Exchange No Action Alternative
			generally positive aspects • Addition of land with Moderate and High SIO (in lieu of land with a Low SIO) could affect the types of forestry and management activities that can occur on those lands • USFS would acquire land with a wider diversity of SIOs and would result in a net increase to the federal estate	generally positive aspects • Addition of land with Moderate and High SIO (in lieu of land with a Low SIO) could affect the types of forestry and management activities that can occur on those lands • USFS would acquire land with a wider diversity of SIOs and would result in a net increase to the federal estate	
Enhancement of recreation opportunities and public access		5.3.11/7.2.4	• See Recreation and Visual Resources in Table 7.2.4-1 for a summary of potential effects to recreation resources from NorthMet Project Proposed Action • Public access to, and therefore use of the Superior National Forest, would increase and therefore increase opportunities for hunting, fishing, and other recreational activities • USFS would exchange lands with limited access for more accessible lands after exchange • Lands would be within the 1854 Ceded Territory; no net loss to 1854 Ceded Territory	• See Recreation and Visual Resources in Table 7.2.4-1 for a summary of potential effects to recreation resources from NorthMet Project Proposed Action • This alternative would result in federal lands becoming isolated to the west of the smaller federal parcel and therefore inaccessible to the public and access points managed by the USFS to the isolated area are limited. Forest Service management on lands west of the smaller federal parcel would require ongoing coordination for access and resource management with others controlling access to those lands. • Public access to, and therefore use of the Superior National Forest, would increase (on a smaller magnitude) and therefore increase opportunities for hunting, fishing, and other recreational activities • USFS would exchange lands with limited access for more accessible lands after exchange • Lands would be within the 1854 Ceded Territory; no net loss to 1854 Ceded Territory	• See Recreation and Visual Resources in Table 7.2.4-1 for a summary of potential effects to recreation resources from NorthMet Project Proposed Action • There would be no change in the amount of acres available for public access and recreational use • The presence of a privately owned road (Dunka Road) and rail on the southern border of the federal lands would continue to limit public access to and use of the federal lands
Consolidation of lands and/or interests in lands, such as mineral and timber interests, for more logical and efficient management and development		5.3.1	• Would result in relinquishing the federal parcel with severed, private mineral rights and known, economically developable minerals and acquiring parcels with predominantly low risk of conflict and predominantly moderate title quality • Improves the quality of title and reduces the complexity of title to the federal and non-federal lands • Risk of conflict and title quality may be further improved through subsequent arrangements with holders of mineral rights on the non-federal lands or affirmative title insurance coverage	• Would result in relinquishing the federal parcel with severed, private mineral rights and known, economically developable minerals and acquiring parcels with moderate risk of conflict and moderate title quality • Improves the quality of title and reduces the complexity of title to the federal and non-federal lands • Risk of conflict and title quality may be further improved through subsequent arrangements with holders of mineral rights on the non-federal lands or affirmative title insurance coverage	• Interest in development of mineral potential on the federal lands could continue
Consolidation of split estates		5.3.1.2.5/5.3.1.3.5	• Consolidates about 6,495.4 acres of split estate at the site of proposed open pit mine • Superior National Forest acquires 7,075.0 acres with moderate to low (primarily low) risk of conflict between mineral interests and USFS surface management	• Consolidates about 4,752.6 acres of split estate at the site of proposed open pit mine • Superior National Forest acquires up to about 4,926.3 acres with moderate mineral development potential, except for potential surficial aggregate resources in the far northeastern corner of Tract 1	• Existing split estates would continue • Conflict between mineral interests and USFS surface management of the federal parcel would remain
Expansion of communities		5.3.10	• Creates positive economic effects through increased opportunity for forestry and recreation and associated employment, earnings, and revenue • Negligible negative effects on other socioeconomic factors, including housing, public facilities and services,	• Creates positive economic effects (to a lesser degree than the Land Exchange Proposed Action) through increased opportunity for forestry and recreation and associated employment, earnings, and revenue • Negligible negative effects on other socioeconomic	• No change to the federal lands, and the non-federal lands would remain inaccessible to the public (including tribal entities) • No direct or indirect effects on socioeconomics

Factors	EIS Section Citation	Land Exchange Proposed Action	Land Exchange Alternative B	Land Exchange No Action Alternative
		EJ populations, and subsistence	factors, including housing, public facilities and services, EJ populations, and subsistence	
Accommodation of existing or planned land use authorizations	5.3.1	• Compatible with the USFS Management Areas and zoning/land use designations of adjacent lands	• Compatible with the USFS management areas and zoning/land use designations of adjacent lands	• Compatible with relevant local zoning ordinances and planning designations
Promotion of multiple-use values		• Current National Forest System lands would be mined on 1,673.2 acres; remainder would be privately owned forested lands • 7,075.0 aces of non-federal parcels would become subject to Superior National Forest Land and Resource Management Plan	• Current National Forest System lands would be mined on 1,673.2 acres; remainder would be privately owned forested lands • 4,926.3 aces of non-federal parcels would become subject to Superior National Forest Land and Resource Management Plan	• Existing multiple-use uses would continue on federal lands at the proposed mine site
Implementations of applicable Forest Land and Resource Management Plans	1.0/3.3.3	• Addresses Purpose and Need described in Section 1.3.2.2 and Forest Plan desired condition direction • Eliminates Conflict in terms of D-LA-1 arrangement of National Forest System lands and eliminating conflicts, and • Environmentally Sound in terms of D-MN-2, mineral development and production are conducted in environmentally sound manner • Pending necessary agency decisions and permitting, the proposed mining, and minerals production would take place as described in Chapter 3 with the potential environmental and socioeconomic consequences identified in Chapters 5 and 6.	• Addresses Purpose and Need described in Section 1.3.2.2 and Forest Plan desired condition direction • Eliminates Conflict in terms of D-LA-1 arrangement of National Forest System lands and eliminating conflicts, and • Environmentally Sound in terms of D-MN-2, mineral development and production are conducted in environmentally sound manner • Pending necessary agency decisions and permitting, the proposed mining, and minerals production would take place as described in Chapter 3 with the potential environmental and socioeconomic consequences identified in Chapters 5 and 6.	• Does not fully address Purpose and Need described in section 1.3.2.2. • Does Not Eliminate Conflict in terms D-LA-1 arrangement of National Forest System lands and eliminating conflicts, and • Environmentally Sound in terms D-MN-2, mineral development and production are conducted in environmentally sound manner • Conflicts resulting from split estate would continue to require resolution with the potential environmental and socioeconomic consequences identified in Chapters 5 and 6.
Fulfillment of public needs	5.3.10/7.2.4	• See Water Resources in Table 7.2.4-1 for a summary of potential effects to water resources from NorthMet Project Proposed Action • Would result in an active mining operation that would generate federal, state, and local tax revenue, in addition to employment • Could increase economic activity associated with recreation and tourism. • Could generate four direct and 12 indirect forestry jobs. • To the degree that increased availability of publicly accessible land improves property value and generates revenue in the study area, could have positive effects on environmental justice populations • Would result in the loss of subsistence resources and opportunities on the federal lands, and a gain in subsistence resources and opportunities on the non-federal lands. • Would result in a loss of some of the ecosystem functions provided by the forest, wetland, and other natural habitats on the federal lands, particularly the portions of the federal lands (i.e., the Mine Site) where habitat would be replaced by mine facilities. Some of these functions could be restored during the post-closure period, when the federal lands (as well as the Plant Site) are revegetated. In exchange, would enable the USFS to directly manage the ecosystems functions on the non-federal lands.	• See Water Resources in Table 7.2.4-1 for a summary of potential effects to water resources from NorthMet Project Proposed Action • Would result in an active mining operation that would generate federal, state, and local tax revenue, in addition to employment; however these benefits would be less than from the Land Exchange Proposed Action. • Could increase economic activity associated with recreation and tourism. • Could generate some direct and indirect forestry jobs (fewer than under the Land Exchange Proposed Action). • To the degree that increased availability of publicly accessible land improves property value and generates revenue in the study area, could have positive effects on environmental justice populations; however these benefits would be less than from the Land Exchange Proposed Action. • Would result in the loss of subsistence resources and opportunities on the federal lands, and a gain (smaller than in the Land Exchange Proposed Action) in subsistence resources and opportunities on the non-federal lands. • Would result in a loss of some of the ecosystem functions provided by the forest, wetland, and other natural habitats on the federal lands, particularly the portions of the federal lands (i.e., the Mine Site)	• See Water Resources in Table 7.2.4-1 for a summary of potential effects to water resources from NorthMet Project Proposed Action • No change to the federal lands, and the non-federal lands would remain inaccessible to the public (including tribal entities) • Given other private ownership (e.g., the Dunka Road and railroad), the federal and non-federal lands would remain generally inaccessible to the public • No direct or indirect effects on socioeconomics

Factors	EIS Section Citation	Land Exchange Proposed Action	Land Exchange Alternative B	Land Exchange No Action Alternative
			where habitat would be replaced by mine facilities. Some of these functions could be restored during the post-closure period, when the federal lands (as well as the Plant Site) are revegetated. In exchange, would enable the USFS to directly manage the ecosystems functions on the non-federal lands. However, this loss of some of the ecosystem functions would be less than from the Land Exchange Proposed Action.	

419

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7.4 AGENCY-PREFERRED ALTERNATIVE

CEQ regulations (40 CFR 1502.14) states that based on the information and analysis presented in the affected environment and environmental consequences sections of an EIS, the EIS should present the environmental impacts of the proposal and the alternatives in comparative form to provide a clear basis for choice among the alternative options by the decision makers and the public. The regulations further state under 1502.14(e) that federal agencies shall identify the agency's preferred alternative or alternatives, if one or more exists, in the draft statement and identify such alternative in the final statement unless another law prohibits the expression of such a preference; however, the regulations do not require a rationale for the choice. No similar requirement to identify a preferred alternative exists for the MDNR under state law.

For the USFS, the Agency-Preferred Alternative is the Land Exchange Proposed Action described in Section 3.3.2. Potential effects specifically relating to the Land Exchange Proposed Action are identified in Sections 5.3 and 6.3. Table 7.3.5-1 summarizes potential effects relating to public interest factors considered for the Land Exchange Proposed Action and its alternatives.

For the USACE, Appendix B of 33 CFR 325 supersedes the CEQ requirement to identify an agency-preferred alternative. These procedures state that, "*the Corps is neither an opponent nor a proponent of the applicant's proposal; therefore the applicant's final proposal will be identified as the "applicant's preferred alternative" in the Final EIS"*. The information in the FEIS will be used by USACE to determine whether the applicant's proposal is in compliance with the requirements of Section 404 of the CWA and in the overall public interest.

7.5 LEAST ENVIRONMENTALLY DAMAGING PRACTICABLE ALTERNATIVE

The CWA Section 404(b)(1) Guidelines require that the USACE determine whether a project is water dependent. "Water dependent" means that the project requires access or proximity to, or siting within, a special aquatic site to fulfill its basic purpose. If a project is determined not to be water dependent, the regulations presume that: 1) an alternative site that does not involve special aquatic sites (in this case, wetlands) is available, and 2) practicable alternatives are available that would result in less environmental loss, unless clearly demonstrated otherwise by the applicant (40 CFR 230.10[a][3]). The regulations further require that the USACE alternatives analysis identifies the least environmentally damaging practicable alternative (LEDPA). Under the Section 404(b)(1) Guidelines, the USACE may not permit discharges of dredged or fill material into waters of the United States if there is a practicable alternative to the proposed discharge that would have less adverse impact on the aquatic ecosystem, so long as the alternative does not have other significant adverse environmental consequences (40 CFR 230.10(a)). "Environmental" in this context is defined by the USACE as non-aquatic natural resources. The term "practicable" is defined in 40 CFR 230.3(q) as "available and capable of being done after taking into consideration cost, existing technology, and logistics in light of the overall project purposes."

The regulations also require that the USACE consider a full range of public interest factors and conduct an alternative analysis in order to identify the least environmentally damaging practicable alternative. NEPA provides a broad-based approach to impact balancing. However, NEPA does not contain substantive requirements that compel agencies to choose a particular alternative as is required by Section 404(b)(1) of the CWA. Compliance with NEPA requirements may not necessarily translate to compliance with Section 404(b)(1) Guidelines during the Section 404 permit process. For NEPA actions where the USACE is a permitting agency, the analysis of alternatives required for NEPA EISs will, in most cases, provide the necessary information for the evaluation of alternatives under the CWA Section 404(b)(1) Guidelines (40 CFR 230.10(a)(4)). The NEPA alternative analysis would be evaluated by the USACE to determine if it is considered the LEDPA in order to proceed with authorization under the CWA. The alternatives screening process should therefore be designed to provide sufficient information regarding impacts to the aquatic ecosystem, purpose and need, and proposed impacts to the natural environment. The FEIS should contain sufficient information to identify and substantiate the LEDPA but is it not required to identify a LEDPA; however, the final determination on the LEDPA will be made within the ROD, which serves as the USACE's decision document and the basis for the DA permit decision. The LEDPA is the only alternative that is allowable pursuant to the CWA Section 404(b)(1) Guidelines. The applicant must clearly demonstrate that the preferred alternative in the FEIS is the LEDPA and that the other alternatives are not practicable for reasons of logistics, technology, cost, or other elements of project viability. Failing this, other alternatives may be considered "practicable" for the Section 404 alternatives analysis.

Under Subpart B of the Section 404(b)(1) Guidelines, the USACE's evaluation of the NorthMet Project Proposed Action is required to address the following four tests that the NorthMet Project Proposed Action must meet in order to receive a Section 404 permit:

- 40 CFR 230.10(a): Whether there is a practicable alternative to the proposed discharge that would have less adverse impact on the aquatic ecosystem, so long as that alternative would not result in other significant adverse environmental consequences. The alternative identified by this test is referred to as the LEDPA.
- 40 CFR 230.10(b): Whether the discharge would violate any applicable state water quality standards, Section 307 of the CWA, the ESA, or federal laws concerning marine sanctuaries.
- 40 CFR 230.10(c): Whether the discharge would cause or contribute to significant degradation of waters of the United States.
- 40 CFR 230.10(d): Whether appropriate and practicable steps have been taken that would minimize potential adverse impacts of the discharge on the aquatic ecosystem.

The ROD will include the Section 404(b)(1) analysis and the public interest review, and would determine the LEDPA. Furthermore, the ROD cannot be finalized until 30 days after release of an FEIS. Any comments received [on the FEIS] during the 30-day period may be considered in the ROD. The ROD will recommend issuance, issuance with conditions, or denial of the NorthMet Project Proposed Action.

In order to determine the LEDPA for the NorthMet Project Proposed Action, the identified project alternatives would be evaluated pursuant to the four tests identified above. Alternatives that do not meet the objectives of the project sponsor will not be further evaluated. Those alternatives that satisfy the criteria of 40 CFR 230.10(a)-(d) and meet the objectives of the project sponsor would be further investigated for selection of the LEPDA. In order to determine which alternative is the LEPDA, each alternative would be evaluated for its potential impact to air quality, biological resources, floodplains, geology and soils, hazardous material and wastes, infrastructure, land use, noise, prime farmland, water resources, and wetlands. In evaluating those resources, best professional judgment will be necessary in order to determine the degree of potential adverse effect resultant from evaluated alternatives. Similarly, in determining which alternative is the LEDPA, best professional judgment will be necessary because some alternatives may impose greater environmental harm to some resources over others. As such, a qualitative approach to selecting the LEDPA is the most effective.

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8.0 MAJOR DIFFERENCES OF OPINION

8.1 SUMMARY

This chapter discloses major differences of opinion Tribal Cooperating Agencies identified with the analysis that was presented in the SDEIS and updated for the FEIS. This information is provided to ensure that EIS reviewers are aware that major differences of opinion (MDOs) exist between the Co-lead Agencies and the Bands, GLIFWC, and 1854 Treaty Authority regarding the effects of the NorthMet Project Proposed Action and Land Exchange Proposed Action on the environment. The Co-lead Agencies' rationale for the analysis as presented in the FEIS, including references to where relevant concepts are discussed in the document, is also provided.

The USEPA is also a Cooperating Agency. Although the USEPA provided comments, the USEPA did not identify MDOs during preparation of the SDEIS.

8.2 INTRODUCTION

In developing the NorthMet Mining Project and Land Exchange EIS, the Co-lead Agencies invited the Bois Forte, Grand Portage, and Fond du Lac Bands to be Cooperating Agencies in preparation of the EIS. Other Tribal entities participating in the EIS process include the 1854 Treaty Authority and GLIFWC. In addition, THPOs and staff from the 1854 Ceded Territory Bands have been, and continue to be, involved in Section 106 consultation with the USACE and USFS regarding potential effects on historic properties in the NorthMet Project area as directed in 36 CFR 800.

The EIS process anticipated comment and input from the Tribal Cooperating Agencies in the development of the FEIS. The Communications and Coordination Plan commits the Co-lead Agencies to actively seek input from the Bands on how potential effects of the NorthMet Project Proposed Action and Land Exchange Proposed Action on natural and cultural resources would affect the Bands' traditional cultural practices, and to identify and disclose where differences exist between the parties.

Consistent with the Communications and Coordination Plan commitment, the Co-lead Agencies engaged the Tribal Cooperating Agencies throughout development of the EIS and took into consideration their comments on the DEIS and SDEIS, and other concerns brought forth through their participation in a series of post-DEIS technical teams, along with other information-sharing and disclosure venues. These include:

- **Impact Assessment Planning (IAP)**. The Co-lead Agencies convened a series of workgroups from September 2010 through July 2011 to identify the evaluations necessary to determine effects on the environment of the Agencies' Draft Alternative for the NorthMet Project Proposed Action. Impact areas assessed in the IAP process included air, wetlands, geotechnical stability, and water resources in four areas (surface water, groundwater, geochemistry, and impact criteria). Each workgroup was charged to update the analyses from the DEIS required for the analysis of the Agencies' Draft Alternative in terms of: 1) impact analysis requirements, 2) modeling assumptions, and 3) work plan requirements. Tribal Agencies and USEPA involvement varied across teams as a function of relevant expertise and subject matter, including instances where these agencies did not participate. Each workgroup adopted a Final IAP Summary Memo to capture these requirements, but also identified key issues, decision points, and areas of disagreement with the Tribal Cooperating Agencies where applicable. See IAP Final Summary Memos (MDNR et al. 2011).

- **Tribal Issue Review Meetings**. After the DEIS and prior to the release of the SDEIS, meetings were held approximately every other month between the Co-lead Agencies and Tribal Cooperating Agencies to discuss the potential effects of the proposed NorthMet Project Proposed Action and Land Exchange Proposed Action on tribal interests. These sessions included the Co-lead Agencies' feedback on how these same comments and concerns have been taken into consideration in the development of the SDEIS. Participants typically included staff from the Co-lead Agencies, Tribal Cooperating Agencies, and the USEPA. Twelve meetings were held from June 2011 through March 2013, and included numerous opportunities for the Tribal Cooperating Agencies to engage the Co-lead Agencies on issues of concern and disagreement.
- **Monthly Cooperating Agency Meetings**. Meetings were held once a month between the DEIS and SDEIS publications to provide the opportunity for the Co-lead Agencies to brief the Tribal Cooperating Agencies on the status of concerns from the Tribal Issue Review Meetings or otherwise articulated by the Bands. These sessions were facilitated by the USACE using a general agenda, where participants typically included staff from the Co-lead Agencies, Tribal Cooperating Agencies, and USEPA. High-level outcomes typically addressed coordination and information needs or gaps identified by the Cooperating Agencies.

These were the primary venues where Tribal Cooperating Agencies were provided opportunities to express their points of view on the potential effects of the NorthMet Project Proposed Action and Land Exchange Proposed Action on the environment, including points of disagreement with the Co-lead Agencies, prior to the release and review of the SDEIS. Other opportunities took the form of ongoing coordination for information development and availability, and ad hoc technical meetings.

Following the publication of the SDEIS, the Cooperating Agencies were invited to participate at the three public meetings held during the SDEIS public comment period. The Tribal Cooperating Agencies hosted a Tribal Cooperating Agency informational booth at each of the meetings, which were open to the public.

Regular Cooperating Agency meetings were reestablished prior to the SDEIS comment period (December 2013), through development of the Preliminary FEIS (May 2015). These meetings were facilitated by the USFS to provide a continuing opportunity for the Co-lead Agencies to brief the Tribal Cooperating Agencies and USEPA on the status of the project, and for the Cooperating Agencies to identify specific topics for more detailed discussion at separate technical meetings. Several technical meetings were conducted in order for the Co-lead Agencies to fully understand and consider the specific Cooperating Agency comments received on the SDEIS, as well as for the Co-lead Agencies to update the Cooperating Agencies on how the comments would be addressed for the FEIS.

The Communications and Coordination Plan also included provisions for the Co-lead Agencies to identify and disclose in the SDEIS differences of opinion with the Cooperating Agencies. The Communications and Coordination Plan notes for the MDNR, in its capacity as RGU, that

Minnesota Rules part 4410.2300, item H, states: "The EIS shall identify and briefly discuss any major differences of opinion concerning significant impacts of the proposed project on the environment." For the USACE and USFS, in their capacity as federal Co-lead Agencies, 40 CFR § 1502.9 and 1503.4 note they are obligated to work with the Cooperating Agencies to obtain their comments and "shall make every effort to disclose and discuss at appropriate points in the draft statement all major points of view on the environmental impacts of the alternatives including the proposed action." The Co-lead Agencies believe these information disclosure requirements were satisfied by providing the Tribal Cooperating Agencies MDOs in this chapter of the SDEIS and in the FEIS.

8.3 MAJOR DIFFERENCES OF OPINION

The Co-lead Agencies distributed a Preliminary Supplemental Draft Environmental Impact Statement (PSDEIS) and requested review by the Cooperating Agencies (both Tribal and USEPA) and the MPCA. Reviewers assessed the document for accuracy and identified gaps in technical information or general logic that could substantially affect the reader's understanding of the subject material. Comments were generated from all entities involved. The Co-lead Agencies reviewed all comments and incorporated suggested edits or provided additional clarification or analysis in the PSDEIS as required. All substantive comments were reviewed and discussed by work groups comprised of technical experts from the Co-lead Agencies and MPCA.

The Co-lead Agencies worked diligently with the Cooperating Agencies over the course of the PSDEIS's development to consider and resolve any concerns prior to its release for Cooperating Agencies' review and comment. While the USEPA provided comments and suggested edits on the PSDEIS, none of these were identified as representing an MDO. For comments from the Tribal Cooperating Agencies on the PSDEIS, there were cases where the Co-lead Agencies disagreed with the comments and determined that the PSDEIS analysis was valid and best disclosed potential environmental effects and permitting requirements as directed by NEPA and MEPA. Those comments were identified as potentially representing MDOs. Three workshops were held to identify the specific issue areas and reach consensus on the language summarizing tribal views. Ultimately, 18 issue areas were identified in the workshops as being "unresolved" and determined to represent MDOs in the SDEIS.

Supporting documentation and independent analyses for the 18 issue areas were also provided by the Tribal Cooperating Agencies (see Section 8.4). Although this information was considered, the Co-lead Agencies ultimately determined that the analyses and supporting documentation presented in the SDEIS were valid and best disclose potential environmental effects as directed by NEPA and MEPA.

All Cooperating Agencies submitted comment letters on the SDEIS. The USEPA gave the SDEIS a rating of EC-2 (Environmental Concerns – Insufficient Information) and provided detailed recommendations to improve the analysis. The Tribal Cooperating Agencies provided comments that included the previously identified MDOs, as well as additional comments on the SDEIS. In order to address the comments received on the SDEIS, the Co-lead Agencies considered new information, and also engaged with the Cooperating Agencies to fully understand their comments prior to addressing or responding to them in the FEIS.

As a result of addressing the SDEIS comments, the analysis relating to some of the Tribal Cooperating Agencies' MDOs was updated.

Table 8-1 summarizes the information presented by the Tribal Cooperating Agencies by providing:

- the 18 issue areas as identified in the SDEIS;
- the Tribal Position Summaries as identified in the SDEIS;
- the Tribal Cooperating Agency(ies) holding the MDO;
- the Co-lead Agencies' responses on the issues for the SDEIS and updated responses for the FEIS; and
- the location in the FEIS of reference material supporting the Co-lead Agencies' opinion on the issues.

Table 8-1 Major Differences of Opinion

MDO #	Specific Major Difference of Opinion Area	Tribal Position Summary	Co-lead Agency Response	
			SDEIS	**FEIS**
1	Impacts to flow in Embarrass and Partridge Rivers	Grand Portage, Fond du Lac, and GLIFWC believe that projected reductions in average stream flows in the Partridge and Embarrass Rivers, and subsequent impacts to aquatic habitat in these same systems, result in measurable impacts. They believe that the interaction of the project's impacts with natural variability in precipitation would be more adverse than reported in the SDEIS. This is because effects of climatic variability are additive to the project-related change, which would be especially true for drier periods. These agencies believe there is very little understanding of the hydrology of the Upper Partridge River, and the XP-SWMM model used to extrapolate flow data is flawed and does not produce usable results. Appendix C provides additional information from these agencies on this major difference of opinion revealed in the development of the SDEIS.	The Co-lead Agencies believe the understanding of the hydrology of the Partridge and Embarrass rivers is sufficient to assess effects and that the SDEIS adequately predicts potential changes to flow in the Embarrass and Partridge rivers. The NorthMet Project Proposed Action is not predicted to result in any substantial changes to average stream flow when compared to existing conditions. Underlying impact assessment methodologies are presented in SDEIS Section 5.2.2.2.2 and provide readers with specific information and cited reference documents that support the basis for the Co-lead Agencies' position. Surface water flow monitoring is proposed for both rivers and is presented in SDEIS Section 5.2.2.3.5 for permitting agencies to consider. If actual NorthMet Project Proposed Action effects were found to be higher than predictions, then steps could be taken to reduce those effects.	The Co-lead Agencies believe the understanding of the hydrology of the Partridge and Embarrass rivers is sufficient to assess effects and that the FEIS adequately predicts potential changes to flow in the Embarrass and Partridge rivers. The NorthMet Project Proposed Action is not predicted to result in any substantial changes to average stream flow when compared to existing conditions. FEIS Section 5.2.2.2.2 describes the methodology and results of the water impact analysis. Surface water flow monitoring is proposed for both rivers. Section 5.2.2.3.5 describes the monitoring and adaptive management measures that could be applied to minimize impact on flow, including impacts to tributaries extending from the Tailings Basin (as appropriate). Section 5.2.6 describes the impacts on aquatic species.
2	Predicted decrease in mercury loading	Fond du Lac, Grand Portage, and GLIFWC do not believe the proposed project will result in a decrease in mercury loading to the Embarrass and Partridge River aquatic systems. For the Embarrass River, they do not believe that: 1) the tailings basin will function as a mercury sink; and 2) mercury	The Co-lead Agencies believe that the SDEIS thoroughly considers potential sources of mercury, including those identified by the Tribal Cooperating Agencies. The SDEIS discloses in Section	The Co-lead Agencies' position as reflected in the SDEIS response remains unchanged for the FEIS. The mercury mass balance presented in the SDEIS has been revised to reflect updates to the water models and

MDO #	Specific Major Difference of Opinion Area	Tribal Position Summary	Co-lead Agency Response: SDEIS	Co-lead Agency Response: FEIS
		methylation would decrease due to projected reductions in sulfate contributions. For the flows for the Partridge River, Embarrass River, or their tributaries, they disagree that the project would not significantly impact flow and water level fluctuations, thus leading to increased mercury methylation and bioaccumulation, which taken together may be sufficient to impact habitat leading to alterations of species composition, food web structure, and ultimately mercury bioaccumulation. Potential mercury contributions from peat stored at the Overburden Laydown and Storage Area have also not been addressed. Mercury-related concerns are present for created wetlands at the East Pit and mercury concentrations in water discharged from the West Pit. Air-related mercury emissions do not account for sources from energy generation of vehicle use at the site. For the Lake Superior watershed, any additional mercury releases to the environment are exacerbating already existing impairments including fish advisories set for recreational fishing. Increased fish mercury levels will also have direct impacts on both the cultural and recreational resources of the region. Appendix C provides additional information from these agencies on this major difference of opinion revealed in the development of the SDEIS.	5.2.2.3.4 that the Embarrass River is predicted to result in a net increase in mercury-loadings of up to 0.6 grams per year, from 22.3 grams to 22.9 grams. For the Partridge River, the SDEIS indicates mercury-loading is predicted to decrease 1.2 grams per year, from 24.2 grams to 23.0 grams. This represents a projected 0.6 grams per year reduction across both river systems. Mercury-related analyses include water mass-balances, human health air risk assessments, potential bioaccumulation, and wetland/riparian sources of methylmercury generation. Impact assessment methodologies are presented in SDEIS Section 5.2.2.1.2 and provide readers with specific information and cited reference documents that support the basis for the Co-lead Agencies' position. The Co-lead Agencies understand the NorthMet Project Proposed Action includes features to control air emissions such that statewide TMDL reduction goals would not be impeded. The wastewater treatment facilities are also expected to provide mercury removal from the process water waste streams. The Co-lead Agencies respectfully disagree with the Tribal Cooperating Agencies and believe the Tailings Basin would act as a mercury sink, at least similar to other media like soils, and believe it cannot be predicted	air emissions inventory. The new results disclosed in Chapter 5, Section 5.2.2 are consistent with the conclusions made in the SDEIS that predict a net decrease of mercury-loadings of approximately 0.6 grams per year (i.e., a net decrease of 1.2 grams per year in the Partridge River and a net increase of 0.6 grams per year in the Embarrass River), resulting in a net decrease in overall mercury loadings to the St. Louis River. Total potential mercury emissions to air are estimated to be 4.6 lbs/year from the Plant Site and less than 1.0 lb/yr for the Mine Site. Mercury-related effects are addressed in FEIS Sections 5.2.2, 5.2.5, 5.2.6, 5.2.7, 5.2.9, 5.2.10, and 6.2.3. Surface water quality monitoring and adaptive management methods are presented in FEIS Section 5.2.2.3.5 for permitting agencies to consider.

MDO #	Specific Major Difference of Opinion Area	Tribal Position Summary	Co-lead Agency Response	
			SDEIS	FEIS
			whether methylmercury production may or may not change under the NorthMet Project Proposed Action. In addition, surface water quality monitoring and adaptive management methods are presented in SDEIS Section 5.2.2.3.5 for permitting agencies to consider. If actual NorthMet Project Proposed Action effects were found to be higher than predictions, then steps could be taken to reduce those effects.	
3	Wild rice standard regulatory applicability determinations and areas of production	Grand Portage, Fond du Lac, GLIFWC, and The 1854 Treaty Authority disagree with the MPCA's draft staff recommendations about the applicability determination of the wild rice 10 mg/L sulfate surface water standard to the NorthMet Project. These agencies do not agree with a seasonal application of the standard, or the reaches of waters determined as used for the production of wild rice, and compliance points for the sulfate standard, nor do they agree with basing a determination of a wild rice production water on the density of wild rice found growing there. The 1854 Treaty Authority states that it is arbitrary to define how much rice presence is required, especially given the lack of long-term monitoring data on a given water. Embarrass Lake is considered a water used for the production of wild rice under current MPCA draft staff recommendations; water quality is not meeting the wild rice water quality	The Co-lead Agencies acknowledge that both the proper application of the existing standard and the questions of whether and how that standard should be applied are the subjects of continuing general controversy. The Co-lead Agencies believe the MPCA's project-specific guidance on the applicability of the wild rice standard is a relevant and appropriate water quality evaluation criterion to use in the SDEIS. The Co-lead Agencies acknowledge that the MPCA's project-specific guidance may change as their NPDES/SDS permitting process progresses. If their guidance were to change in the future while the EIS is underway, the new guidance would be considered as appropriate for use in the FEIS and permitting. The wild rice standard is based in rule where applicability is determined by the MPCA. Any future regulatory	The Co-lead Agencies' position as reflected in the SDEIS response remains unchanged for the FEIS.

MDO #	Specific Major Difference of Opinion Area	Tribal Position Summary	Co-lead Agency Response: SDEIS	Co-lead Agency Response: FEIS
		standard there and wild rice is also found further upstream in the Embarrass River because it is an existing use defined by the Clean Water Act. Grand Portage states that the wild rice sulfate standard for waters used in the production of wild rice applies in the Embarrass River. The 1854 Treaty Authority notes that research and evaluation of the standard are ongoing, and that application of the standard may change. All believe the State's application of the wild rice standard is not in compliance with the Clean Water Act. This difference of opinion is directed at an element of the State's water quality regulatory program, but is offered in the SDEIS because the effects analysis presented in the SDEIS is based on the regulatory program. Appendix C provides additional information from these agencies on this major difference of opinion revealed in the development of the SDEIS.	determinations and basis for applicability of the wild rice standard is outside of the scope of this SDEIS. The Co-lead Agencies also note there will be opportunities for Grand Portage, Fond du Lac, GLIFWC, and The 1854 Treaty Authority to engage the MPCA in these regulatory determinations outside of this project-specific EIS, and these opportunities would be the more appropriate venue to raise these concerns.	
4	Impaired waters list regulatory designation should be made for Embarrass River watershed	Grand Portage and Fond du Lac believe that sulfate concentrations should be a criteria used for designation of an impaired wild rice water. They note that no wild rice waters in the state have been designated impaired by the MPCA. Grand Portage states that all segments of the Embarrass River that are identified as wild rice waters by MPCA are impaired due to water quality exceedances for sulfate. Grand Portage further notes waters where wild rice historically occurred, all exceed the 10 mg/L sulfate standard and therefore should be on the impaired waters list because it is	The Co-lead Agencies believe it is appropriate to rely on the MPCA's Clean Water Act Section 303(d) final 2012 TMDL List of impaired waters in the SDEIS. The Co-lead Agencies recognize that there are segments of the Embarrass River on the 2012 List, but the listing is for an impairment not specific to sulfate and/or wild rice. The Co-lead Agencies give regulatory deference to the MPCA and USEPA's process for determining the basis for, and finalizing, the impairments	The Co-lead Agencies' position as reflected in the SDEIS response remains unchanged for the FEIS.

MDO #	Specific Major Difference of Opinion Area	Tribal Position Summary	Co-lead Agency Response: SDEIS	Co-lead Agency Response: FEIS
		known that wild rice previously grew in these waters. These agencies contend the Embarrass River is already impaired so any sulfate additions constitute cumulative effects. This difference of opinion is directed at the MPCA's impaired waters regulatory program, but is offered in the SDEIS because the effects analysis impact criteria presented in the SDEIS are based on information developed with respect to this regulatory program. Appendix C provides additional information from these agencies on this major difference of opinion revealed in the development of the SDEIS.	assigned to a given reach of water on the 303(d) list. The development of the 303(d) list is a separate biennial process outside the scope of the EIS. Furthermore, the Co-lead Agencies will continue to rely on MPCA's project-specific guidance on the applicability of the wild rice standard as a relevant and appropriate water quality evaluation criterion to use in the SDEIS.	
5	Underground Mining analysis	GLIFWC believes that the Underground Mine Alternative has been prematurely eliminated from consideration in the NorthMet Project SDEIS and it would provide significant environmental benefits when compared to the proposed project. An underground mine would largely eliminate impacts to wetlands, and would substantially limit water quantity and quality impacts for surface- and groundwater resources. GLIFWC concurs that underground mining is technically feasible and available at the site, leaving only the lack of economic feasibility as the rationale used by the Co-lead Agencies to eliminate the alternative. On this GLIFWC's opinion is that the Co-lead Agencies did not fully assess information on economic feasibility provided by the proposer. Deficiencies noted by GLIFWC are related to the: error term for economic	The Co-lead Agencies believe that adequate consideration was given to the Underground Mining Alternative prior to eliminating it from further consideration for the SDEIS. This option was screened against specific alternatives-consideration criteria in terms of purpose and need, technical and economic feasibility, availability, and environmental and socioeconomic benefit. Both the SDEIS Section 3.2.3.4.1 and the Co-lead Agency position paper (Appendix B) disclose that an underground mine would result in a smaller footprint, thus offering certain environmental benefits such as reduced effects on wetlands, vegetation, and wildlife habitat. However, both the SDEIS and the Co-	The Co-lead Agencies' position as reflected in the SDEIS response remains unchanged for the FEIS.

MDO #	Specific Major Difference of Opinion Area	Tribal Position Summary	Co-lead Agency Response	
			SDEIS	FEIS
		projections; rates on return on investment; costs of the land exchange; environmental goods and services provided by natural systems; economic impact and inconsistency with state mineland reclamation program goals regarding perpetual maintenance and water treatment at the site. Appendix C provides additional information from this agency on this major difference of opinion revealed in the development of the SDEIS.	lead Agency position paper also disclose that the tonnage/volume and grade (amount of metals) of rock would not generate enough revenue to pay for all costs associated with underground mining. Therefore, underground mining would not be economically feasible. The Co-lead Agencies also considered that a smaller mining operation would employ fewer workers for a shorter amount of time, resulting in fewer socioeconomic benefits than the NorthMet Project Proposed Action. Also, preliminary economic screening by PolyMet determined that sale of metal precipitates produced from an underground mine would not meet the NorthMet Project Proposed Action Purpose and Need, which is integral to whether an alternative should be evaluated in the SDEIS. Therefore, it was found to not be a reasonable alternative and was eliminated from further consideration.	
6	West Pit backfill option analysis	GLIFWC believes that the West Pit Backfill option has been prematurely eliminated from consideration in the NorthMet Project SDEIS. They believe the potential environmental benefits to long term water quality have not been fully assessed and mineral encumbrance issues can be avoided. This alternative meets the purpose and need, is available, and is technically and economically feasible. By limiting the consideration of environmental benefits to only a screening-level analysis, the full effect of the alternative on the	The Co-lead Agencies believe that the West Pit Backfill option was given adequate consideration prior to eliminating it from further examination for the SDEIS. SDEIS Section 3.2.3.4.2 details the factors considered by the Co-lead Agencies regarding this potential alternative, including: backfill sequencing; volume of material; water quality and WWTP treatment; visual aesthetics; operational air, noise, and	The Co-lead Agencies' position as reflected in the SDEIS response remains unchanged for the FEIS. FEIS Section 3.2.3.4.2 details the factors considered by the Co-lead Agencies regarding this potential alternative.

MDO #	Specific Major Difference of Opinion Area	Tribal Position Summary	Co-lead Agency Response SDEIS	Co-lead Agency Response FEIS
		environment is not known, especially for water quality and potential need for perpetual treatment (contrary to state mineland reclamation program goals). The issue of mineral encumbrance is raised as proposer concern, but is avoided by employing standard underground mining techniques from other locations. GLIFWC's opinion is that economic considerations of a future mine expansion are the only concrete reasons for not conducting a full analysis, and every available option that might improve long term impacts should be explored regardless of mineral lease commitments. Appendix C provides additional information from this agency on this major difference of opinion revealed in the development of the SDEIS.	dust impacts; footprint impacts for wetlands; mineral encumbrance lease provisions; and costs. These factors were weighed against specific alternatives-consideration criteria in terms of purpose and need, technical and economic feasibility, availability, and environmental and socioeconomic benefit. The screening analysis revealed the opportunity to reclaim wetlands and vegetation at the Category 1 Stockpile footprint would be the only measurable environmental benefit offered by backfilling the Category 1 Stockpile into the West Pit. However, because the stockpile would have to be constructed anyway even under a backfilled option, these impacts would still occur with mitigation required under wetlands-related permitting or site reclamation requirements under the Permit to Mine. On balance, it is the Co-lead Agencies' opinion that the West Pit Backfill option would not provide substantial environmental benefit to the project as proposed. As such, the option to backfill the West Pit was eliminated from further consideration in the SDEIS.	
7	Partridge River baseline base flow and XP-SWMM model	Grand Portage, Fond du Lac, and GLIFWC believe that basic site surface water flow hydrology at the Mine Site is inadequately characterized. The XP-SWMM model predictions may have underestimated	The Co-lead Agencies believe that the SDEIS adequately predicts Partridge River baseline baseflow and that the XP-SWMM model calibration was	The Co-lead Agencies have concluded after additional analysis and discussion that the USGS gage data and derived XP-SWMM values used in the EIS remain the most reasonable estimate of

MDO #	Specific Major Difference of Opinion Area	Tribal Position Summary	Co-lead Agency Response SDEIS	FEIS
	calibration	baseflow conditions in the Partridge River by a factor of five (5). If true, this mis-characterization might affect water quality compliance projections in that although more baseflow might mean more dilution of contaminants, it could also mean transport of greater quantities of pollutants or drawdown for the Partridge River. They also contend that XP-SWMM's projections, which are based on data from 17 miles away collected from 1978 to 1987, do not align with the rating curve from new MDNR winter monitoring data, or the results of GLIFWC's own projections taken from two years of new data from the Dunka Road gage. Because XP-SWMM's low estimates of baseflow are used in the calibration of the MODFLOW model, it will influence many aspects of the baseline site characterization and impact prediction. These include pit inflow, dewatering impacts to the Partridge River and wetlands, water treatment needs, groundwater flow rates, contaminant transport times and concentrations, and contaminant dilution in the Partridge River watershed. Appendix C provides additional information from these agencies on this major difference of opinion revealed in the development of the SDEIS.	appropriate. Baseflow estimation methodologies, including limitations, and data sources are presented in SDEIS section 4.2.2.2.2 and provide readers with specific information and cited reference documents that support the basis for the Co-lead Agencies' position. Section 5.2.2.2.2 identifies the methods to assess existing conditions in the Partridge River, while Table 5.2.2-4 provides the results of the XP-SWMM modeling for various reaches of the river. Regarding the use of the 1978 to 1987 flow data, the Co-lead Agencies believe it is reasonable to rely on this information because there have not been any relevant changes in the watershed since that time. In addition, the SDEIS acknowledges the issue by noting in Section 4.2.2.2.2 the implications of using a lower modeled baseflow are that any changes of flow volume due to withdrawals, discharges, or augmentation would result in greater effects during the impact modeling than if higher baseflow values were used, such as showing higher concentrations of solutes in the rivers and creeks. Surface water flow monitoring is proposed for the Partridge River and is presented in SDEIS Section 5.2.2.3.5 for permitting agencies to consider. If actual NorthMet Project Proposed Action effects were found to be higher	groundwater baseflow conditions in the Partridge River for the purposes of MODFLOW and GoldSim modeling. Groundwater baseflows for the Partridge River developed in the SDEIS are best-estimate values and were retained for the FEIS. In addition, a groundwater baseflow sensitivity analysis was performed to consider the effect of variable groundwater baseflow inputs on water quality. Results show that modeled groundwater and surface water concentrations are sensitive to changes in groundwater baseflow. However, the NorthMet Project Proposed Action's ability to meet groundwater quality and surface water quality evaluation criteria is not sensitive to changes in baseflow. As per the SDEIS, FEIS Section 5.2.2.2.2 describes the methodology and results of water impact analysis. Surface water flow monitoring is proposed for the Partridge River, with Section 5.2.2.3.5 describing the monitoring and adaptive management measures that could be applied to minimize impacts to water resources. Section 5.2.6 describes the impacts on aquatic species.

MDO #	Specific Major Difference of Opinion Area	Tribal Position Summary	Co-lead Agency Response SDEIS	Co-lead Agency Response FEIS
			than predictions, then steps could be taken to reduce those effects.	
8	Analog method to assess indirect impacts from mine dewatering	Grand Portage, Fond du Lac, GLIFWC, and The 1854 Treaty Authority believe that the Co-lead Agencies' proposed analog method of assessing potential indirect impacts from mine site pit dewatering is not rigorous, and as such should not be the sole means of indirect impact assessment for the SDEIS. Resource assessment areas of concern include wetlands, groundwater, and surface waters. All these agencies consider the impact zones and distances to be somewhat arbitrary, and also challenge the automatic exclusion of ombrotrophic wetlands from potential drawdown effects. Accounting for these factors GLIFWC conducted an independent assessment using the same methods as the Co-lead Agencies, along with additional analog data from other mining-impacted sites, which found an estimated total of 5719.75 acres of wetlands would be potentially susceptible to severe indirect impacts from mine pit drawdown. These agencies are of the opinion that the USACE should require up front mitigation for all severely impacted wetlands, but at a minimum up front mitigation should be required for wetlands occurring in zone 1. They also contend that additional up front mitigation should be considered for wetlands that are classified in the moderate to severe category, with robust monitoring being required for wetlands in the moderate category. These agencies also note that the upper Partridge River is located in Zone 2;	The Co-lead Agencies believe that the SDEIS adequately uses the analog method to assess potential indirect effects from mine dewatering. The complex mixes of bedrock, glacial till, and wetland soils at the Mine Site impede the ability to reasonably model and accurately assess the potential effect of pit dewatering on wetlands. In light of this modeling limitation, wetlands were divided into zones based on distance from the open pit. The closer a wetland was to the pit during dewatering, the greater the water table drawdown would be and the greater potential there would be for hydrologic effects on overlying wetlands. These impact assessment methodologies are presented in SDEIS Sections 5.2.2.3.2 and 5.2.3.1.2. The Co-lead Agencies respectfully believe reliance on potential impact zones is appropriate but recognize uncertainty remains. In the event that the required wetland monitoring identifies additional indirect effects, permit conditions would likely include a plan for adaptive management practices to be implemented, such as hydrologic controls or additional off-site compensatory mitigation, which may be identified through annual reporting.	The Co-lead Agencies believe that the analog method used in the SDEIS to assess potential indirect effects from mine dewatering is adequate. Further, the FEIS has been revised to address concerns raised by the Bands regarding the assertion that ombrotrophic bogs would not be impacted by mine dewatering. Section 5.2.3.2.2 of the FEIS applies a more conservative assumption of the potential indirect effects for all bog communities within the 0-1,000-ft analog zone. Specifically, ombrotrophic bogs were reclassified from the "no effect" category to the "low likelihood" category, the same status as that assigned to minerotrophic bogs. The complex mixes of bedrock, glacial till, and wetland soils at the Mine Site impede the ability to reasonably model (e.g., using MODFLOW) and accurately assess the potential effect of pit dewatering on wetlands. In light of this modeling limitation, wetlands were divided into zones based on distance from the open pit. The closer a wetland was to the pit during dewatering, the greater the water table drawdown would be and the greater potential there would be for hydrologic effects on overlying wetlands. These impact assessment methodologies are presented in

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		GLIFWC's independent analysis estimated drawdowns of 3 to 5 ft under the river, which would severely reduce baseflow in the channel, indirectly impact riparian wetlands downstream, and affect other surface water features. Appendix C provides additional information from these agencies on this major difference of opinion revealed in the development of the SDEIS.		Sections 5.2.2.3.2 and 5.2.3.1.2 of the FEIS. The Co-lead Agencies are not relying solely on the potential impact zones determined in the analog method for the FEIS but would monitor wetlands for potential indirect effects if the NorthMet Project Proposed Action were approved. In the event that the required wetland monitoring identifies additional indirect effects, permit conditions would likely include a plan for adaptive management practices to be implemented. Additional compensatory mitigation would be required if indirect wetland impacts were identified during monitoring and annual reporting.
9	Mine Site groundwater impact travel times	Grand Portage and GLIFWC believe that assumed groundwater pollutant travel times at the mine site are underestimated. They contend that relevant literature and data suggest otherwise, and this has not been captured in the modeling of bedrock aquifer transport of pollutants from the mine pit to surface water features. Grand Portage further disagrees with the Co-lead Agencies' assumption that the Duluth Complex would remain highly competent with extremely low hydraulic conductivities post-blasting. If true, resulting groundwater travel times through bedrock would be shorter than predicted in the SDEIS. They recommend conducting a greater characterization of the entire Partridge River watershed and mine site.	The Co-lead Agencies believe that the SDEIS adequately predicts groundwater impact travel times at the Mine Site as a function of bedrock hydraulic conductivity. The hydrogeology of the mine site bedrock units has been evaluated as detailed in SDEIS Section 4.2.2.2.1, including the potential that fractures, including faults and fracture zones, may exist that could permit transmission of groundwater through the bedrock over distances of thousands of feet. SDEIS Section 5.2.2.2.1 considers how fractures may affect hydraulic conductivities at the Mine Site, and although the presence of fractures	The Mine Site GoldSim model was changed following the SDEIS in response to comments and additional analysis occurred relating to hydraulic conductivities. The modeled bedrock and surficial aquifers contribute groundwater baseflow to the Partridge River. FEIS Section 5.2.2.2.1 describes that the Duluth bedrock hydraulic conductivity was increased and a bedrock flowpath thickness was established at 15 m at the Mine Site to better represent the likelihood of an upper zone of more fractured bedrock than deeper in the formation. The increased bedrock hydraulic conductivity is still less than

MDO #	Specific Major Difference of Opinion Area	Tribal Position Summary	Co-lead Agency Response	
			SDEIS	FEIS
		Appendix C provides additional information from these agencies on this major difference of opinion revealed in the development of the SDEIS.	cannot be completely ruled out, site-specific data such as boring logs indicate the bedrock appears competent. Deep fractures are rarely encountered near the surface, and hydrogeologic investigations have indicated that the bulk of hydraulic conductivity of bedrock at this Mine Site is very low. Blasting-related effects within the pit wall have also been considered. They are expected to be limited in terms of lateral extent and do not have much effect on solute transport in bedrock. In addition, bedrock groundwater monitoring to evaluate bedrock water quality trends is proposed at the Mine Site as presented in SDEIS Section 5.2.2.3.5 for permitting agencies to consider. If actual NorthMet Project Proposed Action effects were found to be higher than predictions, then steps could be taken to reduce those effects.	the value for the surficial deposits. For the bedrock flowpaths that originate at the mine pits, the travel time for water to reach the property boundary is much longer than the modeled 200-year period. Surficial groundwater travel times are related to river groundwater baseflow estimates. Partridge River groundwater baseflow estimates used in the SDEIS are reasonable. A groundwater sensitivity analysis was completed which predicted higher peak concentrations that occur sooner for some constituents. However these peaks remain below evaluation criteria for most parameters. Groundwater monitoring and adaptive measures to manage pit groundwater flows, including for any water conducting features or faults if encountered, are described in FEIS Section 5.2.2.3.5.
10	No Action Alternative analysis	Fond du Lac, Grand Portage and GLIFWC believe CEQ guidance require that water quality modeling of a No Action alternative should include activities that will occur under the existing Cliffs Consent Decree. The consent decree requires mitigation for water quality exceedances from Area Pit 5, the LTVSMC tailings basin, and the Dunka Pit, all of which under the No Action alternative would cause compliance with all water quality standards with no additional reductions in flows. Further,	The Co-lead Agencies believe that the SDEIS adequately analyzes effects on water resources under the No Action Alternative as required by NEPA/MEPA. Future remedial actions that would be required at the LTVSMC Tailings Basin under the consent decree and other permits are not established so it is not possible to model those conditions. The No Action Alternative is described in SDEIS Section 5.2.2.4 and	The Co-lead Agencies' position as reflected in the SDEIS response remains unchanged for the FEIS. To further refine the impact assess and consistent with this position, the Co-lead Agencies have elected to remove the Northshore Pit discharges to the Partridge River from both the continuation of existing conditions and project model scenarios at year 2070. This was done because the timing and the effects of the Northshore Pit

MDO #	Specific Major Difference of Opinion Area	Tribal Position Summary	Co-lead Agency Response SDEIS	Co-lead Agency Response FEIS
		they contend the current modeling of the "continuation of existing conditions," which omits the dilution effect of precipitation on the water quality of the basin, is not appropriate. Claims that the basin's water quality has stabilized and that current conditions will not change over time is based on pond water sampling for only 4 years (2001-2004). If precipitation since 2004 has not influenced water quality by further diluting water chemistry in the pond, then more recent data on basin pool water chemistry is needed to support the assumption. These agencies are of the opinion while the CEQ makes it clear that a blind "continuation of existing conditions" model is inappropriate as a No Action alternative, a "continuation of existing conditions" model that ignores simple environmental processes such as precipitation is even less appropriate. Appendix C provides additional information from these agencies on this major difference of opinion revealed in the development of the SDEIS.	acknowledges it is not static, but at this time the exact nature, timing, and effectiveness of measures under the consent decree are unknown, and thus are not quantifiable for the SDEIS. The Co-lead Agencies have considered the water quality implications of the No Action Alternative and believe it is reasonable to expect that water quality within the Embarrass River could improve over time, absent other unforeseen activities that could affect water quality. The Co-lead Agencies are not relying on the continuation of existing conditions modeling scenario in consideration of the No Action Alternative. This model run represents conditions in the absence of the NorthMet Project Proposed Action and allows for a direct comparison of the predicted water quality model results with the same run with the proposed project. The Continuation of Existing Conditions Scenario facilitates the assessment of the extent to which the NorthMet Project Proposed Action would result in changes in water quality as captured in the model. The Co-lead Agencies believe this comparison is valuable in considering the efficacy of measures available to mitigate potential NorthMet Project Proposed Action-related adverse water quality effects for both the mine and plant sites. These	discharge cessation are reasonably known.

MDO #	Specific Major Difference of Opinion Area	Tribal Position Summary	Co-lead Agency Response: SDEIS	Co-lead Agency Response: FEIS
			mitigative measures are already contained in the design of the NorthMet Project Proposed Action, or are available as adaptive or contingent NorthMet Project Proposed Action features as detailed in SDEIS Section 5.2.2.2.5.	
11	Cumulative Effects to groundwater and surface water quality and quantity	Grand Portage, Fond du Lac, GLIFWC, and The 1854 Treaty Authority disagree with the Final SDD and SDEIS conclusion that no cumulative effects to groundwater resources are expected. They note bedrock and surficial groundwater pollution is already documented at the old LTVSMC site (i.e., plant site; area pits 5, 6, and 9S) and the Dunka Pit. Cumulative effects at these locations should be assessed with the proposed project along with potential groundwater pollution from the Peter Mitchell Pit, Laskin Energy, Arcelor-Mittal, United Taconite, and US Steel Minntac. They suggest a future action that should be considered in a cumulative effects analysis is any potential future backfill of Virginia Formation waste rock for in-pit disposal at the Cliffs Peter Mitchell Pit. And they contend that potential dewatering-related interaction effects between the proposed NorthMet Project and the Peter Mitchell Pit should be evaluated for cumulative effects. Appendix C provides additional information on this major difference of opinion revealed in the development of the SDEIS.	The Co-lead Agencies believe that the SDEIS appropriately considered the potential for cumulative groundwater effects and accurately predicts cumulative effects to surface water quality and quantity. Cumulative effects impact assessment methodologies for both groundwater and surface water resources are presented in SDEIS Section 6.2.3.3 and provide readers with specific information and cited reference documents that support the basis for our position. The Co-lead Agencies believe the potential for cumulative effects on groundwater resources from the NorthMet Project Proposed Action is not supported. The SDEIS reports the NorthMet Project Proposed Action would affect groundwater levels, but this effect would be limited geographically and temporally, the latter being that groundwater levels would begin to be restored once pit dewatering ceases, and is subject to interactions causing cumulative effects. The Co-lead Agencies do believe, however, that assessment of cumulative	The Co-lead Agencies believe that the FEIS appropriately considers cumulative effects for both groundwater and surface water resources. Water-related cumulative effects assessment methodologies and results are presented in FEIS Section 6.2.2. In addition to the NorthMet Project Proposed Action, water-related cumulative actions considered in the FEIS include: ArcelorMittal Deposits (Laurentian and East Reserve deposits), City of Aurora POTW, City of Babbitt POTW, City of Biwabik POTW, City of Hoyt Lakes POTW, Former LTVSMC Pits and Tailings Basin, Mesabi Nugget (formerly Mesabi Nugget Phase I), Mesabi Mining Project (formerly Mesabi Nugget Phase II), Minnesota Power Laskin Energy Center, Northshore Mine, and Northshore Mine Closure. Cumulative impacts result when the effects of an action are added to or interact with other effects in a particular place and within a particular time. The modeled groundwater

MDO #	Specific Major Difference of Opinion Area	Tribal Position Summary	Co-lead Agency Response: SDEIS	Co-lead Agency Response: FEIS
			effects on surface water quality does require consideration of potential groundwater solute contributions. SDEIS Section 6.3.3.3 provides a complete examination of this concern, including existing and potential future actions. The actions considered are: Arcelor-Mittal; Northshore Mine; Area 5 NW Pit; four POTWs; Cliffs Erie LTVSMC site; Mesabi Nugget; Mesabi Mining; Mesaba Energy – East Range Site; and Minnesota Power Laskin Energy Center.	flowpaths of the NorthMet Project Proposed Action do not interact with other groundwater flowpaths. There may be other plumes from other projects in the vicinity of the NorthMet Project Proposed Action, but the effects of these plumes would only interact with NorthMet Project Proposed action impacts within surface waters. This has been evaluated. The only exception is the seepage effects from existing LTVSMC Tailings Basin that the NorthMet Project Proposed Action would supplant. This combined effect has been considered in the groundwater quality models presented in Section 5.2.2. The Northshore Mine Progression Ultimate Pit Limit project which includes the in-pit stockpiling of Virginia Formation waste rock in the Peter Mitchell Pit would have no impact on the Partridge River, as all operations discharges would be primarily to Langley Creek.
12	CEAA for Partridge and Embarrass Rivers	Fond du Lac, Grand Portage, GLIFWC, and The 1854 Treaty Authority believe that limiting the cumulative effects analysis area (CEAA) for water resources to the Partridge and Embarrass River watersheds is too small. Rather, they contend the analysis should be expanded to include the St. Louis River. Impacts associated with United Taconite's proposal for 1,200 acres of wetland destruction to build a new tailings basin should be considered. More broadly, they contend the project would	The Co-lead Agencies believe that the SDEIS uses an appropriate cumulative effects assessment area, or CEAA. The Co-lead Agencies have appropriately defined the spatial extent for the water resources CEAA to be at the scale of contributing watersheds. This is reasonable geographic area because the Plant Site is within the Embarrass River watershed and the Mine Site is within the Partridge River watershed as	The Co-lead Agencies' position as reflected in the SDEIS response remains unchanged for the FEIS. Section 6.2.2.1.1 describes the water resources CEAA.

MDO #	Specific Major Difference of Opinion Area	Tribal Position Summary	Co-lead Agency Response SDEIS	Co-lead Agency Response FEIS
		add to the load of pollutants that are already causing an excursion from the water quality standards in the St. Louis River and would reduce tributary flows to the river. If true, then project-related impacts that may occur due to the project could be underestimated (due to modeling concerns), and would not stop before reaching the St. Louis River. This would mean that any added impact from the project to the St. Louis River would in turn impact Lake Superior, so this should be the scale to analyze cumulative effects. Appendix C provides additional information from these agencies on this major difference of opinion revealed in the development of the SDEIS.	detailed in SDEIS Section 6.2.3.3.1 The Co-lead Agencies have also considered the appropriateness of defining the CEAA for surface water quality to include the St. Louis River. Because the NorthMet Project Proposed Action would result in only minor changes in surface water hydrology and quality of the Embarrass and Partridge rivers, cumulative effects to the St. Louis River cannot be definitively assigned so it is not included in the CEAA.	
13	Effects on groundwater and surface water hydrology	Fond du Lac, Grand Portage, and GLIFWC disagree with the conclusion that the Proposed Project is not predicted to result in any significant effects on groundwater or surface water hydrology. XP-SWMM relies on antiquated data from far downstream, which means the model's projection of hydrologic effects cannot be supported. They believe GoldSim cannot reliably predict whether the 28 solutes modeled at both the plant and mine sites would meet the Minnesota water quality standards. Appendix C provides additional information from these agencies on this major difference of opinion revealed in the development of the SDEIS.	Similar and related to MDOs #1 and #7 above, the Co-lead Agencies believe that the SDEIS adequately predicts effects on groundwater and surface water hydrology. Overall water impact assessment methodologies are presented in SDEIS Section 5.2.2.2 and provide readers with specific information and cited reference documents that support the basis for the Co-leads Agencies' position. The Co-lead Agencies approved GoldSim to be programmed with a suite of complex algorithms to estimate the release of 28 solutes or contaminants from the mine facilities and their transport to groundwater and surface water evaluation locations. A probabilistic method was also approved	The Co-lead Agencies' position as reflected in the SDEIS response remains unchanged for the FEIS. The water models were updated to address comments received on the SDEIS and to consider new information. As described in FEIS Section 5.2.2.2 the conclusions of the updated model results support those in the SDEIS. In addition, a groundwater baseflow sensitivity analysis was performed to consider the effect of variable baseflow inputs on water quality. Results show that modeled groundwater and surface water concentrations are sensitive to changes in groundwater baseflow. However,

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			SDEIS	**FEIS**
			to estimate the probability of a given water quality outcome occurring as a means to account for uncertainties. This is unlike deterministic modeling where all inputs are known or estimated, and when modeled, always produce a single result without accounting for uncertainty. Lack of accounting for uncertainty was identified as a concern regarding the original DEIS's analyses. The Co-lead Agencies believe focusing on the P90 threshold in assessing the NorthMet Project Proposed Action's potential to meet applicable water quality standards is logical because it generally equates to a reasonable worst-case scenario and has been adopted for other mining NEPA documents where probabilistic modeling was used. Regardless, the Co-lead Agencies' reliance on the P90 criterion does not supersede how water quality-based effluent limits (WQBELs) would be developed for NPDES/SDS permitting. Appropriate WQBELs would be derived based on water quality standards and implemented in the permit. In addition, water monitoring and adaptive management methods are presented in SDEIS section 5.2.2.3.5 for permitting agencies to consider. If actual NorthMet Project Proposed Action effects were found to be higher than predictions, then steps could be	the NorthMet Project Proposed Action's ability to meet groundwater quality and surface water quality evaluation criteria is not sensitive to changes in groundwater baseflow

MDO #	Specific Major Difference of Opinion Area	Tribal Position Summary	Co-lead Agency Response: SDEIS	Co-lead Agency Response: FEIS
			taken to reduce those effects.	
14	GoldSim not able to replicate Tailings Basin water/Partridge River Water Quality under the No Action Alternative	GLIFWC believes that the GoldSim model does not accurately predict existing water quality conditions, such as the existing exceedance of the aluminum standard in the Embarrass River, or existing conditions in the Partridge River. This agency contends that if a model is unable to accurately predict current conditions, then it is even less likely to accurately predict future project conditions. GLIFWC notes that for many parameters at several water bodies, the No-Action P50 model of annual average value is substantially different than the observed average under existing conditions. The GoldSim model(s) need to be better calibrated to existing conditions. Without new calibrations, the GoldSim model's projections are not adequate to ensure protection of water resources. Appendix C provides additional information from this agency on this major difference of opinion revealed in the development of the SDEIS.	The Co-lead Agencies believe that the GoldSim model adequately replicates NorthMet Project Proposed Action water quality for Tailings Basin water and the Partridge River under the Continuation of Existing Conditions modeling scenario for the SDEIS. The same hydrology and water quality existing conditions datasets that were used for modeling the Proposed Action were used for the Continuation of Existing Conditions modeling scenario. Also, this scenario never introduces any NorthMet mine features or activities and conducts the same simulations for the same durations. Models calibrated for the SDEIS to address differences between observed and simulated values include Mine Site MODFLOW and XP-SWMM models, Mine Site Natural Runoff, Plant Site MODFLOW, Plant Site Natural Runoff, and existing LTVSMC Tailings Basin loading. The existing tailings basin calibration included aluminum, as well as a number of other solutes. The Co-lead Agencies evaluated the various model calibrations underlying GoldSim and believe the differences between the observed and simulated values for each of the calibration targets are minimized within accepted modeling norms. The GoldSim model set up and calibration information is presented in	While the Co-lead Agencies' position remains consistent with that reflected in the SDEIS, the Mine Site and Plant Site water models were updated to address SDEIS comments, including using new, available data collected since the SDEIS. This required new calibrations to better reflect existing conditions. In addition for the Mine Site modeling, a new variable was added to account for runoff contributions to Colby Lake. The FEIS water sections for the NorthMet Project, Sections 4.2.2, 5.2.2, and 6.2.2, have been updated accordingly. The conclusions of the updated model results are consistent with those in the SDEIS.

MDO #	Specific Major Difference of Opinion Area	Tribal Position Summary	Co-lead Agency Response	
			SDEIS	FEIS
			SDEIS section 5.2.2.2.3. Model predictions are also reliable and are presented in the "GoldSim Model Operations and Output" and "Application of Evaluation Criteria to Probabilistic Modeling Results" subsections in SDEIS Section 5.2.2.2.3.	
15	Mineral fibers	Fond du Lac, Grand Portage, and The 1854 Treaty Authority believe the risks associated with exposure to mineral fibers are greater than portrayed in the SDEIS. Fond du Lac disagrees that 9% amphibole fibers identified by PolyMet testing can be considered a "small" percentage of the fibers identified, while Grand Portage notes chrysotile fibers that would be expected to be found in the NorthMet deposit are not considered. Grand Portage and Fond du Lac indicate that information cited from studies in this section is outdated and that the section should be updated to rely on the most recent reports (i.e.; U of M study released in April 2013). The Bands contend that one year of monitoring as currently proposed is not adequate to account for the variability and unpredictable mineralogy in the rock to be mined, and that monitoring for mineral fibers should be conducted for the duration of the mining operation. Fond du Lac identifies that risks associated with ingestion should be considered in addition to inhalation; risks from ingestion are not discussed in the air quality section or the human health risk section of the document. Appendix C provides additional information from these agencies on this major difference of opinion revealed in the	The Co-lead Agencies believe that the SDEIS adequately describes the risks associated with mineral fibers, including chrysotile (or serpentine) minerals, and potential ingestion risks. Findings from the University of Minnesota study updates to the Minnesota Legislature in April 2013 are considered in the mineral fibers portion of the document. The SDEIS also includes monitoring and mitigation measures described in Section 5.2.7.5.	The Co-lead Agencies' position as reflected in the SDEIS response remains unchanged for the FEIS.

MDO #	Specific Major Difference of Opinion Area	Tribal Position Summary	Co-lead Agency Response	
			SDEIS	**FEIS**
		development of the SDEIS.		
16	Rail car spillage and dust	GLIFWC disagrees that the amount of ore that could escape from rail cars would be small because the rail cars proposed for use are not sealed. GLIFWC states that, given the design and current condition of rail cars proposed for transport, an ecologically significant amount of spillage could occur into streams, wetlands, and their watersheds. GLIFWC believes that fugitive dust escaping through gaps in the rail cars is also a concern. GLIFWC does not believe that the method described to segregate fines in the center of the rail car, away from the gaps, is realistic. Further, GLIFWC does not believe that monitoring of the creeks along the rail line will be effective in preventing or minimizing impacts because once detected in monitoring, the impact will have already occurred. GLIFWC states that cleanup of ore dust in an aquatic environment is a long and difficult process. Appendix C provides additional information from this agency on this major difference of opinion revealed in the development of the SDEIS.	The Co-lead Agencies believe that the SDEIS adequately predicts the rail car spillage and potential environmental effects. No substantial reactive airborne fugitive dust emissions from rail transport are expected. However, the Co-lead Agencies note that estimates of potential spillage are presented in SDEIS Section 5.2.2.3.2, and potential effects are presented in Sections 5.2.2.3.2, 5.2.3.2.2, and 5.2.7.1.3. These sections provide readers with specific information and cited reference documents that support the basis for the Co-lead Agencies' position. Water quality monitoring for the streams located along the Transportation and Utility Corridor is recommended. If streams along the railroad corridor between the Mine Site and Plant Site were to show degradation in water quality as a result of material spilled from railcars, then contingency mitigation would be available through developing catchment areas adjacent to the tracks at stream crossings to minimize the amount of material that reaches the streams. This information is available for permitting agencies to consider as necessary.	While the Co-lead Agencies' position as reflected in the SDEIS response remains unchanged for the FEIS, the proposer has made a commitment to refurbish the proposed rail cars to minimize gaps and therefore spillage between the Mine Site and the Plant Site. Further detail on the rail cars is provided in FEIS Section 3.2.2.2.4.
17	Use of water evaluation criteria vs. water quality standards	Fond du Lac and Grand Portage do not agree with statements in the document that indicate there is "no impact" when that assertion is based on not exceeding an	The Co-lead Agencies believe that the SDEIS appropriately considers effects on water, including the evaluation criteria specific to the NorthMet Project	The Co-lead Agencies' position as reflected in the SDEIS response remains unchanged for the FEIS. Section 6.2.2.4.1 contains details on

MDO #	Specific Major Difference of Opinion Area	Tribal Position Summary	Co-lead Agency Response	
			SDEIS	**FEIS**
		evaluation criteria. They believe the SDEIS should acknowledge where there is a change, regardless if a criteria or standard is exceeded. With regard to the water quality effects analysis, Grand Portage and GLIFWC note that evaluation criteria are not equivalent to water quality standards. Grand Portage further notes that some evaluation criteria are high enough to cause human health impacts and evaluation criteria are not equal to or a substitute for water quality standards compliance. GLIFWC notes that in some areas, for example the cumulative effects section for the Partridge River, the text states all water evaluation criteria would be met, though water quality standards would be exceeded for several constituents. Appendix C provides additional information from these agencies on this major difference of opinion revealed in the development of the SDEIS.	Proposed Action. It is also appropriate for the reporting of effects to reflect specific evaluation criteria based on the applicable water quality standard. CEQ guidance identifies that whether an action threatens to violate a federal, state, or local law or requirements imposed for the protection of the environment is an appropriate intensity factor for evaluating significance. The SDEIS also discloses where any given evaluation criterion differs from the water quality standards, which is necessary for some constituents because a specific standard has not been formulated. Regarding assessing effects on the Partridge River, relevant cumulative effect water evaluation criteria are described in SDEIS Section 6.2.3.3.4.	cumulative effects for the Partridge River.
18	Loss of "High Biodiversity Significance Values" sites	Fond du Lac, GLIFWC, and Grand Portage believe that native plant communities identified by the Minnesota Biological Survey will be impacted by the proposed mine site and related transportation and utility corridor without appropriate mitigation for their landscape-scale and ecosystem values. There are two MBS sites of high biodiversity significance (18.8 acres) located within the transportation and utility corridor, including the 100 mile swamp and the upper Partridge River. They state that forty-one percent of the mine site consists of imperiled/vulnerable communities, but there is no proposed	The Co-lead Agencies believe that the SDEIS appropriately discloses potential effects (loss) to high biodiversity significant sites as listed in the Minnesota Biological Survey characterization data. There is no policy or requirement to mitigate effects on MBS Sites of High Biodiversity Significance for those attributes. SDEIS Section 4.2.4 discloses these MBS sites. Sections 3.2.2 and 5.2.4 also describe mine reclamation that would be completed as part of the NorthMet Project Proposed Action, some of which may allow such MBS sites to re-	Based on consideration of comments received on the SDEIS, the Co-lead Agencies have clarified information regarding sites of biodiversity significance in the FEIS and believe that the FEIS appropriately discloses potential effects (loss) to high biodiversity significant sites as listed in the Minnesota Biological Survey characterization data. In addition, FEIS Sections 4.2.4 and 4.3.4 discuss and provide maps of the MBS Sites (Figures 4.2.4-1, 4.2.4-2, 4.2.4-5, 4.3.4-1, and 4.3.4-2) to provide clarity on locations and extent. WCA rules

MDO #	Specific Major Difference of Opinion Area	Tribal Position Summary	Co-lead Agency Response SDEIS	Co-lead Agency Response FEIS
		mitigation. Fond du Lac and Grand Portage's opinion is that there will be a net loss to the federal estate of these MBS communities that would not be compensated with equivalent MBS land exchange parcels gained through the USFS land exchange. Appendix C provides additional information from these agencies on this major difference of opinion revealed in the development of the SDEIS.	establish.	(including those parts applicable to mining projects under *Minnesota Rules* 8420.0930) include a special consideration for wetlands that are rare natural communities (*Minnesota Rules* 8420.0515, subp 3). There is no state or federal policy or requirement to mitigate effects on MBS Sites of High Biodiversity Significance that are not wetlands. However, FEIS Sections 3.2.2 and 5.2.4 describe mine reclamation activities that would be completed as part of the NorthMet Project Proposed Action, some of which may allow such MBS sites to re-establish. The Permit to Mine would address special consideration of wetlands that include rare natural communities. Additional information on rare natural communities would be included in the wetland permit application as part of the Permit to Mine process for further refinement of site-specific conditions.

137

138

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8.4 TRIBAL AGENCY APPENDIX – SUPPORTING INFORMATION FOR TRIBAL COMMENTS

Although not required by NEPA and MEPA, the Co-lead Agencies committed to providing an appendix in the SDEIS that contained the Tribal Cooperating Agencies' comments and supporting documentation representing MDOs. The Co-lead Agencies have engaged the Tribal Cooperating Agencies extensively on these issues in preparation of the SDEIS and FEIS, and examined the information provided in the appendix in support of Tribal Cooperating Agency comments submitted on the SDEIS. Response to the Tribal Cooperating Agency comments on the SDEIS is provided in Appendix A.

See Appendix C for comments and supporting documentation from the Bois Forte, Grand Portage, Fond du Lac, GLIFWC, and the 1854 Treaty Authority. These take the form of eight position papers and a Co-lead Agencies' PSDEIS comment disposition spreadsheet for the Tribal Cooperating Agencies. The Tribal Cooperating Agency submittals in Appendix C are provided verbatim and in identical form as they were for the SDEIS. They were considered in the development of the FEIS.

Issue areas provided in Appendix C include:

- Hydrology Section;
- Mercury Section;
- Wild Rice Section;
- Underground Mine and West Pit Backfill Alternatives Section;
- Wetlands Section;
- Cumulative Effects Analysis Section;
- Proposed Transport of Ore Section;
- Perpetual Maintenance and Water Treatment at the NorthMet Project Section; and
- Tribal Responses to Co-lead Agencies' Disposition of Tribal PSDEIS Comments.

164 -Page Intentionally Left Blank-

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2

LIST OF REFERENCES

GENERAL INFORMATION

The Reference Section follows the general Chicago Manual of Style Guidelines, in that the following information is included in each citation, where possible, and in this order:

1. Author Last Name, First Name [followed by second author First Name Last Name, and third author First Name Last Name, etc., if applicable].
2. Year of Publication.
3. *Title of Document*.
4. Publication Information.

For Example:

- Smith, David. 2013. *Updated Formatting Guide for NorthMet Reference List*. St. Paul, MN: The Best Printing Press.
- Smith, David and Mark Jones. 2012. *Basic Formatting for NorthMet Master Reference List*. References Today, 4(31), 50-62. April 1, 2012.
- Smith, David, Mark Jones, and John Doe. 2011. *Guidelines for Creating Consistency in Formatting*. Accessed: September 22, 2013. Retrieved from: http://www.allaboutnorthmetrefs.com

The intext citations help the reader locate the full reference information in the Master Reference List. There are unique intext citations for each reference, and they include the following information:

1. First author last name and second author last name, if applicable (first author last name followed by et al. for three or more authors)
2. Year of publication

For Example:

- (Smith 2013)
- (Smith and Jones 2012)
- (Smith et al. 2011)

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Appendix A

Response to Comments on the NorthMet Mining Project and Land Exchange Draft and Supplemental Draft EIS

A.0 RESPONSE TO COMMENTS ON THE NORTHMET MINING PROJECT AND LAND EXCHANGE DRAFT AND SUPPLEMENTAL DRAFT EIS

A.1 INTRODUCTION

The Supplemental Draft Environmental Impact Statement (SDEIS) for the NorthMet Mining Project and Land Exchange was published on December 13, 2013. A 90-day public comment period followed publication of the SDEIS, extending from December 14, 2014, to March 13, 2014. This Appendix summarizes the process used by the Co-lead Agencies' Final EIS (FEIS) to organize, analyze, and respond to the comments received on the SDEIS, and includes the responses to those comments. This Appendix also includes the comment themes received on the 2009 Draft EIS (DEIS) and shows the relationship between those DEIS comment themes and the SDEIS comments themes and responses.

A.1.1 Opportunities for Public Comment on the Supplemental Draft EIS

The SDEIS was made available to the public for download on MDNR's Project-specific website, http://www.dnr.state.mn.us/input/environmentalreview/polymet/index.html. Paper copies of the SDEIS were also sent to Cooperating Agencies and other entities that requested them, as described in FEIS Section 2.3.4. Public review copies of the SDEIS were also placed in libraries in Minnesota: St. Paul, Grand Rapids, Hibbing, Hoyt Lakes, Babbitt, Duluth, and Minneapolis. A limited number of paper copies and CD-ROMs were distributed upon request to MDNR.

As discussed in the FEIS Section 2.3.5, three public meetings were held during the public comment period:

- January 16, 2014, at the Duluth Entertainment Convention Center;
- January 22, 2014, at Mesabi East High School in Aurora, MN; and
- January 28, 2014, at the Saint Paul River Center.

Attendees were provided three options to submit public comments at these meetings:

- Public oral testimony, transcribed by a court reporter;
- Individual oral testimony, also transcribed by a court reporter; and/or
- Written comments, placed in designated collection boxes.

In addition to the testimony and comments received at the public meetings, commenters were instructed to submit comments via a Project-specific email address or via mail.

A.1.2 Amount and Type of Input Received

In total, the Co-lead Agencies received 57,872 e-mails, written and typed letters, postcards, and instances of public testimony (henceforth referred to as *submissions*) during the public comment period for the SDEIS. Senders included federal, state, and local representatives; members of the public; federal, and state government agencies; American Indian tribes; non-governmental organizations (NGOs); and other interested groups and stakeholders. Table A-1 summarizes the number and type of submissions received. Copies of these submissions are available in Attachment 1.

Table A-1 Number and Type of Public Comment Submissions on the SDEIS

Submission Type	Definition	Number	Percent of Total
All Submissions		57,871	100%
Form Letters	Identical or substantively identical submissions	53,906	93%
Form Letter Variants	Standard form letter text that was altered by the sender by deleting standard text and/or by adding sender-composed text	3,469	6%
Form Letter Non-Variants	Standard form letter text was not substantively altered.	50,437	87%
Unique Submissions	Submissions composed entirely by the sender.	3,965	7%
Comments	Unique, substantive comments extracted from within the submissions		16,498

Of the 57,871 total submissions, 53,906 submissions (93 percent of the total) were duplicate *form letters* sponsored by outside entities (NGOs, unions, and other groups). A total of 43 distinct form letters were received from 14 outside entities, in addition to 6 form letters whose source could not be determined. Form letters were identified when two or more unrelated individuals submitted identical or substantively identical submissions, or when a submission was determined to consist entirely (or nearly so) of text provided by a website (such as a website maintained by an NGO) for the purpose of mass e-mailing.

Within the 53,906 form letter submissions were 3,469 form letter *variants,* submissions that consist of standard form letter text that was altered by the sender by deleting standard text and/or by adding sender-composed text (the remaining 50,437 form letters are referred to as *non-variant*). Variants were identified through use of a computer algorithm that evaluated the similarity of a submission against the known form letter "template." The algorithm's results were confirmed through a manual review of a statistically significant sample of submissions.

The 3,965 submissions (7 percent of the total) not identified as form letters were *unique* submissions composed entirely by the sender (including oral testimony at public meetings).

The 57,871 submissions, including both form letters and unique submissions, contained 16,498 unique, substantive comments. However, not all unique submissions contained substantive comments. For example, many only stated an opinion as to whether the proposed Project should or should not be built, with minimal or no additional content. A *comment* is defined as an individual statement, question, or concern within a submission that substantively addresses the proposed Project and that contains more than just a statement of approval or disapproval of the Project. Comments were extracted from all unique and variant submissions. One copy of each standard form letter was also reviewed for the purpose of extracting comments. Each unique, substantive comment received on the SDEIS is provided in Attachment 1.

Previously published materials, such as newspaper or journal articles, website content, or submissions provided during previous phases of the EIS process were not reviewed for comments, but were retained for reference by the Co-lead Agencies. In cases where the same comment appeared more than once in a submission, only one instance was recorded.

A.2 COMMENT REVIEW METHODOLOGY

Under the Minnesota Environmental Protection Act (MEPA) (*Minnesota Rules 4410.2600 Subpart 10)* and National Environmental Policy Act (NEPA) (40 CFR 1503.4), the Co-lead Agencies considered and responded to all substantive comments received during the SDEIS public comment period. Given the large number of submissions and individual comments received on the SDEIS, the Co-lead Agencies determined that the comment analysis process would be more effective by grouping similar comments into broad *themes* and responding to those themes, instead of responding to each comment individually.

Initially, the text of all submissions was entered into a database to facilitate the review. Non-variant form letters were identified via computer matching algorithm. Each unique and variant submission was reviewed in order to identify substantive comments.

Each comment was categorized according to the overall topic area, or *issue*, addressed in the comment. Issues are listed in Table A-2 and generally correspond to the resource areas addressed in Chapters 4, 5, and 6. Issue codes were used for ease of comment management. A total of 23 issue areas were identified. In many cases, a comment was categorized as applicable to more than one issue. Submissions and issue assignments were each reviewed by at least two separate individuals to ensure accuracy. The unique, substantive SDEIS comments and their associated theme linkages are provided in Attachment 1.

Table A-2 Issue Codes for Public Comments on the SDEIS

Issue	Issue Code	Description (Comments related to…)
Air Quality	AIR	The Project's impacts on local and regional air quality and visibility.
Alternatives	ALT	Alternatives to the proposed Project that meet the Purpose and Need, such as underground mining, as well as the No Action Alternative.
Aquatic Species	AQ	The Project's effects on aquatic species.
US Army Corps of Engineers 404 Permit	COE	The USACE permit issued under Section 404 of the Clean Water Act.
Cultural Resources	CR	The Project's impacts on historic and cultural resources, including Tribal resources, as well as the process for interacting with the Bands and other Tribal entities.
Financial Assurance	FIN	The Co-lead Agencies' approach to, and/or the proponent's ability to provide sufficient financial assurance for potential impacts of the Project.
General Topics	GEN	General statements regarding the Project that are substantive (i.e., that express more than simple approval or disapproval), but that are too general to belong in other issue areas.
Geotechnical Stability	GT	The geotechnical stability of the stockpiles, mine pit, and other elements of the NorthMet Project Proposed Action.
Hazardous Materials	HAZ	Hazardous materials used, generated, transported, and/or disposed of as part of the NorthMet Project Proposed Action.
Human Health and Safety	HU	The Project's effects on human health and safety.
US Forest Service Land	LAN	The nature, extent, and/or appropriateness of, and/or the process for

Issue	Issue Code	Description (Comments related to…)
Exchange		defining the Land Exchange Proposed Action
Land Use, Recreation, and Visual Resources	LU	The Project's effects on private land use, recreational resources and activities, and visual resources (except for regional visibility issues addressed in AIR).
Mercury	MERC	The generation, removal, management, and consequences of Mercury from the NorthMet Project Proposed Action.
Noise and Vibration	N	The nature, extent, and impacts of noise and vibration generated by the NorthMet Project Proposed Action
NEPA and MEPA Topics	NEPA	Purpose and Need statements, the public engagement process, and the SDEIS's adherence to NEPA and MEPA requirements, guidelines, and principles.
Project Description	PD	The description of the NorthMet Project Proposed Action and/or Land Exchange Proposed Action, including omissions, errors, and suggested revisions.
Permitting and Regulatory Considerations	PER	The type and appropriateness of permits to be issued by the Co-lead Agencies (except for the USACE 404 Permit), as well as the relationship of the Project and SDEIS process to existing regulations.
Socioeconomics and Environmental Justice	SO	The Project's impacts on economic factors (such as employment, income, public tax revenues), as well as public services, housing, and the SDEIS's evaluation of Environmental Justice considerations under Executive Order 12898.
Vegetation	VEG	The Project's impacts on vegetation, including threatened and endangered species.
Wetlands	WET	The Project's impacts on wetlands (except for comments related to the USACE 404 Permit).
Terrestrial Wildlife	WI	The Project's impacts on terrestrial wildlife, including threatened and endangered species.
Wilderness and Special Designation Areas	WILD	The Project's impacts on the Boundary Waters Canoe Area Wilderness (BWCAW), national, state, and local parks, portions of Superior National Forest designated for environmental conservation, and other special-designated areas.
Water Resources	WR	The Project's impacts on water quality, water quantity, and the modeling of water resources conditions and effects.

Some comments that did not fall within one of the issue areas listed in Table A-2 were tracked to ensure that they received consideration by the Co-lead Agencies. These include the categories listed below (issue codes are listed in parentheses):

- Suggestions for editorial changes (EDIT), such as grammar, punctuation, or word choice, or suggested text revisions (as long as those suggested revisions did not constitute a change in the intent of the FEIS's findings or conclusions).
- Requests for information (RFI), such as requests for CD-ROM copies of the SDEIS.
- Suggestions that the Co-lead Agencies review specific publications or other references (REF).

The comment evaluation process used a thematic response approach. Subject matter experts from the Co-lead Agencies and their consultants reviewed and grouped comments within each issue area according to the common topic they addressed; each topic area is referred to as a *theme*.

Each of the 23 issue areas includes multiple themes in order to characterize the specific topics addressed by comments. Each comment was assigned to at least one theme. In cases where a comment addressed more than one theme, it was either assigned to the most appropriate theme or, in some cases, was assigned concurrently to multiple themes. A total of 580 themes were identified. For ease of sorting, each theme was given a code corresponding to its issue; for example, the third theme in the Financial Assurance issue is referred to as FIN 03.

For each theme, the Co-lead Agencies developed a concise statement that paraphrased and/or summarized the intent of each group of similar comments. Subject matter experts developed a *thematic response* for each theme statement. The response briefly describes how the theme is addressed in the FEIS. Where applicable, the actual text of the FEIS should be referenced for a more complete response to comments. Theme statements and responses are provided in Section A.4.

Comments characterized as REF were passed along to FEIS authors, while RFI were passed along to Co-lead Agency representatives. Editorial (EDIT) comments received direct responses. Comments from Cooperating Agencies were assigned to issues and themes as described above, but also received direct responses (see Section A.3).

A.3 COMMENTS RECEIVED AFTER END OF PUBLIC COMMENT PERIOD

The public comment period on the SDEIS closed on March 13, 2014. Comments received after this date were retained and were provided to FEIS authors for their review; however, these comments are not included in the theme statements and responses in Section A.4, nor in the list of individual comments in Section A.6.

A.4 COOPERATING AGENCY COMMENTS AND RESPONSES

Cooperating Agencies provided seven submissions, within which 465 discrete comments were identified. Table A-3 lists each of these comments, the response to each comment, and the theme(s) to which each Cooperating Agency comment was assigned.

Table A-3 Cooperating Agency Comments and Responses

Comment ID	Comment	Response	Theme(s)
Comments from the USEPA (Submission ID 47834)			
2981	Comment # 1. Spill prevention is an important part of the mitigation for this project. Using new or retrofit side dump rail cars (possibly with hydraulic air-operation conversions) should be considered as part of the mitigation package for the proposed action. Proactive mitigation through the use of updated rail infrastructure would help reduce spillage and subsequent environmental concerns, possibly including the need for additional long-term water treatment. Recommendation: Consider use of new or retrofit side-dump rail cars when producing the spilled ore plan.	To guard against possible adverse effects from spilled ore, PolyMet plans to refurbish the ore cars, tightening or replacing the couplings and linkages to minimize gaps along the hinges and joint areas where spillage would occur. The quantity of ore that could potentially spill through the door and hinge gaps of a refurbished ore car is estimated to be 0.20 ton per year. This is a 97% reduction from the originally calculated value of 6.14 tons per year. Water quality monitoring is recommended downstream from the rail line on the Partridge River tributary streams to check for any potential deteriorations of water quality over time from ore spillage, and, if detected, adaptive water management measures would be implemented. Dust could be mitigated by spraying water on the loaded ore prior to transport. If significant accumulation of ore spillage occurs, it would be removed. The Permit to Mine would further address rail cars design in a section titled Ore Management, Handling and Transport. The Permit to Mine (PTM) would address detail design of rail cars (this topic/consideration) in a section titled Ore Management, Handling and Transport.	WR 151
2982	Comment # 2. Pages 5-50 forward describe how the company has classified its waste rock and tailings into four categories based on their likelihood to generate acid rock drainage. We understand from discussion with the co-lead agencies that lime will be added to Category l waste rock, which is expected to result in neutral to slightly basic pH. Recommendation: The FEIS should indicate that Category I waste rock leachate is expected to have a neutral to slightly basic pH due to the addition of lime.	Mine waste rock would be sorted and stored into four categories based on its potential to contaminate water. Category 1 waste rock would have a low potential and Category 4 waste rock would have a high potential. Category 1 waste rock would be stored in a permanent stockpile that would be encompassed by a water containment system to capture surface and groundwater from the stockpile and direct it to a water treatment facility and would have a geomembrane cover at closure. Because Category 1 waste rock has a low potential to generate acid, and because water from the stockpile would be captured and treated, lime is not anticipated to be needed for neutralization, and, therefore, the addition of lime for Category 1 waste rock is not proposed. Category 2/3 and Category 4 waste rock would be stored temporarily in lined stockpiles, and then backfilled into the East Pit following completion of mining there. Lime may be added to the waste rock during East Pit backfilling to maintain pH in the pit pore water as needed. The volume of lime required would be based on monitoring results. Waste rock characterization and categorization, as well as	WR 027

Comment ID	Comment	Response	Theme(s)
		management and storage during operations and closure, and water management at the stockpiles, are addressed in FEIS Sections 3.2.2.1.7, 3.2.2.1.8, 3.2.2.1.9, and 3.2.2.1.10.	
2983	Comment # 3. Page 5-157, Section 5.2.2.3.3, 2nd Paragraph: information on the design, operations, and monitoring plans for the hydrometallurgical research facility (HRF) is insufficiently detailed. Recommendation: The FEIS should provide information on the HRF's design and operations in sufficient detail for the reader to understand potential impacts associated with this facility and how those impacts will be avoided or mitigated. This includes explaining that a detailed Residue Management Plan for this facility will be required during permitting.	FEIS Section 5.2.14.2.3, which expands upon the discussion from the SDEIS on the design and construction of the Hydrometallurgical Residue Facility, and Geotechnical Data Package Volume 2 (PolyMet 2014c as cited in the FEIS), indicate that the design would meet appropriate factors of safety. The Hydrometallurgical Residue Facility would be constructed over the LTVSMC emergency basin. During operations, the double liner system for the Hydrometallurgical Residue Facility would minimize release of residue leachate, and any collected leakage through the primary liner would be collected in the leakage collection and recovery system (LCRS) and pumped back to the Hydrometallurgical Residue Facility pond. During reclamation and closure and long-term maintenance, any leakage would be routed and cycled through the WWTP. The Hydrometallurgical Residue Facility would be double-lined at the bottom to facilitate collection of water that has contacted the hydrometallurgical residue. More specifically, the double liner would consist of a composite liner system that utilizes a geomembrane liner above a geosynthetic clay liner with a second liner placed above the first, separated by a LCRS, substantially reducing hydraulic head from the lower liner. This design is intended to mitigate leakage from the Hydrometallurgical Residue Facility to groundwater resources. The collection system capture rate was calculated and included in Section 5.2.2.5.4 of Geotechnical Data Package Volume 2 (PolyMet 2014c as cited in the FEIS). The Residue Management Plan (PolyMet 2014r, as cited in the FEIS) includes a description of the operating plans, monitoring procedures, and adaptive management approaches for the Hydrometallurgical Residue Facility. Information on the design of the Hydrometallurgical Residue Facility is in FEIS Section 3.2.2.3.10. The FEIS includes available details from Mine Site Water Management Plan (PolyMet 2015r as cited in the FEIS), which is updated from the version used in the SDEIS. The management plan details proposed operational plans, monitoring activities, annual reporting requirements, and plans for reclamation and closure and long-term maintenance for the Hydrometallurgical Residue Facility. Details would be finalized in permitting and be subject to periodic reassessment.	PD 17 WR 066

Comment ID	Comment	Response	Theme(s)
2984	Comment # 4. Page 4-336 discusses the possibility of inundating an existing coal ash landfill located within the proposed tailings basin. Based on current knowledge of leachate concentrations found in groundwater at such landfills, inundation may lead to future water quality impacts. Recommendation: The FEIS should discuss how constituents found in the coal ash landfill may impact water quality in the Embarrass River, how this landfill will be protectively managed, and how any impacts will be mitigated.	The coal ash landfill (landfill) is located on the east side of the former LTVSMC Tailings Basin Cell 1E in approximately the northeast quarter. The landfill was operated by LTVSMC to accept coal ash from LTVSMC's Taconite Harbor facility, and coal contaminated soil from the LTVSMC abandoned coal yard. The landfill was closed per the "Closure Plan for the Tailings Basin Coal Ash Disposal Area." The final footprint of the landfill (AOC 36) is estimated to cover approximately 4 acres and contain approximately 260,000 cubic yards total of material (including coal ash, tailings, and soil covers). As the current footprint of the landfill lies within the future footprint of an area to be inundated by placement of NorthMet Project flotation tailings, the plan is to relocate the contents of the landfill to the future NorthMet Hydrometallurgical Residue Facility, which has a design capacity of 6,170,000 cubic yards, and would be a double-lined storage facility. The double liner would consist of a composite liner system utilizing a geomembrane liner above a geosynthetic clay liner, with a second liner placed above the first, separated by a leakage collection system. This would substantially remove hydraulic head from the lower liner and thereby virtually eliminate leakage to groundwater from the Hydrometallurgical Residue Facility. Leakage that is collected would be pumped back to the Hydrometallurgical Residue Facility pond, which is collected and pumped back for use at the Hydrometallurgical Plant. This facility is currently planned to be constructed and in use prior to the time period at which the landfill would be inundated with NorthMet flotation tailings (mine year 7).	WR 028
2985	Comment # 5. CWA requirements for antidegradation ("nondegradation" in Minnesota's terminology) help ensure that a proposed project will not result in a loss of existing uses of surface waters, and preclude reduced water quality unless the State determines it is necessary to accommodate important social and economic development (see 40 CFR 131.12). This review must occur before project activity that may result in a new or increased discharge commences, and should not be deferred until NPDES permitting. EPA understands from discussion with MPCA that much, if not all, of the information needed for an antidegradation review is already contained in the SDEIS.	*Minnesota Rules* 7050.0180 describes the nondegradation rules applicable to discharges to Outstanding Resource Value Waters (ORWV) and waters upstream of ORVWs. The NorthMet Project Proposed Action would not discharge to listed ORVWs, nor would there be any deterioration of water quality in Lake Superior, the nearest ORVW downstream of the proposed NorthMet Project area. Thus, the requirements of this rule are not applicable. *Minnesota Rules* 7080.0185 describes the nondegradation requirements applicable to discharges to all waters of the state. As part of the permitting process for the project, the MPCA would determine whether additional control measures are required to minimize the impact of the project on downstream waters while considering the factors identified in the rule. *Minnesota Rules* 7052.0300 describes the nondegradation requirements applicable to waters in the Lake Superior basin for bioaccumulative chemicals of concern (BCCs) and bioaccumulative substances of immediate concern (BSICs) of which mercury is the only one	PER 09 WR 109

Comment ID	Comment	Response	Theme(s)
	Recommendation: The FEIS should include an evaluation of which of Minnesota's nondegradation rules (7050.0180, 7050.0185, 7052.0300) apply to this project, and explain how the project complies with the applicable nondegradation rules	applicable to the NorthMet Project Proposed Action. As part of the permitting process, the MPCA would apply these requirements to mercury discharges as appropriate.	
2986	Comment # 6. The proposed project provides significant overall environmental improvements over the proposal in the DEIS through installation of seepage containment and other controls at the former LTV tailings basin. However, the SDEIS modeling predicts increases in aluminum (Al) and lead (Pb) in surface waters affected by the proposed project- including exceedances of evaluation criteria for Al and Pb at locations on four tributaries to the Embarrass River (p. 5-7 to 5-8). These predicted increases are based on a number of assumptions, including the contribution from remediation of the former LTV tailings basin. The SDEIS modeling also predicts other increases and exceedances of evaluation criteria based on the "Continuation of Existing Conditions" scenario. EPA understands that monitoring of receiving waters downgradient of the existing tailings basin is being carried out now. This monitoring data will be an important source of information to consider along with modeling results. Recommendation: Available monitoring data should be used to inform NPDES permitting. Monitoring should continue throughout the life of the project to inform permitting, adaptive management, and additional measures to prevent or mitigate impacts to aquatic life as necessary.	Monitoring would be a critical component of the NorthMet Project Proposed Action to better understand impacts and to inform facility operation and maintenance and the selection and implementation of possible adaptive or contingency mitigation measures. Overviews of the water monitoring plans at the Mine Site and Plant Site, with PolyMet proposed monitoring locations and frequencies, are presented in the FEIS. The specifics of monitoring—including specific locations, frequencies, and parameters—would be finalized during the permitting process after a detailed evaluation. An NPDES permit would be required for any point source water discharge that adds pollutants to waters of the United States.	AQ 12 AQ 30 WR 139
2987	Comment # 7. The SDEIS anticipates that pollutants will be discharged from mine site features, travel via groundwater pathways and reach the Partridge River several years following the start of the mining project. See SDEIS Table	It is acknowledged that while there could be groundwater discharge to jurisdictional wetlands along a flowpath, this process is not incorporated into the GoldSim model because it is considered speculative and quantitatively uncertain. The EIS considers that permitting for the NorthMet Project Proposed Action, if approved, would require monitoring	PER 05

Comment ID	Comment	Response	Theme(s)
	5.2.2-26. However, as EPA has stated previously, the pollutants originating from mine site features may discharge to jurisdictional wetlands and tributaries prior to reaching the Partridge River. CWA Section 301 prohibits any point source discharge of pollutants to waters of the United States, either directly or via directly connected groundwater, unless the discharge complies with a NPDES permit. Waters of the United States include jurisdictional wetlands and tributaries. See 40 CFR 122.2. Recommendation: The FEIS should reflect the fact that a NPDES permit is required before the pollutants from the mine site reach waters of the U.S. (including jurisdictional wetlands and tributaries). Statements in the SDEIS about when discharges will reach waters of the U.S. should be revised, and these changes should be reflected in the FEIS.	that would likely include water levels and water quality in groundwater and potentially affected waters of the U.S., including wetlands and tributaries. The goal of this monitoring is to anticipate or predict the potential for an NPDES discharge so that the NPDES discharge can either be eliminated, or alternatively permitted with NPDES permit coverage prior to its occurrence. See FEIS Section 5.2.2.3.6 for more information on groundwater and wetland monitoring and possible future mitigations. The FEIS states that an NPDES permit would be required for any point source water discharge that adds pollutants to waters of the U.S. The Final EIS correctly identifies the waters of the U.S.	
2988	Comment # 8. The Tribal Cooperating Agencies Cumulative Effects Analysis (September 2013) included in Appendix C of the SDEIS states: "PSDEIS Table 4.2.2-18 reports Colby Lake as currently having an observed mean for Arsenic of 0.78 to 1.4 ug/L (depending on the data set), whereas Figure 5.2.2-35, the No-Action (continuation of current conditions)" P50 model for Colby Lake Arsenic shows annual maximum values of 0.5 ug/L." In addition, the SDEIS shows Colby Lake's current mean arsenic concentration as 0.78-1.4 ug/L on Table 4.2.2-18, with a range of 0.25-2.3 ug/L, while the modeled P90 maximum value in Figure 5.2.2-35 lists the maximum concentration of arsenic in Colby Lake as 0.70 ug/L. Comparing the modeled mean for arsenic in Colby Lake to existing site-specific data in the SDEIS, the model outputs underestimate arsenic concentrations by up to 100%. Colby Lake is currently modeled as a continuation of the	The Mine Site GoldSim model used for the SDEIS was modified for the FEIS (PolyMet 2015m) to include a new chemical loading source in Colby Lake and was calibrated to the measured chemical concentrations in the lake. This calibration considered new surface water chemistry data collected through the end of 2013. The same chemical loading source was applied to both the Continuation of Existing Conditions model and Proposed Action model (PolyMet 2015m). The chemical loading source was constant and did not exhibit seasonal or long-term variations for future conditions. Incorporation of the loading source addressed the issue by providing predicted chemical concentrations in Colby Lake for existing conditions that are similar to currently measured concentrations. The average arsenic concentration based on 33 samples in Colby Lake is 0.95 µg/L. The GoldSim Continuation of Existing Conditions modeling scenario predicts an average concentration of 0.80 µg/L at P50 over the 200 year modeling period.	WR 046

Comment ID	Comment	Response	Theme(s)
	Partridge River because there is insufficient data to model it as a lake, which may be causing this discrepancy. We understand that monitoring is ongoing, which may provide additional information on observed arsenic concentrations. Recommendation: The FEIS should document an analysis is that addresses this discrepancy between existing conditions in Colby Lake and modeling results, taking into account all necessary data. The FEIS should include any follow-up actions that will be necessary based on this analysis.		
2989	Comment # 9. Modeling using MODFLOW assumes no seepage through the berm on the east side of the tailings basin. The co-lead agencies have agreed to reexamine this assumption. MODFLOW outputs are used as an input to the GoldSim model, so changes to these outputs may require updated GoldSim modeling as well. Recommendation: Recalibrate MODFLOW as necessary to reflect seepage on the east side of the tailings basin, and update GoldSim modeling as necessary. The FEIS should explain how this comment was addressed.	The Plant Site MODFLOW and GoldSim water quality models were updated to incorporate the east side of the Tailings Basin to reflect a surficial material layer at this site. The FEIS also addresses inclusion of a new containment system at this site in Section 5.2.2.	WR 054 WR 102
2990	Comment #10. Modeling of water quality parameters is subject to inherent uncertainties that call for ongoing evaluation. For example, acid rock drainage (ARD) in cold, wet climates raises uncertainty due to climatic factors including distinct freeze-thaw cycles, varying contributions from rain and snow, and a period of significant melting during the spring thaw. Recommendation: The permit to mine should require water quality modeling throughout the life of the mine, assuring that the model uses input from actual monitoring discharge data as it becomes available, so this information can be used to support adaptive management. The model should accommodate specific climatic factors	The NPDES/SDS permit and MDNR Permit to Mine would require a periodic 'model verification analysis' for as long as is necessary (during both operation and closure) to compare actual monitoring data against model assumptions, inputs and predictions generated during the EIS process. This analysis can then be used to support adaptive mitigation as appropriate. The details of the analysis procedures and methods would be developed during permitting but are likely to utilize on-site 'internal' performance data and groundwater data in addition to discharge monitoring data.	WR 130 WR 139

Comment ID	Comment	Response	Theme(s)
	associated with the site.		
2991	Comment #11. MDNR has collected new Partridge River flow data that vary from the base flow calculations used for modeling in the SDEIS. The co-lead agencies have explained that the model accounts for this discrepancy, which is correlated with pit dewatering from the upstream Peter Mitchell Pit, a factor that was not present during the time period used for continuous flow data in the SDEIS (1978-1987), Details are provided in a technical memorandum from the colead agencies. While the flow data used in the S DEIS was appropriate, low-flow conditions may not represent the most conservative conditions, though they are conservative in that they assume less dilution of contaminants. However, dilution is the only variable considered. High-flow conditions, while increasing dilution, may mobilize contaminants to a greater extent than expected under low-flow conditions. Recommendation: The FEIS should evaluate how base flow affects variables other than dilution, taking into account high-flow as well as low-flow scenarios.	The FEIS reports a formal sensitivity analysis of groundwater baseflow for the Partridge River. The analysis used the FEIS Mine Site GoldSim model (PolyMet 2015m) with groundwater baseflows at all locations on the Partridge River artificially increased by a factor of 4 (e.g., from 0.5 to 2 cfs at SW-003 and 5.3 to 21 cfs at SW-006). Other hydrologic parameters affected under the sensitivity analysis include aquifer recharge values and hydraulic conductivities of surficial deposits. Both of these increased by a factor of 3 to 4 as a function of recalibrating the Mine Site MODFLOW model to measured groundwater heads and the higher groundwater baseflows. The higher values of groundwater baseflow, aquifer recharge, and hydraulic conductivity of surficial deposits were input into the Mine Site GoldSim model (PolyMet 2014v, as cited in the FEIS). In a separate but related analysis using the GoldSim existing conditions model, surface runoff concentrations were also recalibrated to new values based on higher groundwater baseflows and these were also incorporated into the GoldSim Mine Site model to create the “high groundwater baseflow scenario.” This scenario accounted for all GoldSim parameters that would be directly or indirectly affected by considering higher groundwater baseflows in the Partridge River, not just the dilution effect. Results of the GoldSim high groundwater baseflow scenario were compared with the best-estimate scenario to evaluate the degree to which predicted Proposed Action impacts are sensitive to groundwater baseflow and related inputs. The sensitivity GoldSim run indicated that groundwater and surface water concentrations did not change appreciably when higher groundwater baseflow (and associated input parameters) were modeled for the Mine Site (i.e., water quality impacts were not sensitive to groundwater baseflow). The only substantive changes in GoldSim results were: 1) migration velocities in the surficial groundwater flowpaths increased by approximately a factor of 3-4; 2) groundwater travel times to Evaluation Locations and the Partridge River were reduced by approximately a factor of 3-4; 3) peak groundwater concentrations increased for some constituents at some locations; and 4) mine pit groundwater inflow rates increased nominally. However, there were no exceedances of water quality impact criteria at the groundwater Evaluation Locations and no exceedances of new constituents at the surface water Evaluation Locations. The frequency of exceedances for sulfate in the Partridge River did not increase significantly relative to the best-estimate GoldSim analysis. The interpretation of these results is that the increased chemical loadings at	WR 091 WR 165

Comment ID	Comment	Response	Theme(s)
		the upgradient end of the flowpaths (due to higher groundwater flow rates) are offset by: 1) increased dilution from aquifer recharge water along the flowpath; and 2) increased dilution in the river from higher groundwater baseflows during winter low-flow conditions. In other words, for low (i.e., winter) streamflow conditions, the higher chemical mass loading into the river was offset by dilution associated with the higher river groundwater baseflows. In regard to chemical concentrations and regulatory criteria, it is reasonable to conclude from the results of the sensitivity analysis that the Mine Site GoldSim model is relatively insensitive to the Partridge River groundwater baseflow variable. By analogy, the Plant Site GoldSim model is also considered insensitive to groundwater baseflows in the Embarrass River (PolyMet 2015j, as cited in the FEIS). The FEIS reports the results of the Partridge River groundwater baseflow sensitivity analysis in Section 5.2.2.3.2.	
2992	Comment # 12. There is insufficient detail to explain why "outlier" data were excluded from consideration in the GoldSim model. Recommendation: The FEIS should provide a specific justification to support excluding any such data from modeling.	Various data sufficiency documents within the FEIS record support decisions related to the exclusion or inclusion of data. The primary data sufficiency document for the FEIS is titled, "Technical Memorandum: Ongoing Groundwater and Surface Water Data Collection for NorthMet Water Quality Modeling Version 1" (Barr 2014d, as cited in the FEIS).. The FEIS does not provide specific justification to include or exclude data from modeling because the FEIS is focused on evaluating effects to the human and natural environment, alternatives, and mitigation. .	WR 072
2993	Comment # 13. Page 5-61: the SDEIS shows that tailings leachate pH increases after 300 weeks, but does not show how leachate pH was extrapolated to the longer term, such as 50-100 years. We understand this data is already available. Recommendation: The FEIS should show how leachate pH was extrapolated to the longer term, such as 50-100 years, through a graph or chart.	The pH in leachate from the various mining features was not predicted by the GoldSim model. However, the permanent subaerial waste facilities (e.g., Category 1 Stockpile and Tailings Basin) would contain material that testing results indicate would not produce acidic leachate. The nonacid generating waste was identified using multi-year kinetic tests (humidity cells) on NorthMet Project Proposed Action rock samples.,. The long-term humidity cell tests on NorthMet waste rock consist of 42 samples of Category 1 waste rock, with tests that have run for over 450 weeks; and 33 LTVSMC tailings humidity cell tests run between 84 and 304 weeks. This information is presented in Section 4.3 and Attachment E, respectively, of PolyMet 2015q, as cited in the FEIS. These tests demonstrate that tailings and Category 1 waste rock do not generate acidic leachate, and acid generation rates decreases by depletion of sulfide S minerals. Regarding the tailings in particular, the pH in the flotation tailings humidity	WR 001

Comment ID	Comment	Response	Theme(s)
		cells have been observed to be stable or increasing between 100 and 300 weeks of humidity cell testing. However, pH of the flotation tailings in the GoldSim model is not directly based on, or extrapolated from, the observed pH in the humidity cells. This is because the neutralization mechanism for NorthMet Project Proposed Action tailings is understood to be silicate mineral dissolution, not carbonate weathering. As noted above, the humidity cells provide information on rates of acid producing and acid neutralizing reactions, which are similar for flotation tailings and Category 1 waste rock due to the similar sulfur content of these materials. A separate geochemical model was used to estimate long-term pH resulting from these reactions, including the conservative assumption that CO_2 is elevated above atmospheric levels throughout the tailings. See FEIS Section 5.2.2.2.3 for more information.	
2994	Comment # 14. The SDEIS could be interpreted to imply that the plant site is expected to need water treatment for up to 500 years, and the mine site for up to 200 years. We understand from discussion with the co-lead agencies that this interpretation is incorrect. Recommendation: The FEIS should clearly explain the timeframe during which water treatment is projected, for both the plant and mine sites.	The water quality objective of closure is to provide mechanical or non-mechanical treatment for as long as necessary to protect regulatory standards at applicable groundwater and surface water compliance points. Water quality modeling performed in support of the FEIS indicates that water treatment systems would be needed at the Mine Site and Plant Site indefinitely. The water models constructed to assess the potential effects from the NorthMet Project Proposed Action were not designed to predict the duration of treatment nor do they capture all the factors that influence the duration of treatment, for example potential future regulatory and technological changes. Therefore, the models cannot be used to predict when treatment would end. Actual treatment requirements would be assessed on a recurring basis throughout operation and closure based on results of ongoing discharges, performance, and water resource monitoring, ensuring continuous protection of ground and surface water quality and compliance with applicable water quality standards. This reassessment process would rely on measured monitoring results rather than the results of the predictive modeling included in the FEIS. Regardless of the precise duration of effects or water treatment at either the Mine Site or Plant Site, there are measures available to address impacts to natural resources, such as those identified in the Adaptive Water Management Plan (PolyMet 2015d, as cited in the FEIS) and permit conditions. PolyMet would be held accountable for maintenance and monitoring required under the permit and would not be released until all conditions have been met. PolyMet would be required to provide financial assurance to MDNR (managed independently) for closure and maintenance costs as a contingency if PolyMet or the operating company at that time were unable to fulfill the obligations under	WR 036

Comment ID	Comment	Response	Theme(s)
		the Permit to Mine.	
2995	Comment # 15. Page 5-20: the SDEIS states that "mercury was not included in the GoldSim model, as insufficient data and a general lack of definitive understanding of mercury dynamics prevented modeling mercury like the other solutes." It also states that "regardless, the NorthMet Project Proposed Action would still need to demonstrate consistency with the mercury evaluation criteria (see Section 5.2.2.1)." Given the absence of modeling data for mercury, it is unclear how consistency with mercury evaluation criteria will be determined. Recommendation: The FEIS should either provide a supporting rationale that explains why elemental mercury does not warrant modeling, and how consistency with mercury evaluation criteria will be determined; or include modeling and evaluation of elemental mercury. If GoldSim is not suitable to model this pollutant, elemental mercury can be modeled using a different water quality model, such as the Water Quality Analysis Simulation Program (WASP), which is commonly used by EPA to model elemental mercury.	Elemental mercury is unlikely to exist in the water column. However, elemental mercury was evaluated using the MPCA's Mercury Risk Estimation Method to assess the potential incremental change in fish mercury concentrations and the potential incremental risks to human health. The FEIS assesses NorthMet Project Proposed Action-related mercury contributions using a mass-balance methodology. This approach was identified during scoping of this EIS as the appropriate analytic tool for predicting mercury concentrations during scoping of this EIS and it is a common and reliable analytical tool used by agencies to assess mercury impacts in impact assessments. This estimation method is preferred over a detailed mechanistic model because it incorporates the important input and removal processes for mercury, it is transparent with regard to data inputs, it typically provides conservative estimates of aqueous mercury concentrations, and it allows for easy assessment of the effect of changing parameter values on mercury concentrations. The RO treatment plant is expected to discharge mercury at or below the mercury standard of 1.3 ng/L, which includes all surface water that would be discharged at the Plant Site, including water used for flow augmentation. Mercury loadings from the Mine Site are projected to decrease due to the NorthMet Project Proposed Action and the combined contributions from the Embarrass River and Partridge River are unchanged when estimated at the St. Louis River at the Fond du Lac reservation boundary. Therefore, the potential effects are expected to be less than significant, and the mass balance approach is appropriate to provide a reasonable estimate of potential contributions for purposes of environmental review. West Pit inflows during pit flooding are not projected to exceed the 1.3 ng/L water quality standard; RO would further reduce these concentrations in closure. The WWTP and WWTF would use mercury-capturing greensand filtration for pretreatment prior to RO. Adaptive management would be implemented as necessary based on monitoring for total mercury to determine whether the treated water could be discharged to surface waters, or whether some additional treatment is needed. PolyMet has identified the following adaptive management strategies: • Pretreatment modifications such as chemical scavenger addition to obtain additional metals; • Use of tighter RO membranes for the primary RO system;	MERC 13

Comment ID	Comment	Response	Theme(s)
		• Treatment of some portion of the VSEP permeate by the primary RO system to further remove some dissolved constituents; and • Addition of polishing treatment units for removal of trace metals (e.g., ion exchange).	
2996	Comment # 16. Page 5-509, Section 5.2.10.2.6, 5th paragraph: The SDEIS states that "increased mercury concentrations, and associated increases in mercury bioaccumulation in fish tissue could therefore constitute an environmental justice impact for Band members and other subsistence consumers of fish;" and that "deposition of mercury from the NorthMet Project Proposed Action would cease at closure, but mercury bioaccumulation in fish tissue and existing fish consumption limits could persist beyond the mine's operational life." Table 5.2.2-51 shows how much elemental mercury is expected to leave the project site under currently-proposed control measures. Further consideration of mercury impacts is needed. Recommendation: The FEIS should refine the quoted statement to more clearly characterize the risks associated with mercury releases. Based on this risk characterization, the FEIS should explain what has been and will be done to avoid, minimize, and mitigate mercury releases from the project.	FEIS Table 1.7-1 provides a summary of FEIS sections that address mercury. Specifically, FEIS Section 5.2.7.2.5 discloses results of the MPCA's Mercury Risk Estimation Method to assess the potential incremental change in fish mercury concentrations and the potential incremental risks to human health; and FEIS Section 5.2.2.3.4 explains the status of mercury science. FEIS Section 5.2.2.3.5 lists methods to reduce mercury discharges, and FEIS Section 5.2.7.2.5 identifies mercury air emissions controls. Adaptive management would be implemented as necessary based on monitoring for total mercury to determine whether the treated water could be discharged to surface waters, or whether some additional treatment is needed. Adaptive management strategies would include pretreatment modifications such as chemical scavenger addition to obtain additional metals, the use of tighter reverse osmosis membranes for the primary reverse osmosis system, treatment of some portion of the Vibratory Shear Enhanced Processing (VSEP) permeate by the primary reverse osmosis system to further remove some dissolved constituents, and addition of polishing treatment units for removal of trace metals (e.g., ion exchange).	MERC 02 MERC 24
2997	Comment # 17. The SDEIS describes current site conditions, including the acreage, type, and quality of the wetland resources at the tailings basin and mine sites. The SDEIS also describes the proposed direct impacts remaining after measures to avoid or minimize direct impacts. However, the SDEIS does not quantitatively assess indirect impacts or measures to minimize and mitigate these impacts, except with respect to wetland losses due to fragmentation. The SDEIS also omits all indirect impacts from the cumulative impacts analysis for	FEIS Section 5.2.3.3 has been revised to include more information on the monitoring and mitigation plan for the potential indirect wetland effects. In addition, the SDEIS and FEIS Section 5.2.3 quantitatively assessed all potential indirect wetland effects. Indirect wetland effects from the NorthMet Project Proposed Action were assessed as a result from one of the following six factors: 1) wetland fragmentation; 2) change in wetland hydrology from changes in watershed area; 3) changes in wetland hydrology from groundwater drawdown resulting from open pit mine dewatering; 4) changes in wetland hydrology from groundwater drawdown resulting from operation of the Plant Site, including groundwater mounding and seepage containment; 5) changes in stream flow near the Mine Site and	COE 02 WET 18

<table>
<tr><th>Comment ID</th><th>Comment</th><th>Response</th><th>Theme(s)</th></tr>
<tr>
<td></td>
<td>wetlands (Section 6.2.3.4).

Recommendation: The FEIS should quantitatively assess all indirect impacts. The FEIS should more clearly describe the proposed mitigation plan, including mitigation for indirect impacts. The monitoring and mitigation plans in the CWA Section 404 permit should clearly explain proposed measures to minimize and mitigate indirect wetland impacts during the project.

Recommendation: The FEIS should include indirect impacts in the analysis of cumulative impacts to wetlands.</td>
<td>Plant Site and associated effects on wetlands abutting the streams; and 6) change in wetland water quality related to atmospheric deposition of dust and rail car spillage associated with Mine Site and Plant Site operations. The assessments provided wetland type and acreage for all six factors; however only wetland acreages were provided for change in wetland water quality related to atmospheric deposition of dust and rail car spillage associated with Mine Site and Plant Site operations. The following table summarizes the page location of where the indirect wetland effects were discussed in the SDEIS.
<table>
<tr><th>Indirect Effects Factor Assessed</th><th>Mine Site</th><th>Transportation and Utility Corridor</th><th>Plant Site</th><th>Second Creek</th></tr>
<tr><td>Wetland fragmentation</td><td>page 5-239</td><td>page 5-239</td><td>page 5-291</td><td>page 5-291</td></tr>
<tr><td>Change in wetland hydrology from changes in watershed area</td><td>page 5-243</td><td>---</td><td>---</td><td>---</td></tr>
<tr><td>Changes in wetland hydrology from groundwater drawdown resulting from open pit mine dewatering</td><td>pages 5-247, 5-259, 5-260; Tables 5.2.3-3, 5.2.3-4</td><td>---</td><td>---</td><td>---</td></tr>
<tr><td>Changes in wetland hydrology from groundwater drawdown resulting from operation of the plant site including groundwater seepage containment</td><td>---</td><td>---</td><td>pages 5-297 and 5-298; Table 5.2.3-10</td><td>pages 5-297 and 5-298</td></tr>
<tr><td>Changes in stream flow near the Mine Site and Plant Site and associated effects to wetlands abutting the streams</td><td>page 5-273</td><td>---</td><td>page 5-299</td><td>page 5-299</td></tr>
<tr><td>Change in wetland water quality related to atmospheric deposition of dust and rail car spillage associated with Mine Site and Plant Site operations as well as leakage from Stockpiles/Mine Features and Seepage from Mine Pits</td><td>page 5-276, 5-284; Table 5.2.3-7</td><td>page 5-277</td><td>page 5-302, 5-307; Table 5.2.3-13</td><td>page 5-291</td></tr>
</table>
It is difficult to predict potential indirect wetland effects within the CEAA, as well as to know what the potential indirect wetland effects would be for</td>
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Comment ID	Comment	Response	Theme(s)
		the projects assessed other than the NorthMet Project Proposed Action. However, based on the amount of potential indirect wetland effects that could occur from the NorthMet Proposed Action, there could be 0.1 to 12.0% cumulatively lost, in addition to the direct wetland impacts assessed, within the Partridge and Embarrass River watersheds as a result of the NorthMet Project Proposed Action. The total wetland resources within the two watersheds during the time periods assessed are as follows: • Pre-settlement wetland resources - 68,251 acres; • Existing conditions wetland resources - 65,567 acres; • Foreseeable future conditions with the NorthMet Project Proposed Action and the other foreseeable projects assessed, which includes direct wetland impacts and future deepwater habitat - 64,979 acres; and • Foreseeable future conditions without the NorthMet Project Proposed Action but with the other foreseeable projects assessed, which includes direct wetland impacts and future deepwater habitat (No Action Alternative) - 65,292 acres. Based on the wetlands crossing analog zones analysis approach, the acreage of wetlands whose hydrology would have a high likelihood of being affected by drawdown at the Mine Site is 866.9 acres. The wetlands categorized as high likelihood are dominated by one alder thicket (848 acres) that has approximately 4 acres (less than 1%) within the 0-1,000 ft analog impact zone. The remainder of this wetland (more than 99%) is located more than 1,000 ft away from the edge of the mine pits and extends out to the edge of Area 1 (see Figure 5.2.3-6 in the FEIS). Furthermore, based on this method, there would be 1,854.5 acres of wetlands within the 0-2,000 ft zone and 2,147.6 acres within the 0-3,500 ft zone that could be affected by potential drawdown. Based on this approach, the total projected potential indirect effects from all six factors that were assessed under this method could be up to 7,694.2 acres of wetlands potentially indirectly affected by the NorthMet Project Proposed Action. Therefore, the potential indirect cumulative effect from the NorthMet Project Proposed Action, in addition to the direct wetland impacts assessed, under this method would range between 1.3 to 12.0%. Based on the method approach of wetlands within analog zones, the acreage of wetlands whose hydrology would have a high likelihood of being affected by drawdown at the Mine Site is 46.4 acres. Furthermore,	

Comment ID	Comment	Response	Theme(s)
		based on this method, there would be 348.4 acres of wetlands within the 0-2,000 ft zone and 733.3 acres within the 0-3,500 ft zone that could be affected by potential drawdown. Based on this approach, the total projected potential indirect effects from all six factors that were assessed under this method could be up to 6,568.8 acres of wetlands potentially indirectly affected by the NorthMet Project Proposed Action. Therefore, the potential indirect cumulative effect from the NorthMet Project Proposed Action, in addition to the direct wetland impacts assessed, under this method would range between 0.1 to 10.2%.	
2999	Comment # 18. The SDEIS uses wetland assessment sites as an approach for evaluating impacts. The location of these assessment sites is discussed in the SDEIS, and Figure 4.2.3-2 shows locations of wetland assessment sites as points in a diagram. There are few wetland assessment site locations north and south of the mine site, and those shown on Figure 4.2.3-2 are far from the site boundary. The SDEIS does not sufficiently explain the assessment approach. Recommendation: The FEIS should describe in more detail the wetland assessment protocol and the assessment sites used, including the assessment methods used at those locations, why these locations were chosen, and how will they be used (e.g., for monitoring future wetland conditions).	FEIS Section 4.2.3 provides a discussion of the wetland functional assessment that was performed for the wetlands in the NorthMet Project areas; this discussion notes that the MnRAM was used to assess wetland functions on the Mine Site, along the Transportation and Utility Corridor, and the Plant Site. During the field wetland surveys for the NorthMet Project areas, data was collected related to the functions of each wetland within the proposed Project areas (i.e., Mine Site, Transportation and Utility Corridor, Plant Site) under an abbreviated MnRAM approach. A total of 87 wetlands were evaluated at the Mine Site for vegetative diversity/integrity and overall functional quality rating and is summarized in FEIS Table 4.2.3-4. Wetland data forms with the MnRAM information collected in the field was presented in Wetland Delineation and Wetland Functional Assessment Report (Barr 2006d, as cited in the FEIS). Approximately 92% of the wetland resources in the Mine Site are of high overall wetland quality and 8% are of moderate overall wetland quality. The wetlands along the Transportation and Utility Corridor have all been rated as high quality. The wetland resources along the Railroad Connection Corridor are moderately affected and have a high vegetative diversity/integrity. The majority (92%) of the wetlands within the Plant Site are currently rated as low-quality with low vegetative diversity/integrity. Eight percent are rated as moderate quality. The wetlands within the Hydrometallurgical Residue Facility are currently rated as low-quality. FEIS Section 5.2.3 discusses the percentage of high, medium, low quality wetlands to be affected by the mine features. In addition, FEIS Section 5.2.3.3 has been revised to include more information on the monitoring and mitigation plan for the potential indirect wetland effects. The wetland assessment sites that were shown on SDEIS Figure 4.2.3-2 are wetland assessment sites, using MnRAM, that were collected for the federal lands and are now shown on FEIS Figure 4.3.3-1. FEIS Section	WET 21

Comment ID	Comment	Response	Theme(s)
		4.3.3 includes a discussion on these findings.	
3000	Comment # 19. Section 5.2.3 states that 26.9 acres will be impacted by fragmentation, and that these losses will be mitigated. The criteria used to determine fragmentation are broadly described in Section 5.2.3.1.2, but lack sufficient detail. Recommendation: The FEIS should describe in more detail the criteria used to determine fragmentation losses.	For each wetland that would not be directly impacted at the Mine Site, along the Transportation and Utility Corridor, or at the Plant Site, an estimate of indirect wetland effects (wetland acres by wetland type, and type of effect) from wetland fragmentation by NorthMet Project area features (e.g., open pits, stockpiles, haul roads) was determined based on an analysis of the various factors that may contribute to fragmentation. A wetland may be fragmented as the result of direct impacts that may split a wetland resource area into multiple parts. These fragmented parts could potentially be isolated from other wetlands and would no longer have any adjacent upland watershed area, which could result in the loss of functions in the wetland fragments. While a wetland may be fragmented by direct impacts, this does not necessarily mean the remaining fragmented part of the wetland resource area would be affected. These fragmented parts therefore required further evaluation to determine if these areas would remain viable and/or would retain its functions (PolyMet 2015b; PolyMet 2015j). PolyMet's evaluation (PolyMet 2015b; PolyMet 2015j) to determine if a wetland resources area would remain viable included the following criteria: change in the size of remaining wetland, wetland type, source of hydrology, direction of flow in the area, location in the current watershed, location in the future watershed, and connectivity to other wetlands. The criteria used are described below: • **The Size of Remaining Wetland:** Wetland fragments that were identified using GIS as having less than about 0.5 acres in size were determined to small to retain their functions. These wetlands were determined for the analysis to be considered fragmented. • **Wetland Type:** The wetland types for the wetland fragments that were greater than 0.5 acres in size were reviewed to determine if they were bogs vs. non-bogs. Ombrotrophic bogs that would become fragmented were not identified as indirectly impacted by fragmentation because they would maintain their functions since their sole source of hydrology is precipitation (see below). Minerotrophic bogs and small non-bog wetlands that were fragmented were further evaluated to determine their hydrologic sustainability. • **Source of Hydrology:** Wetlands were further subclassified as ombrotrophic (solely precipitation-fed) or minerotrophic (receives surface and/or groundwater inputs). The hydrology of ombrotrophic	WET 08

Comment ID	Comment	Response	Theme(s)
		bogs is solely supported by precipitation; therefore, these wetlands are not dependent on the watershed size to maintain their functions and were not identified as indirectly impacted by fragmentation. The hydrology of minerotrophic bogs and non-bog wetlands is primarily supported by shallow, groundwater systems that are connected within different scales – wetland watershed, local (e.g., Mine Site) watershed, or regional watershed. Therefore, these minerotrophic bogs and non-bog wetlands were further evaluated because they are considered to be dependent on their watershed size to maintain their functions and their watersheds would be altered due to construction of Project infrastructure. • **Direction of Flow in the Area:** The Mine Site is located in the Upper Partridge River watershed and water on the Mine Site eventually drains to the Partridge River. Under this criterion, PolyMet evaluated the locations of the minerotrophic bogs and non-bog wetlands relative to the sub-watersheds on each side of the Mine Site groundwater divide which is generally located from southwest to northeast near the northern boundary of the Mine Site. Under existing conditions, water in the northernmost area of the Mine Site generally drains (flows) north and water in the southern area of the Mine Site generally drains (flows) south. There are several sub-watersheds on each side of the divide. Based on the location of predicted wetland fragments on the Mine Site, their locations within the sub-watersheds in relation to direct impacts within that same sub-watershed and the direction of flow were noted. A wetland is more likely to retain its function if the fragment that remains is located in the upper portion of its sub-watershed than in the lower portion. Ultimately, if the area of the wetland's watershed is modified, it could result in a change to the equivalent flow (expressed as ac-ft/yr per acre of wetland), a measure of hydrologic support. • **Determination of the Wetland's Current Watershed:** The current watersheds for ombrotrophic bog wetlands were not analyzed since they are not dependent on watershed area for their hydrology as they are precipitation-fed. The current (existing) conditions include the wetlands and watersheds which represent the existing, relatively undisturbed conditions in the Mine Site Area. The watersheds for the minerotrophic bogs and non-bog wetlands are the land areas that contribute surface water to the wetlands (upland areas and wetland	

Comment ID	Comment	Response	Theme(s)
		areas). For each minerotrophic bog and non-bog wetland in the analysis, GIS was used to determine the acreage of its watershed area. The location of each minerotrophic bog and non-bog wetland in its current (existing) watershed was compared with its location in the future watershed. • **Location of the Minerotrophic Bog and Non-bog Wetland Fragment in the Wetland's Future Watershed:** During operations, some watershed areas would be directly impacted by the NorthMet Project Proposed Action and would no longer be considered as tributary areas to the minerotrophic bogs and non-bog wetlands. Using the same methodology as in the previous criteria, for each minerotrophic bog and non-bog wetland in the analysis, GIS was used to determine the acreage of upland area and wetland area within its watershed area. As a result, the amount of water potentially contributed by the watershed to support the hydrology of the remaining wetland may also change (increase or decrease). If the wetland fragments had a change in equivalent yield of +/- 20 percent, the minerotrophic bogs and non-bog wetlands were further determined to have a potential for indirect impacts. Depending on the results of the other criteria, the minerotrophic bog and non-bog wetland fragments were either considered to be indirectly affected or included as a monitoring location in the wetland hydrology monitoring plan. • **Connectivity to Other Wetlands:** Each wetland fragment was evaluated based on its location, adjacency to upland, and adjacent infrastructure characteristics to determine if it would be expected to maintain its functions. Some of the wetland fragments as a result being divided by Mine Site infrastructure would become isolated from other wetlands; therefore, no longer located within or adjacent to an intact, relatively undisturbed upland. These wetland fragments were not expected to maintain their functions. However, other wetland fragments would still be hydrologically connected to wetlands and would be located within or adjacent to an intact, relatively undisturbed upland. These fragmented wetlands would be located in the vicinity of the haul roads on the Mine Site. Construction of the haul roads would require excavation and fill with blasted rock that would allow groundwater connectivity for wetlands on either side of the haul road. The purpose of this analysis for the fragmentation factor was to provide an	

Comment ID	Comment	Response	Theme(s)
		estimate of potential indirect wetland effects from fragmentation. The wetland fragments that are not expected to maintain their functions, approximately 26.9 acres, have been identified in FEIS Section 5.2.3 and on Figure 5.2.3-1. PolyMet's proposed mitigation for the NorthMet Project Proposed Action would be providing upfront compensatory mitigation for the 26.9 acres of wetland fragmentation. The monitoring and mitigation requirements for potential indirect effects, including fragmentation, would be determined during permitting. The wetland fragments that have not been accounted for in the upfront mitigation would be included in the wetland hydrology and vegetation monitoring plan that would be developed and implemented for the NorthMet Project Proposed Action. FEIS Section 5.2.3.3 includes a detailed discussion on the monitoring and mitigation plan for the potential indirect wetland effects. The proposed wetland impact, avoidance, minimization, mitigation, and monitoring plan presented in the FEIS would be reviewed, modified as required, and approved during permitting; therefore, this information could change during permitting.	
3001	Comment # 20. Figure 5.2.3-4 highlights wetland acres at the mine site where the proposed mine features would indirectly impact wetlands by fragmentation. Fragmentation is defined in the SDEIS as causing a change in the watershed area by greater than 20%. The SDEIS (Page 5-226) briefly describes how fragmented wetlands were identified, but does not explain the method for determining the 20% threshold. Indirect impacts from fragmentation at the mine site will also include habitat fragmentation, divisions in vegetative communities, and the general loss of functions in wetlands that are divided from adjacent wetlands and made smaller by mine features. Wetland acres that are surrounded on all sides by mine features will be fragmented because their ecological functions will be impaired. Recommendation: The FEIS should explain how the 20% threshold was determined. The FEIS should also recognize that the term "fragmentation" may define indirect impacts other than changes in watershed size. These other factors should be included when estimating fragmentation	Figure 5.2.3-4 of the FEIS has been clarified. The potential indirect wetland effects as a result of 1) fragmented wetlands and 2) change in watershed area share a common graphic, and the title of the figure has been revised. FEIS Section 5.2.3.3 has been revised to include more information on the monitoring and mitigation plan for the potential indirect wetland effects. The indirect effects analyses performed for the EIS were not performed to characterize impacts but were done to inform where monitoring should take place for those areas that were identified as having a potential for indirect wetland effects. As a result of these analyses performed to determine where monitoring should occur, quantification of wetland types and acres of potential indirect wetland effects were also generated. The Co-lead Agencies agree that multiple factors can affect whether a wetland would experience indirect effects due to a project. Fragmentation and a change in watershed area (20% or greater) are two of the six factors being considered in the identification of potential indirect wetland effects that would be actively monitored due to the NorthMet Project Proposed Action, if the project were to be permitted. Other factors in the consideration of monitoring for potential indirect wetland effects as described in the FEIS: changes in hydrology at the mine site (drawdown), changes in hydrology at the Plant Site (mounding or drawdown), changes in stream or river flow, and changes in water quality. PolyMet proposes that if a wetland would potentially experience three or	WET 01 WET 08

Comment ID	Comment	Response	Theme(s)
	impacts. Compensatory mitigation should also be proposed for all losses of wetland functions due to wetland fragmentation (in addition to adverse impacts from changes to a wetland's watershed).	more of these factors, a monitoring well and a vegetation plot would be installed at that wetland for use in monitoring for indirect effects. A rating system (0-6) was developed for the wetlands based on the number of factors that may potentially affect it. Wetlands that were not determined to be potentially indirectly affected would be rated as zero, and wetlands that were determined to be potentially indirectly affected by all six factors would be rated as a six; however, no wetlands were rated as a six (see FEIS Figures 5.2.3-24 through 5.2.3-29). Monitoring is proposed within all wetlands with a factor rating of 3 to 5 and also for a subset of those wetlands with factor ratings of 1 or 2 as described in FEIS Section 5.2.3.3 (see Figures 5.3.2-31 and 5.2.3-32). The 20% change in watershed area is a metric used to assist in identifying wetlands to be monitored for indirect effects (see FEIS Figure 5.2.3-4). It comes from a scientific paper (Richter, et al, 2011) and its use in the EIS indirect effects wetland assessment is based on the assessment of potential water-related impacts (including to aquatics) in the EIS. With regard to daily flow alterations (i.e., in streams or rivers), the paper states that, "Alterations greater than 20% will likely result in moderate to major changes in natural structure and ecosystem functions." Though the 20% metric discussed in this paper is applied to streams and rivers, the Co-lead Agencies believe that a 20% change is a reasonable metric to apply when identifying wetlands for monitoring, in particular with respect to potential ecological changes that may be triggered with a change in watershed contribution (water yield) of this magnitude or greater. As stated above, the 20% change in watershed is just one of six factors used to identify which wetlands would be proposed to be actively monitored for indirect effects. Fragmentation is another of the six factors described above. As noted in FEIS Section 5.2.3.2.2, wetlands were determined to be fragmented, and their associated remaining acreage identified as being indirectly affected if the remaining portions of the wetlands were small remnants of a directly impacted wetland located between project features (e.g., in the area between the Category 1 Waste Rock Stockpile and the West Pit). FEIS Section 5.3.2.1.2 provides a discussion of the criteria considered in identifying a wetland as fragmented. As noted in the FEIS, compensatory mitigation for the 26.9 acres of wetland fragmentation (see FEIS Figure 5.2.3-1) estimated to occur due to the NorthMet Project Proposed Action is proposed to occur up front (see	

Comment ID	Comment	Response	Theme(s)
		FEIS Tables 5.2.3-17, 5.2.3-18, 5.2.3-19). Potential indirect effects to wetlands due to factors other than fragmentation would be identified through monitoring. The monitoring and mitigation for potential indirect effects would be determined during permitting. Additional compensatory mitigation for indirect wetland effects would also be addressed in permitting. When an agency is evaluating reasonably foreseeable significant adverse effects on the human environment in an EIS and there is incomplete or unavailable information because the overall costs of obtaining it are exorbitant or the means to obtain it are not known, NEPA directs the agency to make it clear that such information is lacking, discuss the relevance of the lacking information, and discuss any information relevant to evaluation of the future impacts. In these cases, NEPA also directs the agency to evaluate these impacts based upon theoretical approaches or research methods generally accepted in the scientific community provided that the analysis of the impacts is supported by credible scientific evidence, is not based on pure conjecture, and is within the rule of reason. The Co-lead Agencies believe this is the case for evaluating indirect wetland effects. The Co-lead Agencies have thoroughly considered throughout the development of the EIS and through the Wetland Impact Assessment Planning Work Group how to assess potential indirect wetland effects. As a result, strengths and weaknesses of the approach used as well as other suggested approaches have been carefully considered. The Co-lead Agencies ultimately decided the use of the 20 percent metric described in Section 5.2.3 as one of the factors considered in identifying potential indirect effects to wetlands is a credible and reasonable approach consistent with the requirements of NEPA.	
3002	Comment # 21. Section 5.2.3 describes the proposed wetland mitigation plan. EPA previously commented on the proposed mitigation ratios, and supports the mitigation ratios proposed in USACE's May 29,2013 Draft Memorandum on The Application of the Federal Mitigation Rule and St. Paul District Policy Guidance on Compensatory Mitigation, as described on page 5-316. The SDEIS describes the proposed ratios, but also states, "The determination of final mitigation credits ... would be determined during permitting"	The USACE has determined—based on the mitigation plans, information gathered on site, and review of the monitoring reports—that the three mitigation sites selected (Aitkin, Hinckley, and Zim) and the wetland mitigation credits generated at these sites would be acceptable for use in compensating for direct wetland losses. The USACE has not made a final decision on the mitigation ratios that would be required to compensate for direct wetland impacts; however, if fully successful, it is likely these mitigation sites would generate sufficient credits to compensate for the 940 acres of direct and fragmented wetland impacts. In the event that not all of the credits generated at these sites are utilized to compensate for direct wetland impacts, any excess credits could be used to compensate for	WET 04

Comment ID	Comment	Response	Theme(s)
	(p 5-224). Recommendation: The FEIS should provide a status update on development of final wetland mitigation credits. EPA will work with USACE during CWA Section 404 permitting to determine the final wetland mitigation credits needed, including mitigation for indirect impacts.	indirect losses (USACE 2015a, as cited in the FEIS). The FEIS (see FEIS Section 5.2.3.3) includes the proposed direct compensatory mitigation credits and ratios for the NorthMet Project Proposed Action (see FEIS Tables 5.2.3-17, 5.2.3-18, and 5.2.3-19), which are based on the federal guidance policies and state replacement ratio rules. The amount of credit generated by the mitigation sites would ultimately be determined by the permitting agencies. This would be based on the extent to which the sites meet the target goals established during permitting. These include, among other things, restoration of wetland appropriate hydrology and the establishment of a target plant community or type. Financial assurances for the direct wetland impact mitigation would be required until success of the mitigation sites can be assured. While this wetland mitigation is expected to be approved and constructed in advance of any authorized wetland impacts, it is unclear whether these sites would be well enough established for financial assurances to be waived. The USACE would also consider the application of financial assurances for potential indirect wetland effects and monitoring. Both the USACE and state would require consideration of financial assurances during the permitting process. The NorthMet Project Proposed Action is estimated to directly impact 913.8 acres of wetlands. Depending on the location, type, and timing of compensatory mitigation, the minimum required amount of replacement wetlands for direct impacts could range from 913.8 acres up to 1,827.6 acres (i.e., 1:1 up to 2:1 compensation ratios). In addition, compensatory mitigation for the 26.9 acres of wetland fragmentation would also be provided up front. The USACE St. Paul District guidance allows for in-kind, in-place, and in-advance incentives to reduce the recommended base ratios and these would be considered at the time of permitting. Please refer to the response to theme WET 01.	
3003	Comment # 22. The proposed mitigation plan includes post-mining on-site wetland mitigation. Restoration of wetlands on the site as part of reclamation is positive and important, but EPA and USACE have agreed that mitigation credits are not appropriate given how long it will be before this mitigation is carried out. The SDEIS contains inconsistent statements regarding whether or not on-site mitigation is proposed to generate mitigation credits.	The post-closure establishment of the estimated 101.8 acres of on-site wetland is not included in the wetland mitigation credits. The generation of wetland credits in these areas has the potential to be used on a contingency basis, but compensatory credit would not be considered at this time for a variety of reasons including the fact that any restoration efforts would not occur for many years. The summary of proposed wetland mitigation credits, presented in FEIS Table 5.2.3-17, does not include the on-site wetland restoration. The Executive Summary and FEIS Section 5.2.3.3.3 have been updated to also note that the on-site wetland would not be considered in the wetland mitigation credits at this time.	COE 01

Comment ID	Comment	Response	Theme(s)
	Recommendation: The FEIS should be clear that post-mining, on-site mitigation will not be used for mitigation credits. The mitigation plan in the CWA Section 404 permit should exclude mitigation credits for post-mining, on-site wetland mitigation.		
3004	Comment# 23. Page 6-36, Table 6.2-8 and Pages 6-40 to 6-42, Table 6.2-11: There appear to be some inconsistencies between Table 6.2-8 and Table 6.2-11 with respect to reported future wetland and water resource numbers, including the bullet summaries for the Partridge River (Page 6-40) and Embarrass River (Page 6-42). For the Partridge River, Table 6.2-11 and bullet summary text note future condition with 3,516 acres of deepwater resources, while Table 6.2-8 indicates 1,922 acres. Recommendation: The FEIS should resolve or explain these inconsistencies.	FEIS Table 6.2.3-1 shows the proposed net change in wetland and water resources for the eight specific projects that were included in the wetlands cumulative effects analysis. Table 6.2.3-4 shows the projected future resources in total for the two watersheds when combined with the eight projects that were assessed. For example, the 1,922 acres of deepwater resources shown in Table 6.2.3-1 is the amount that would be added to the Partridge River watershed from the projects that were evaluated, which would result in a net increase of 370 acres of deepwater habitat from these projects (existing deepwater habitat from these projects is 1,552 acres). The 3,516 acres of deepwater habitat discussed in the bullets on page 6-40 and in Table 6.2.3-4 is correct. There is a total of 3,146 acres of existing deepwater resources in the Partridge River watershed, which, when combined with the net increase of 370 acres of deepwater habitat from the four projects, results in 3,516 acres. Section 6.2.3 of the FEIS has been updated to clarify the information presented in the tables.	EDIT 01
3005	Comment# 24. Page 6-21, Section 6.2.3.3.2: the “Contributing Past, Present, and Reasonably Foreseeable Actions“ section, lists twelve foreseeable future actions with potential cumulative effects on surface water hydrology and quality in the Partridge River and Embarrass River watersheds. There is some inconsistency between this list and Table 6.2-1 (Page 6-7). “Cliffs Erie, LLC- Hoyt Lakes Area (former LTVSMC),” and “Cliffs Erie, LLC- Area 5 NW Pit” are not included in the table, at least not by these names. Recommendation: The FEIS should resolve or explain these inconsistencies, and use consistent names for foreseeable future actions to simplify cross-referencing by the reader.	The FEIS has been revised to ensure consistency with project names.	EDIT 01

Comment ID	Comment	Response	Theme(s)
3006	Comment # 25. Page 6-26 states: "In summary, the maximum cumulative effects of the NorthMet Project Proposed Action, plus present and reasonably foreseeable future actions on the hydrology of the Partridge River, would be expected to reduce average annual flow in the Lower Partridge River at any time during operations by no more than 8.4 cubic feet per second (cfs) and 2.4 cfs (2 percent) during closure of the NorthMet Project Proposed Action, based on average annual flow of 112 cfs at USGS gauging station 04016000 downstream of Colby Lake." In some cases, this effect is well above the mean recorded flow of the Upper Partridge River during certain times of the year. The SDEIS does not address how flow reductions will affect the Partridge River and its resources. Recommendations: The FEIS should include a total or net effect calculation for each table in the water resources section, similar to that provided for the wetlands analysis in Table 6.2-8, (Page 6-36) which shows total and incremental cumulative effects. The FEIS should add a row for the total or net effect to Table 6.2.2. The FEIS should discuss the magnitude and significance of these flow reductions, including additional analysis or information as necessary. Potential impacts caused by these reductions should be discussed in section 6.2.3.3.3.	Upper Partridge River flows are currently influenced by the timing and magnitude of Northshore Mine discharges from the Peter Mitchell Pit at SD-009 and would be influenced by the cessation of those discharges in approximately mine year 55. Available records show an average annual discharge to the Partridge River ranging from 6.8 to 15.1 cfs, with a highest reported monthly discharge of 34 cfs (Barr 2008f). Over the past several years (2004 to present), the average annual daily discharge from the Northshore Mine has been approximately 5.8 cfs, but this rate is quite variable, ranging from zero (mostly during the winter and summer droughts) to as high as approximately 20 cfs. These flow contributions would cease around 2070. Monthly Peter Mitchell Pit pumping records for the Northshore Mine provide a poor estimate of actual contributions to the Upper Partridge River because the Northshore Mine does not discharge directly to it. The Northshore Mine's actual contributions are uncertain due to the variability of the Peter Mitchell pit pumping, complex storage and release mechanisms (e.g. wetlands, ponds, losses in the Partridge River, and ice storage), and also seepage from the West Pond. To address these uncertainties the Co-lead Agencies relied on available sulfate and flow data to derive a continuous flow of 2.6 cfs from the Northshore Mine to use as the basis for water quality impact predictions in the FEIS (Co-Lead Agencies and ERM 2014c). This estimated flow is reasonable for purposes of both water quality impact predictions and cumulative effects to flow. The NorthMet Project Proposed Action would also influence future Partridge River flows through 1) WWTF discharges starting in mine year 52; 2) a watershed reduction; 3) pit inflows during operations and reclamation; and 4) groundwater flowpath contributions from stockpiles and pits during operations, reclamation, and closure. The WWTF would discharge continuously at rate of 0.65 cfs. Watershed area reductions resulting from the NorthMet Project Proposed Action for SW-001, SW-002, SW-003, SW-004, and SW-004a range from 0 percent to 2.1 percent, which translates to a reduction	WR 024

Comment ID	Comment	Response	Theme(s)
		of 0.39 cfs below current and future flows at SW-004a. Pit inflows would reduce Partridge River flows by less than 2 cfs. The P50 average annual modeled flows assessed for the 200-year simulation in the Partridge River at SW-004a considering the totality of these influences are estimated to decrease by no more than 4 percent and increase by no more than 2 percent. Figure 6.2.2-2 shows P10, P50 and P90 flow rates to represent the range of potential effects to flows to capture the uncertainty in the hydrology described above. The decrease in flows occurs during operations. The increase in flows would occur during closure for about a 3 year period when the WWTF and Northshore Mine are both discharging to the Partridge River. Change to groundwater flows are considered negligible.	
3008	Comment # 26. Pages 6-22 to 6-25 and 6-27 to 6-28, Section 6.2.3.3.3: This text does not reference sources of hydrological effects data for each action. Recommendation: The FEIS should reference sources of hydrological effects data for each action.	Change has been made, as requested.	EDIT 01
3009	Comment# 27. Table 6.2-15 shows the direct effect of other actions in terms of populations of each plant species affected. However, the SDEIS notes that for 4 out of 9 potentially contributing actions, "The NHIS data and MDNR take permit data were reviewed and no vegetation records were available for these actions. As a result, these actions are not considered in the cumulative effects analysis for vegetation." Recommendation: The FEIS should indicate whether the lack of vegetation records indicate no cumulative effects on vegetation, or simply lack of data on the subject.	The FEIS uses MDNR Natural Heritage Information System (NHIS) data to analyze the statewide status of each species, and Table 6.2.4-3 summarizes the percentage of statewide populations affected. The NHIS data also clarifies whether there is a lack of data in the cumulative project footprints or an absence of species in surveys conducted on site. The FEIS has been updated to include the new state ETSC status listings from August 19, 2013, as well as any new federal status listing changes to assess effects to species in the cumulative analysis.	VEG 08
3010	Comment # 28. We understand that MDNR will not calculate detailed financial assurance until the	FEIS Section 3.2.2.4 provides available details regarding financial assurance. Additional details on the cost estimates and calculations that	FIN 01 FIN 08

Comment ID	Comment	Response	Theme(s)
	Permit to Mine process, although it may have additional information before the FEIS is issued. Recommendation: The FEIS should include additional information on financial assurance as available.	would be required for the project would be addressed during permitting. Section 3.2.2.4.1 discusses what activities would be considered in cost estimates, and that cost estimates would be updated annually under the Permit to Mine.	
3011	Comment # 29. The SDEIS does not identify the least environmentally damaging practicable alterative (LEDPA). This information will be required for CWA Section 404 permitting under CWA Section 404(b)(l). Recommendation: The FEIS should describe the process that will be used to determine the LEDPA, and should provide LEDPA information to the extent it is available.	The LEDPA process is described in FEIS Section 7.5. The ROD for the USACE would include the Section 404(b)(1) analysis is and the public interest review, and would determine the LEDPA. Furthermore, the ROD for the USACE cannot be finalized until 30 days after release of an FEIS. Any comments received during the 30 day period may be considered in the ROD for the USACE. The ROD for the USACE would recommend issuance, issuance with conditions, or denial of the Project.	COE 02
3012	Comment # 30. The Noise section and page 5-370 of the SDEIS does not sufficiently describe potential noise impacts from blasting and vibrations on wildlife. A cited Federal Highway Administration technical document in Appendix C of the SDEIS provides information on the sound threshold and frequency range for four biologic classes (mammals, birds, reptiles, and amphibians). Recommendation: The FEIS should contain analyses of noise and vibration impacts to wildlife based on the above biologic classes' sound threshold and frequency range, based on information included and cited in the SDEIS. Any impacts and/or mitigation measures should be noted in the FEIS.	FEIS section 5.2.5 (Wildlife Impacts) has been updated to include noise and vibration impacts to wildlife, including Canada lynx and song birds at the local and regional level. Appropriate mitigation and impact areas have been clearly defined. For more details please see response to Theme Code WI 05 (under wildlife). In addition, please see the Biological Assessment for further details on noise impacts to the Canada lynx, gray wolf, and northern long-eared bat, as well as the Biological Evaluation for details on noise impacts to wildlife.	N 04
3013	Comment # 31. On pages 1-14 and 1-15, the SDEIS notes that the USFS must determine that "the public interest will be well served" before it can enter into a discretionary, voluntary real estate transfer (36 CFR 254.3(b)). This analysis is included in the SDEIS, but should be made clearer and more focused. Recommendation: The FEIS should clearly and	CEQ regulations (40 CFR 1502.14) state that an EIS should present the environmental impacts of a proposal and its alternatives in comparative form to provide a clear basis for choice among the alternative options by the decision makers and the public. The regulations further state (40 CFR 1502.14(e)) that agencies shall identify their preferred alternative (or alternatives, if one or more exists) in the DEIS as well as the FEIS, unless another law prohibits the expression of such a preference; however, the regulations do not require a rationale for the choice. The ROD from the USFS would contain the rationale for the selected alternative, as well as a	LAN 01

Comment ID	Comment	Response	Theme(s)
	concisely summarize the analysis is of the proposed land exchange (Alternative A) and Alternative B under 36 CFR 254.3(b), including a clear explanation of the rationale and criteria for selecting the preferred land exchange alternative, and of how protecting cultural resources is included in the public interest determination.	discussion of how the public interest is served under 36 CFR 254.3(b). The FEIS includes the factors relating to how the public interest would be served by the Land Exchange Proposed Action, Land Exchange Alternative B, and the Land Exchange No Action Alternative. The ROD would incorporate these findings in its determination. As stated in FEIS Section 1.4.3, factors that must be considered include: • the opportunity to achieve better management of federal lands and resources; • to meet the needs of state and local residents and their economies; and • to secure important objectives, including but not limited to: protection of fish and wildlife habitats, cultural resources, watersheds, and wilderness and aesthetic values; enhancement of recreation opportunities and public access; consolidation of lands and/or interests in lands, such as mineral and timber interests, for more logical and efficient management and development; consolidation of split estates; expansion of communities; accommodation of existing or planned land use authorizations; promotion of multiple-use values; implementations of applicable Forest Land and Resource Management Plans; and fulfillment of public needs. See 36 CFR 254.3(b) and 254.4(c)(4). Table 7.3.5-1 of the FEIS presents a comparison of how the alternatives address these factors. To determine that a land exchange serves the public interest, the authorized officer must find that: 1. The resource values and the public objectives served by the non-federal lands or interests to be acquired must equal or exceed the resource values and the public objectives served by the federal lands to be conveyed; and 2. The intended use of the conveyed federal land will not substantially conflict with established management objectives on adjacent federal lands, including Indian Trust lands (36 CFR 254.3(b)(2)). The findings and supporting rationale for the public interest determination would be documented and made part of the administrative record pursuant to 36 CFR 254.3(b)(3).	
3014	Comment# 32. The SDEIS states that modeled groundwater capture system efficiency at the tailings basin is at least 90%. However, it does not explain the basis for this estimate.	The design of the Tailings Basin capture system includes 1) a slurry wall keyed into bedrock, 2) a collection trench on the tailings side, and 3) permanent pumping of the collection trench to depress the groundwater level on the tailings side. The proposed capture system uses pumping on the	PER 05 WR 018

Comment ID	Comment	Response	Theme(s)
	Recommendation: The FEIS should provide the specific model assumptions that were used to make this determination. Recommendation: The FEIS should indicate that any discharge not captured by the proposed capture systems and entering waters of the U.S. (e.g., jurisdictional wetlands, the Partridge and Embarrass Rivers and their tributaries) is subject to NPDES permitting.	tailings side of the slurry wall to reverse hydraulic gradients across the slurry wall and in underlying bedrock inward back toward the Tailings Basin. The conceptual hydraulics of this type of system predicts that it would achieve complete or nearly complete groundwater capture in the surficial aquifer. See FEIS Figure 5.2.2-7. To more fully assess capture efficiencies, the FEIS relies on revising cross-section models from the SDEIS to evaluate containment systems on the northern, northwestern, and western sides of the Tailings Basin. The updated modeling relies on data from a 2014 field program that investigated bedrock along the alignment of the proposed capture system on the northern, northwestern, and western sides of the Tailings Basin. New data were collected on bedrock hydraulic conductivity, Rock Quality Designation, and depth to top of bedrock. Along with the new data, the revised model also considers the presence of an upper more permeable bedrock zone directly below the slurry wall. Sensitivity analyses have included variable bedrock hydraulic conductivity and different upper bedrock zone thicknesses up to 100 feet. The cross-section model results predict that the groundwater capture efficiencies of the proposed Tailings Basin capture systems would be substantially greater than 90%. This analysis supports the conclusion that the assumption of 90% or greater capture efficiency of groundwater in the surficial aquifer is justified. If the NorthMet Project Proposed Action moves ahead with permitting, the MPCA would issue a combined NPDES/SDS permit. The requirements of such a combined NPDES/SDS permit would directly address the potential for contaminants in the groundwater to impact surface waters. The NPDES/SDS permit covering the facility would prohibit a point source water discharge from the containment system that adds pollutants to waters of the U.S. See response to comment 2987 for more information.	
3016	Comment # 33. Pages 4-261 through 4-264 refer to cultural resources/Section 106 resources solely as historic properties. Recommendation: The FEIS should make it clear that cultural resources include archaeological resources.	Change has been made, as requested.	EDIT 01
3017	Comment # 34. Moose is a culturally-important species that has traditionally been subsistence	FEIS Sections 4.2.5, 4.3.5, 5.2.5, and 5.3.5 (Wildlife) have been updated to include the new state endangered, threatened, and special concern (ETSC)	WI 01

Comment ID	Comment	Response	Theme(s)
	hunted by the Chippewa Tribe. The SDEIS does not adequately describe how the proposed project will impact moose population and habitat of moose. Based on information in the SDEIS, it appears that there are unconsidered impacts to moose population and habitat, such as the proposed impacts to two local wildlife corridors, moose reliance on wetlands during warm weather, and impacts on foraging. Recommendation: The FEIS should more completely explain how the proposed action will impact moose population and habitat.	status listings from August 19, 2013, as well as new federal status listing changes. The FEIS includes a more robust analysis on effects to moose, including habitat and displacement.	
3018	Comment# 35. On March 13, 2014, MPCA released preliminary findings on the effects of sulfate on wild rice growth. Recommendation: The FEIS should provide the most current available information on MPCA's findings, and on next steps based on these findings.	The MPCA is overseeing a variety of studies on wild rice. At applicable surface water locations, the FEIS evaluates impacts using an impact criteria based on the current MPCA 10 mg/L standard for sulfate concentration in waters used for the production of wild rice. This impact assessment metric is keyed to the current regulation. It is recognized that the MPCA is currently evaluating the current wild rice sulfate water quality standard and, as part of that process, new information on potential contributing factors on the growth of wild rice has been generated. However, that information has not yet been holistically reviewed in the context of its possible influence on the wild rice standard. Future change to the wild rice sulfate standard, if any, is speculative and outside the scope of the FEIS; applying research findings outside the basis of the current rule is not appropriate.	WR 152
3019	Comment # 36. Section 5.2.14 addresses geotechnical issues at the mine. Reasonable stability analyses were conducted for the permanent waste rock pile, but it is unclear if the company has committed to designing this unit so it meets conservative static stability Factors of Safety (FOS) (static FOS of 1.5 and seismic FOS >1). The company has committed to meeting conservative FOS for both the tailings basin and the HRF. Recommendation: The FEIS should clarify the company's commitment with respect to design of	The design of the Category 1 Stockpile would need to conform with Minnesota Rule 6132.2400. FEIS Section 5.2.14.2.1 provides a summary of the design requirements for the stockpiles, including angles of repose, configured stockpile slopes, factors of safety, as well as the material tests that have occurred to date and that would be required prior to stockpile construction approval under the Permit to Mine. At closure, the Category 1 Stockpile would be covered with a geomembrane system that would be vegetated to meet the requirements of *Minnesota Rules* part 6132.2200, subpart 2, item B. The design of the Category 1 Stockpile cover system was derived from landfill requirements in *Minnesota Rules* part 7035.2815, subpart 6, item D. Long-term maintenance of the Category 1 Stockpile would include repair of erosional damage and removal of woody species and trees from the stockpile cover	GT 04

Comment ID	Comment	Response	Theme(s)
	the permanent waste rock pile.	system. The Factors of Safety estimated during slope stability are not anticipated to change due to long-term performance variation in the geomembrane. FEIS Sections 3.2.2.1.7 and 3.2.2.1.10 provide a summary of the Category 1 Stockpile, including reclamation. Further information on the design and management of the stockpiles is provided in the Geotechnical Data Package, Volume 3 (Stockpiles) (PolyMet 2014p) and the Rock and Overburden Management Plan (PolyMet 2015h). Additional geotechnical investigations to address site conditions, materials and design would be required prior to stockpile construction approval under the Permit to Mine.	
3020	Comment # 37. Liquefaction analyses were not conducted for the HRF, based on the assumption that those wastes could compress and that the likelihood of liquefaction is remote. However, liquefaction and liner leakage could occur at the HRF because the HRF is proposed to be located above a hydraulically-active seep, which will place inward hydraulic pressure on the HRF liners. Recommendation: The potential for liquefaction should be analyzed. The FEIS should clearly summarize the results of this analysis, including next steps in response to this analysis.	The Hydrometallurgical Residue Facility would be constructed using the downstream construction method, whereby dams would be built from dense, well-compacted materials prior to the placement of hydrometallurgical residue. This allows for a constructed dam that is discrete from the residue it holds. The potential for liquefaction in the dams is very low due to the proposed downstream construction method, upstream liners, seepage collection system, and well-compacted materials. While liquefaction may happen in the residue, it would not affect the integrity of the separate dam materials. FEIS Section 5.2.14.2.3, expands upon the SDEIS discussion of the design and construction of the Hydrometallurgical Residue Facility. The Geotechnical Data Package, Volume 2 (PolyMet 2014c) indicates the design would meet appropriate factors of safety. The current Hydrometallurgical Residue Facility design acknowledges the presence of an active seep in the proposed area of construction. As such, a collection drain has been designed to collect water from the active seep below the proposed constructed embankment and liner systems, and to transmit the collected seep to the exterior of the facility. This seepage collection system would include a layer of free-draining soil that would reduce the potential for phreatic build-up below the liner. Details on this design consideration are provided in Section 5.1 of the Geotechnical Data Package, Volume 2 (PolyMet 2014c). FEIS Section 4.2.14.3 describes the details of the existing conditions at the location of the proposed Hydrometallurgical Residue Facility, including the fact that it is proposed to be constructed at the location of the LTVSMC Emergency Basin. FEIS Section FEIS 3.2.2.3.7 broadly describes the Hydrometallurgical Residue Facility, while Section 5.2.14.2.3 provides details on the construction, operation, monitoring, and maintenance for geotechnical stability, including potential liquefaction. Additional technical	GT 11

Comment ID	Comment	Response	Theme(s)
		details on design and construction, factors of safety analysis, operation and management, and reclamation and closure are found in the Geotechnical Data Package, Volume 2 (PolyMet 2014c) the Residue Management Plan (PolyMet 2014r). Details would be finalized in permitting and would be subject to periodic reassessment.	
Comments from the USEPA Regarding Section 404 Permit (Submission ID 47835)			
3021	The alternatives analysis in the application references the 2009 Draft Environmental Impact Statement (DEIS) and 2013 Supplemental Draft Environmental Impact Statement (SDEIS), but does not include the necessary detail to determine that the preferred alternative is the Least Environmentally Damaging Practicable Alternative (LEDPA). Since the DEIS was published in 2009, the project has evolved and many alterative have been eliminated. Chapter 6 in the application describes some of those alternatives as they relate to direct wetland impacts; it is not a comprehensive list of alternatives, and it does not consider indirect impacts to wetlands and streams. EPA recommends that the applicant develop a table describing all alternatives considered during the environmental review process (e.g., mine methods, mine configurations, tailings processing options). The table would assist EPA in determining whether or not the preferred alternative is the LEDPA. The table should also include the reasons each alternative was eliminated, including references, and the potential direct and indirect effects to wetlands and streams.	The LEDPA process is described in FEIS Section 7.5. The ROD for the USACE would include the Section 404(b)(1) analysis and the public interest review, and would determine the LEDPA. Furthermore, the ROD for the USACE cannot be finalized until 30 days after release of an FEIS. Any comments received during the 30 day period may be considered in the ROD for the USACE. The ROD for the USACE would recommend issuance, issuance with conditions, or denial of the Project. Please also refer to FEIS Sections 3.2.3, FEIS Tables 3.2-16 and 3.2-17 for information on alternatives for the NorthMet Project and Section 3.3.3 for information on alternatives for the Land Exchange and Chapter 7 for additional information on alternatives. This would be considered during the Section 404 permitting process.	COE 04
3022	The application does not provide a quantitative assessment of all indirect impacts (except for fragmentation impacts). We recognize that the heterogeneity of the project site and the complexity of the wetlands and hydrology make it difficult to quantity indirect impact, but we recommend that specific impacts to wetlands	FEIS Section 5.2.3.3 has been revised to include more information on the monitoring and mitigation plan for the potential indirect wetland effects. The indirect effects analyses performed for the EIS were not performed to characterize impacts but were done to inform where monitoring should take place for those areas that were identified as having a potential for indirect wetland effects. As a result of these analyses performed to determine where monitoring should occur, quantification of wetland types and acres of	COE 02

Comment ID	Comment	Response	Theme(s)
	within the mine site be identified to the extent possible. The application should better estimate the changes in functions and values at wetlands, especially those surrounded by mine features.	potential indirect wetland effects were also generated. FEIS Section 5.2.3 provides these quantitative values of potential indirect wetland effects. Potential indirect wetland effects from the NorthMet Project Proposed Action were assessed as a result from one of the following six factors: 1) wetland fragmentation; 2) change in wetland hydrology from changes in watershed area; 3) changes in wetland hydrology from groundwater drawdown resulting from open pit mine dewatering; 4) changes in wetland hydrology from groundwater drawdown resulting from operation of the Plant Site, including groundwater mounding and seepage containment; 5) changes in stream flow near the Mine Site and Plant Site and associated effects on wetlands abutting the streams; and 6) change in wetland water quality related to atmospheric deposition of dust and rail car spillage associated with Mine Site and Plant Site operations. The assessments provided wetland type and acreage for all six factors; however, only wetland acreages were provided for factor 6 (change in wetland water quality related to atmospheric deposition of dust and rail car spillage associated with Mine Site and Plant Site operations). Dust, ore spillage, and stockpile leakage is not a regulated discharge to wetlands under the Section 404 of the CWA; however, USACE would consider these types of potential effects in their determination of the LEDPA under the Section 404(b)(1) permit alternative analysis. The potential effects of dust, ore spillage, and stockpile leakage would be evaluated by MPCA under the Section 401 Water Quality Certification and NPDES permitting.	
3023	Specifically, EPA is concerned that there will be indirect impacts to remaining wetland areas in Wetlands Nos. 33A, 45, 48, 57, 68, 101, 88, 96, and 107. Indirect impacts in these wetland areas will include habitat fragmentation, divisions in vegetative communities, and the general loss of functions in wetlands that are separated from adjacent wetlands and made smaller by mine features. Specific compensatory mitigation should be proposed for all losses of wetland functions (including identification of ratios and site locations).	FEIS Section 5.2.3.1.2 has been updated to provide more information on the methodology and criteria for determining potential indirect fragmented wetland effects. The wetland fragments that are not expected to maintain their functions, approximately 26.9 acres, have been identified in FEIS Section 5.2.3 and on Figure 5.2.3-1. PolyMet's proposed mitigation for the NorthMet Project Proposed Action would be providing upfront compensatory mitigation for the 26.9 acres of wetland fragmentation (see FEIS Tables 5.2.3-17, 5.2.3-18, 5.2.3-19). The monitoring and mitigation requirements for indirect effects, including fragmentation, would be determined during permitting. The wetland fragments that have not been accounted for in the upfront mitigation would be included in the wetland hydrology and vegetation monitoring plan that would be developed and implemented for the NorthMet Project Proposed Action. FEIS Section 5.2.3.3 includes a detailed discussion on the monitoring and mitigation plan for the indirect wetland effects. The proposed wetland impact, avoidance,	COE 01

Comment ID	Comment	Response	Theme(s)
		minimization, mitigation and monitoring plan presented in the FEIS would be reviewed, modified as required, and approved during permitting; therefore, this information could change during permitting.	
3024	Large Figure 9 and 10 and Large Table 2 in the application highlight wetland areas at the mine and plant sites where the proposed mine features would indirectly impact wetlands by fragmentation. Compensatory mitigation is proposed for those areas. Page 3 of the Wetland Analysis Workplan (Attachment B) gives a brief description of how fragmented wetlands were identified, but the application should also describe the impact thresholds and how the fragmentation impact criteria were developed.	FEIS Section 5.2.3.1.2 has been updated to provide more information on the methodology and criteria for determining potential indirect fragmented wetland effects. The wetland fragments that are not expected to maintain their functions, approximately 26.9 acres, have been identified in FEIS Section 5.2.3 and on Figure 5.2.3-1. PolyMet's proposed mitigation for the NorthMet Project Proposed Action would be providing upfront compensatory mitigation for the 26.9 acres of wetland fragmentation (see FEIS Tables 5.2.3-17, 5.2.3-18, 5.2.3-19). The monitoring and mitigation requirements for indirect effects, including fragmentation, would be determined during permitting. The wetland fragments that have not been accounted for in the upfront mitigation would be included in the wetland hydrology and vegetation monitoring plan that would be developed and implemented for the NorthMet Project Proposed Action. FEIS Section 5.2.3.3 includes a detailed discussion on the monitoring and mitigation plan for the indirect wetland effects. The proposed wetland impact, avoidance, minimization, mitigation and monitoring plan presented in the FEIS would be reviewed, modified as required, and approved during permitting; therefore, this information could change during permitting.	COE 02
3025	Page 58 of the application states that the purpose of the indirect impacts analysis is to inform the monitoring plan for indirect wetland impacts. The application should include a description of how the impacts analysis will be used to ensure that indirect impacts are avoided, minimized, and mitigated. Section 11-5 in the application implies that the indirect impact monitoring plan will focus on wetlands that are under threat by multiple indirect impact factors (Table 11-1); this is not a valid approach because even wetlands that are under risk of one factor (such as only drawdown or only decreased water quality) would result in a loss of wetland function. We recommend more comprehensive monitoring for indirect impacts at the plant and mine sites.	FEIS Section 5.2.3.3 has been revised to include more information on the monitoring and mitigation plan for the potential indirect wetland effects. The indirect effects analyses performed for the EIS were not performed to characterize impacts but were done to inform where monitoring should take place for those areas that were identified as having a potential for indirect wetland effects. As a result of these analyses performed to determine where monitoring should occur, quantification of wetland types and acres of potential indirect wetland effects were also generated. FEIS Section 5.2.3 provides these quantitative values of potential indirect wetland effects. Potential indirect wetland effects from the NorthMet Project Proposed Action were assessed as a result from one of the following six factors: 1) wetland fragmentation; 2) change in wetland hydrology from changes in watershed area; 3) changes in wetland hydrology from groundwater drawdown resulting from open pit mine dewatering; 4) changes in wetland hydrology from groundwater drawdown resulting from operation of the Plant Site, including groundwater mounding and seepage containment; 5) changes in stream flow near the Mine Site and Plant Site and associated	COE 02

Comment ID	Comment	Response	Theme(s)
		effects on wetlands abutting the streams; and 6) change in wetland water quality related to atmospheric deposition of dust and rail car spillage associated with Mine Site and Plant Site operations. The assessments provided wetland type and acreage for all six factors; however, only wetland acreages were provided for factor 6 (change in wetland water quality related to atmospheric deposition of dust and rail car spillage associated with Mine Site and Plant Site operations).	
3026	The application does not describe monitoring for stream impacts surrounding the project areas. We recommend that the U.S. Army Corps of Engineers (Corps) require monitoring for indirect impacts to headwater streams surrounding the site as well as impacts to wetlands.	FEIS Section 5.2.3.3 has been revised to include more information on the monitoring and mitigation plan for the potential indirect wetland effects. Proposed wetland hydrology monitoring locations for determining whether potential indirect effects are occurring are shown on Figures 5.3.2-31 and 5.2.3-32 of the FEIS. Wetland hydrology and vegetation would be monitored, and additional monitoring locations may be considered during permitting. The wetland mitigation and monitoring would be reviewed and approved by the appropriate regulatory agencies responsible for authorizing the permit application during the permitting process.	COE 02
3027	There is a potential for indirect impacts to wetlands, Spring Mine Creek, and Spring Mine Lake on the east side of the tailings basin, but no monitoring sites are proposed for that area. Wetland and stream monitoring sites should be required for the east side of the tailings basin.	FEIS Section 5.2.3.3 has been revised to include more information on the monitoring and mitigation plan for the potential indirect wetland effects. Proposed wetland hydrology monitoring locations for determining whether potential indirect effects are occurring are shown on Figures 5.3.2-31 and 5.2.3-32 of the FEIS which includes a wetland hydrology monitoring well located east of the Plant Site along Spring Mine Creek and west of Spring Mine Lake. Wetland hydrology and vegetation would be monitored, and additional monitoring locations may be considered during permitting. The wetland mitigation and monitoring would be reviewed and approved by the appropriate regulatory agencies responsible for authorizing the permit application during the permitting process.	COE 02
3028	Section 17.1 of the application describes that wetland monitoring wells 1, 4a, 6, 10, 12, 15, and 21 are "being removed because they are either within the direct project impacts or areas where no potential indirect impacts are anticipated". Figure 16 shows Wells 4a, 6, 10, 12, and 15 just outside the project boundary and between mine features and Yelps Creek and the Partridge River. These wells are in wetland areas that would likely be impacted by adjacent mine features because of their close proximity to the mine features and	FEIS Section 5.2.3.3 has been revised to include more information on the monitoring and mitigation plan for the potential indirect wetland effects. Proposed wetland hydrology monitoring locations for determining whether potential indirect effects are occurring are shown on Figures 5.3.2-31 and 5.2.3-32 of the FEIS. Wetland hydrology and vegetation would be monitored, and additional monitoring locations may be considered during permitting. The wetland mitigation and monitoring would be reviewed and approved by the appropriate regulatory agencies responsible for authorizing the permit application during the permitting process.	COE 06

Comment ID	Comment	Response	Theme(s)
	wetland areas. For a more comprehensive impacts analysis, we recommend that the applicant continues to monitoring at the existing wells where they are outside the direct mine impact locations. Because there are baseline hydrologic data at these locations, changes in wetland hydrology, if they occur, should be evident.		
3029	Some wetland types, such as coniferous and open bogs, are sensitive to subtle changes in hydrology. A 50% change in hydroperiod (the proposed impact criteria) may not be an adequate measure of adverse impacts to the wetland vegetation communities. The applicant should include a more complete description of impact criteria and rationale for the proposed monitoring and reporting schedule.	The wetland mitigation and monitoring section of the FEIS, Section 5.2.3.3, has been revised to include additional details on the proposed monitoring and wetland adaptive monitoring plan. The wetland mitigation and monitoring would be reviewed and approved by the appropriate regulatory agencies responsible for authorizing the permit application during the permitting process. Please refer to the response to theme COE 06.	COE 02
3030	Section 17.4 of the application states that wetland baseline conditions for wetland vegetation will be established during the first growing season after permit issuance. EPA recommends that the Corps require baseline vegetation monitoring prior to permitted impacts to ensure that a true pre-impact baseline is established.	FEIS Section 5.2.3.3 has been revised to include more information on the monitoring and mitigation plan, which includes vegetation monitoring, for the potential indirect wetland effects.	COE 06
3031	The vegetation monitoring is proposed for every 5 years. The basis for the proposed monitoring frequency is not clear from the application. Effectively managing certain threats to the wetlands, such as invasive species or vegetation changes due to drawdown, requires early detection, and monitoring every 5 years might not be sufficient to adequately manage the threat. . EPA recommends increasing monitoring for vegetation changes to every 2 years to better be able to identify and manage any adverse impacts to wetlands early.	The wetland mitigation and monitoring section of the FEIS, Section 5.2.3.3, has been revised to include additional details on the proposed monitoring and wetland adaptive monitoring plan. The wetland mitigation and monitoring would be reviewed and approved by the appropriate regulatory agencies responsible for authorizing the permit application during the permitting process.	COE 06
3032	The adaptive management plan described in Section 17.8 uses a phased approach to assessing indirect impacts and providing compensatory	The wetland mitigation and monitoring section of the FEIS, Section 5.2.3.3, has been revised to include additional details on the proposed monitoring and wetland adaptive plan. The wetland mitigation and monitoring would	COE 02

Comment ID	Comment	Response	Theme(s)
	mitigation for adverse impacts to aquatic resources. Phase I is described a broad based monitoring; while Phase II would be a more detailed assessment. In order to determine if the adaptive management plan is sufficient, EPA needs more information on the timing and methodology of Phases I and II of the monitoring plan. EPA is concerned that Phase II monitoring would not be designed unless deemed necessary, and that the threshold for determining a need for Phase II is not described. Clear impact criteria must be established and potential mitigation options must be developed prior to permit issuance. EPA recommends that Phase II be planned prior to permit issuance to ensure that wetland and stream impacts are not missed.	be reviewed and approved by the appropriate regulatory agencies responsible for authorizing the permit application during the permitting process.	
3033	The application lacks a description of cumulative effects to the aquatic resources within the watersheds except as they apply to wildlife corridors (Section 12.1.2.3). Cumulative Wetland Impacts (Section 5.3) is included in the March 1, 2013 Wetland Data Package V.7, but it is not referenced in the application. It is not clear if this analysis is includes recently proposed projects, as it seems to be missing projects in the iron range (e.g., MINNTAC and UTAC). The cumulative effect assessment in the application should include the most recent and comprehensive information.	FEIS Section 6.2.3.1 provides a description of the approach that was used for the wetland cumulative analysis. The direct, indirect, and cumulative assessments that were performed for the NorthMet Project Proposed Action were agreed upon by the Wetland Impact Assessment Planning Group and per the Wetland Analysis Work Plan (PolyMet 2011m). The following projects were not considered in the wetland resources cumulative analysis as they are outside the Partridge and Embarrass River watersheds: U.S. Steel Minntac mine expansion, U.S. Steel Keetac expansion, United Taconite Tailings Basin, and Cliffs Erie's mine pit expansion. Those projects that were considered reasonably foreseeable and within the Partridge and Embarrass River watersheds were considered in the wetland cumulative analysis. Please refer to the response to themes COE 07, CU 02, and WET 18. Please refer to FEIS Section 6.2.6 for a discussion of aquatic resources.	COE 07
3034	Indirect impacts are not included in the cumulative impacts assessment for wetlands in the Wetlands Data Package V. 7. All adverse impacts to aquatic resources should be considered in this assessment.	It is difficult to predict potential indirect wetland effects within the CEAA, as well as to know what the potential indirect wetland effects would be for the projects assessed other than the NorthMet Project Proposed Action. However, based on the amount of potential indirect wetland effects that could occur from the NorthMet Proposed Action, there could be 0.1 to 12.0% cumulatively lost, in addition to the direct wetland impacts assessed, within the Partridge and Embarrass River watersheds as a result of the	COE 07

Comment ID	Comment	Response	Theme(s)
		NorthMet Project Proposed Action. The total wetland resources within the two watersheds during the time periods assessed are as follows: • Pre-settlement wetland resources - 68,251 acres; • Existing conditions wetland resources - 65,567 acres; • Foreseeable future conditions with the NorthMet Project Proposed Action and the other foreseeable projects assessed, which includes direct wetland impacts and future deepwater habitat - 64,979 acres; and • Foreseeable future conditions without the NorthMet Project Proposed Action but with the other foreseeable projects assessed, which includes direct wetland impacts and future deepwater habitat (No Action Alternative) - 65,292 acres. Based on the wetlands crossing analog zones analysis approach, the acreage of wetlands whose hydrology would have a high likelihood of being affected by drawdown at the Mine Site is 866.9 acres. The wetlands categorized as high likelihood are dominated by one alder thicket (848 acres) that has approximately 4 acres (less than 1%) within the 0-1,000 ft analog impact zone. The remainder of this wetland (more than 99%) is located more than 1,000 ft away from the edge of the mine pits and extends out to the edge of Area 1 (see Figure 5.2.3-6 in the FEIS). Furthermore, based on this method, there would be 1,854.5 acres of wetlands within the 0-2,000 ft zone and 2,147.6 acres within the 0-3,500 ft zone that could be affected by potential drawdown. Based on this approach, the total projected potential indirect effects from all six factors that were assessed under this method could be up to 7,694.2 acres of wetlands potentially indirectly affected by the NorthMet Project Proposed Action. Therefore, the potential indirect cumulative effect from the NorthMet Project Proposed Action, in addition to the direct wetland impacts assessed, under this method would range between 1.3 to 12.0%. Based on the method approach of wetlands within analog zones, the acreage of wetlands whose hydrology would have a high likelihood of being affected by drawdown at the Mine Site is 46.4 acres. Furthermore, based on this method, there would be 348.4 acres of wetlands within the 0-2,000 ft zone and 733.3 acres within the 0-3,500 ft zone that could be affected by potential drawdown. Based on this approach, the total projected potential indirect effects from all six factors that were assessed under this method could be up to 6,568.8 acres of wetlands potentially indirectly	

Comment ID	Comment	Response	Theme(s)
		affected by the NorthMet Project Proposed Action. Therefore, the potential indirect cumulative effect from the NorthMet Project Proposed Action, in addition to the direct wetland impacts assessed, under this method would range between 0.1 to 10.2%.	
3035	The analysis of cumulative effects in the Wetland Data Package V.7 evaluates the percentage loss of all wetland types. Many of the wetlands proposed to be impacted at the Polymet site are high quality bog and forested resources, and indirect impacts of mining often include wetland type changes due to changes in hydrology. The cumulative loss of different wetland types should also be evaluated.	It is difficult to predict potential indirect wetland effects within the CEAA, as well as to know what the potential indirect wetland effects would be for the projects assessed other than the NorthMet Project Proposed Action. However, based on the amount of potential indirect wetland effects that could occur from the NorthMet Proposed Action, there could be 0.1 to 12.0% cumulatively lost, in addition to the direct wetland impacts assessed, within the Partridge and Embarrass River watersheds as a result of the NorthMet Project Proposed Action. The total wetland resources within the two watersheds during the time periods assessed are as follows: • Pre-settlement wetland resources - 68,251 acres; • Existing conditions wetland resources - 65,567 acres; • Foreseeable future conditions with the NorthMet Project Proposed Action and the other foreseeable projects assessed, which includes direct wetland impacts and future deepwater habitat - 64,979 acres; and • Foreseeable future conditions without the NorthMet Project Proposed Action but with the other foreseeable projects assessed, which includes direct wetland impacts and future deepwater habitat (No Action Alternative) - 65,292 acres. Based on the wetlands crossing analog zones analysis approach, the acreage of wetlands whose hydrology would have a high likelihood of being affected by drawdown at the Mine Site is 866.9 acres. The wetlands categorized as high likelihood are dominated by one alder thicket (848 acres) that has approximately 4 acres (less than 1%) within the 0-1,000 ft analog impact zone. The remainder of this wetland (more than 99%) is located more than 1,000 ft away from the edge of the mine pits and extends out to the edge of Area 1 (see Figure 5.2.3-6 in the FEIS). Furthermore, based on this method, there would be 1,854.5 acres of wetlands within the 0-2,000 ft zone and 2,147.6 acres within the 0-3,500 ft zone that could be affected by potential drawdown. Based on this approach, the total projected potential indirect effects from all six factors that were assessed under this method could be up to 7,694.2 acres of wetlands potentially indirectly affected by the NorthMet Project Proposed Action. Therefore, the potential	COE 07

Comment ID	Comment	Response	Theme(s)
		indirect cumulative effect from the NorthMet Project Proposed Action, in addition to the direct wetland impacts assessed, under this method would range between 1.3 to 12.0%. Based on the method approach of wetlands within analog zones, the acreage of wetlands whose hydrology would have a high likelihood of being affected by drawdown at the Mine Site is 46.4 acres. Furthermore, based on this method, there would be 348.4 acres of wetlands within the 0-2,000 ft zone and 733.3 acres within the 0-3,500 ft zone that could be affected by potential drawdown. Based on this approach, the total projected potential indirect effects from all six factors that were assessed under this method could be up to 6,568.8 acres of wetlands potentially indirectly affected by the NorthMet Project Proposed Action. Therefore, the potential indirect cumulative effect from the NorthMet Project Proposed Action, in addition to the direct wetland impacts assessed, under this method would range between 0.1 to 10.2%.	
3036	The mitigation ratios proposed in the application conform to the conditions included in the Corps' May 29, 2013 Memorandum: Application of the Federal Mitigation Rule and St. Paul District Policy Guidance on Compensatory Mitigation-Compensation Ratios for Loss of Wetlands/Aquatic Resources. EPA agrees that the mitigation ratios proposed in the Corps' Memorandum were reasonable.	The USACE has not made a final decision on the mitigation ratios that would be required to compensate for direct wetland impacts. The FEIS (see Section 5.2.3.3) includes the proposed direct compensatory mitigation credits and ratios for the NorthMet Project Proposed Action (see FEIS Tables 5.2.3-17, 5.2.3-18, 5.2.3-19), which are based on the federal guidance policies and state replacement ratio rules. The amount of credit generated by the mitigation sites would ultimately be determined by the permitting agencies. This would be based on the extent to which the sites meet the target goals established during permitting. These include, among other things, restoration of wetland appropriate hydrology and the establishment of a target plant community or type.	COE 12
3037	One concern that remains is that no compensatory mitigation plan exists for indirect impacts to wetlands and streams. Table 11-1 of the application indicates that more than 7,300 acres of wetland would be potentially impacted by the proposed project. Because in-watershed mitigation is so difficult to find, mitigation options for indirect impacts must be discussed in the application.	FEIS Section 5.2.3.3 has been revised to include more information on the monitoring and mitigation plan for the potential indirect wetland effects. The USACE would also consider the application of financial assurances for potential indirect wetland effects and monitoring. Both the USACE and state would require consideration of financial assurances during the permitting process.	COE 02
3038	EPA remains concerned that a majority of the compensatory mitigation for impacted wetlands will occur outside the St. Louis River and Lake	This comment provides general information regarding mitigation that should be considered for wetland mitigation in the future. No changes were made to the FEIS as a result of this comment.	COE 13

Comment ID	Comment	Response	Theme(s)
	Superior Watersheds. This constitutes a permanent loss of aquatic resources within these watersheds. EPA understands that it is difficult to find in-watershed wetland mitigation opportunities, but the soon to be implemented Northeast Minnesota Wetland Mitigation Strategy may support the Corps and permit applicants to better implement a watershed approach to mitigation. Once implemented, EPA recommends that the strategy be used to find additional wetland mitigation sites within the St. Louis and Lake Superior Watersheds to compensate for indirect wetland impacts at the Polymet Site.		
Comments from the Bois Forte Band (Submission ID 42979)			
2974	The Area of Potential Effect (APE) for cultural resources divided the project into two separate sections surrounding the proposed mine site and the proposed plant site should be revised….An APE that encompasses the Mine and Plant sites and surrounding area affected by operations would better describe the undertaking for cultural resource investigations.	FEIS Section 4.2.9.2.3 provides a detailed discussion and analysis of the area in which cultural resources may be affected by the NorthMet Project Proposed Action. The APE takes into account both direct and indirect effects using a geographically expansive area that accounts for direct effects, as well as visual, audible, atmospheric, hydrological, and water quality effects. The APE is based on extensive modeling and other analysis completed for the NorthMet Mining Project and Land Exchange and includes an area much broader than the Plant Site and Mine Site. Since the SDEIS, the APE has been modified to encompass the proposed Mine Site and Plant Site, the Dunka Road corridor, several federal parcels included in the Land Exchange Proposed Action, and the Colby Lake Pumphouse and pipeline.	CR 02
2975	Mesabe Widjiu is correctly identified as a sacred landform, but needs to be considered in its entirety (see attached map as an example). The segment encountered within the project area is small, but integral to the property. Adverse effects to any portion impact the entire feature.	The federal Co-lead Agencies have determined the Partridge River section of the Mesabe Widjiu to be eligible for inclusion in the NRHP under Criterion A for its association with important Ojibwe spiritual and cultural practices. Although the federal Co-lead Agencies are assessing the effects of the NorthMet Project Proposed Action on only the portion of the Mesabe Widjiu within the APE, it is recognized that the property and its significance extends beyond the APE. The federal Co-lead Agencies have updated the FEIS to include a graphic of the entire Mesabe Widjiu, as provided by the consulting Bands.	CR 02 CR 05
2976	The Beaver Bay to Lake Vermilion Trail requires further clarification….Additional fieldwork should be conducted in the spring or fall when ephemeral	The federal Co-lead Agencies believe that the work to justify consideration of the BBLV Trail Segment as an historic property is complete. There has been sufficient background research and fieldwork completed to date as	CR 05

Comment ID	Comment	Response	Theme(s)
	features such as foot trails are less easily concealed by vegetation and more easily discerned.	discussed in FEIS Section 4.2.9.2.3. Additional research and fieldwork may be part of any resolution of adverse effect.	
2977	The Bois Forte THPO is skeptical of the co-leads claim that there will be no effect to the Spring Lake Mine Sugarbush from the proposed NorthMet Project. Indirect effects through dust deposition and unauthorized collection are anticipated since the Sugarbush is situated immediately adjacent to the proposed plant site. While the lead agencies dismiss particulate accumulation as a problem, based on visual effects analysis is conducted for the project and a site visit in 2010, their lack of concern seems speculative. The proximity of the plant site to the Sugarbush and the cumulative effects of dust on leaves, trees and understory flora have not been examined in detail and their long term effects may well be detrimental to vegetation, other than maples, that comprise the Sugarbush. Furthermore, the potential for artifact collection is quite real. When the land containing the site was owned by Cleveland Cliffs, persons employed by the mine removed artifacts associated with Band member use of the Sugarbush. This assertion is based on a donation made to the Bois Forte Heritage Museum by an individual who conducted logging operations on LTV property in the 1970's. When asked where he had found the items, a ladle, bowl, birch bark sap baskets and cedar spiles, he described the location of the Spring Lake Mine Sugarbush and the wooden structure remnants noted by Michael Loftus (1977). Remnants of the structure still exist (see SDEIS 4.2.9.2.4). Loftus also removed artifacts when he visited the Sugarbush in the 1960's.	The NorthMet project would have fugitive dust emissions. To evaluate the impact of those fugitive dust emissions, air quality modeling was conducted to assess impacts from those emissions. The modeled results determined impacts to be below applicable air quality standards. The FEIS used the evaluation criteria available to determine impacts. Secondary ambient air quality standards are used to provide public welfare protection, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings. Significant impact on water resources or historic properties from dust is not expected because areas with the potential to generate dust would be controlled by a Fugitive Dust Control Plan and any dust leaving the site would most likely come from sources that would be characterized as having low sulfide/low metal content, All active areas at the Mine Site and Plant Site would be subject to a Fugitive Dust Control Plan approved by the MPCA, which describes management of fugitive dust generated from unpaved roads across the NorthMet Project Proposed Action area, rock dumping and loading locations on the Mine Site, and areas potentially subject to wind erosion on the Plant Site (see Sections 4.1.6 and 4.3.9 of PolyMet 2015a, as cited in the FEIS). As discussed in FEIS Section 5.2.9.2.1, the federal Co-lead Agencies have determined that the NorthMet Project Proposed Action would adversely affect the Spring Mine Lake Sugarbush. As part of an MOA, the federal Co-lead Agencies would ensure the avoidance, minimization, and mitigation of impacts to cultural resources that may be encountered, such as unauthorized collection, during construction or operation of the NorthMet Project Proposed Action. The federal Co-lead Agencies, in consultation with the Bands, SHPO, and PolyMet, are currently working to resolve adverse effects on this property.	AIR 04 AIR 05
2978	the three properties [Mesabe Widjiu, Beaver Bay to Lake Vermillion Trial, and Spring Lake Mine Sugarbush] would benefit from additional	The federal Co-lead Agencies have officially documented the Spring Lake Mine Sugarbush with the SHPO. The federal Co-lead Agencies believe that there has been sufficient background research and fieldwork to justify	CR 02 CR 05

Comment ID	Comment	Response	Theme(s)
	investigation; the sugarbush has not been formally recorded, the trail has been adequately documented within the SNF proposed land exchange, but requires additional survey in the upland sections of the project area and Mesabe Widjiu should be considered in its entirety. Finally, all three must be formally nominated to the National Register of Historic Places.	consideration of the BBLV Trail Segment as an historic property. Additional research and fieldwork may be part of any resolution of adverse effect. The federal Co-lead Agencies have determined the Partridge River section of the Mesabe Widjiu and the Partridge River section of the BBLV Trail Segment to be eligible for inclusion in the NRHP under Criterion A; however, the federal Co-lead Agencies are assessing the effects of the NorthMet Project Proposed Action on only the portion of those properties within the APE. The federal Co-lead Agencies recognize that the two properties discussed above extend beyond the APE. All three historic properties have been determined eligible for the NRHP. The Co-lead Agencies, in consultation with the Bands, SHPO, and PolyMet, are currently working to resolve adverse effects on these properties. National Register Nomination of these properties may be part of an MOA; however, the federal Co-lead agencies are currently in the process of considering what mitigations may be appropriate.	
2979	Acknowledgement by the SDEIS authors that adjacent habitat is available signifies a lack of analytical rigor in effects assessment of wholesale population displacement in response to mining activity….The SDEIS fails to assess cumulative effects to wildlife population changes, not only in the project area, but the entire region. The co-lead agencies should document how habitat destruction and concomitant wildlife migration will affect local and regional ecology.	The FEIS wildlife sections include an analysis of wildlife displacement effects due to the NorthMet Project Proposed Action. FEIS Section 5.2.5.2.3 discusses the potential effects to species at the NorthMet Project area based on habitat preferences, and uses available scientific literature to analyze displacement effects on local and regional ecology due to noise or increased human activities. FEIS Section 6.2.5.4.2 discusses displacement of wildlife by effects to wildlife corridors across the Mesabi Iron Range.	WI 05
2980	Cooperating agencies' concerns with cumulative effects remain valid and germane, but have yet to be addressed by the Lead Agencies.	The Co-lead Agencies considered the information included in the Tribal Cooperating Agencies' cumulative effects assessment and found no compelling information or analysis to change the original approach or conclusions.	CU 12
3097	A 216,300 acres area bounded by the St Louis River, Lake Superior, Lake Vermilion and the Beaver Bay to Vermilion Trail better describes cultural resources to be effected by the NorthMet project.	The historic district proposed by the Grand Portage Band in a June 27, 2013 letter was addressed. The federal Co-lead Agencies have considered an expanded area for analysis of cumulative effects on cultural resources and natural resources of significance to the Bands, including use of the 1854 Ceded Territory as the CEAA. Use of the 1854 Ceded Territory as the CEAA for cultural resources would actually diminish the significance of any cumulative effects. By evaluating the effects of the NorthMet Project Proposed Action along with other past, present, and reasonably foreseeable future projects in the context of a much larger area with a much larger	CR 04

Comment ID	Comment	Response	Theme(s)
		number of resources similar to those affected by the NorthMet Project Proposed Action, the effect of the NorthMet Project Proposed Action on those resources is diminished. The cumulative effects analysis focuses on the specific resources, or types of resources, affected by the NorthMet Project Proposed Action within an area that is geographically meaningful considering the project under review. Cumulative effects are discussed and addressed differently based on the affected resource. Discussions related to socioeconomics, for instance, use an expanded analysis area compared to other resources. Such expanded analysis areas are used as appropriate. The Cultural Resources sections in FEIS Chapters 4, 5, and 6 address the Co-lead Agencies' determination of the NorthMet Project Proposed Action's direct, indirect, and cumulative areas of potential effect.	

Comment ID	Comment	Response	Theme(s)
Comments from the Grand Portage Band (Submission ID 42994)			
2362	Regardless of the time taken to prepare it, the Band is reissuing many of the same comments on the SDEIS that it has issued on the last DEIS calling for basic evaluation of Project impacts and application of well-established CEQ standards for EIS preparation, and incorporates all those comments by reference here. See Band's Cmts. on DEIS at Ex. A (Band's Cmts. on June 2008 PDEIS) and Ex. B (Band's Cmts. on Jan. 2009 PDEIS).	Comments provided by the Cooperating Agencies were considered. FEIS Chapter 8 outlines the engagement process with the Cooperating Agencies through the development of the EIS. During the development of the SDEIS, major differences of opinion (MDOs) regarding the analysis presented in the document were identified. These MDOs are between the Co-lead Agencies and the Bands, GLIFWC, and the 1854 Treaty Authority, and represent comments from the Tribal Cooperating Agencies that the Co-lead Agencies determined were adequately addressed in the existing analysis. The MDOs are discussed in SDEIS (and FEIS) Chapter 8. Comments submitted by the Bands on the SDEIS included comments reflecting the MDOs. In addressing and developing detailed responses to those comments, the Co-lead Agencies also addressed many aspects of the MDOs. In developing the FEIS, the Co-lead Agencies engaged in ongoing interaction regarding MDOs with the Bands/Tribal Cooperating Agencies. The Co-lead Agencies shared with the Bands how they intended to respond to the Bands' comments, how the MDOs were addressed in the FEIS, and which MDOs had achieved some resolution. FEIS Table 8-1 in Chapter 8 notes where and how the MDOs are addressed in the FEIS. Although it is beneficial to resolve differences of opinion on a project, major differences of opinion often remain unresolved throughout the analysis process. In making decisions on proposed activities, responsible officials utilize information in the FEIS addressing differences of opinion to inform their decisions and to support rationale for those decisions.	NEPA 12
2364	The co-lead agencies have refused to extend the 90-day comment period on the SDEIS, despite repeated requests.	The SDEIS was circulated for public comment for 90 days, which is twice the amount of time required by the federal regulations, and three times the amount of time required by state regulations.	NEPA 07
2365	The SDEIS does not take the required "hard look" at all the environmental consequences of the Project, including polluting surface and groundwater resources and drying up or inundating thousands of acres of wetlands in the 1854 Ceded Territory.	The Co-lead Agencies believe that the EIS contains adequate information and analyses consistent with NEPA and MEPA guidance and best practices. Please refer to the response to themes NEPA 14 and NEPA 09 for more detail.	NEPA 14
2366	The lead agencies must significantly supplement the SDEIS [with study of the adverse effects and determination of possible mitigation measures]	The Co-lead Agencies believe that the EIS contains the best available data and analyses, consistent with NEPA and MEPA guidance and best practices.	NEPA 09

Comment ID	Comment	Response	Theme(s)
	and provide a full opportunity for agency and public review before issuing a final EIS.	The Co-lead Agencies reviewed all applicable documentation submitted by the proposer to fully understand the NorthMet Project Proposed Action. These included detailed technical design documents, including the Project Description, Mine Plan, and several resource-specific management plans, all of which are summarized in FEIS Chapter 3. The level of detail describing the NorthMet Project Proposed Action provided in the EIS is consistent with the requirements of NEPA/MEPA for similar projects at this stage of environmental review. The Co-lead Agencies believe that the project description was sufficient to support a comprehensive scientific analysis of potential impacts to allow decision makers to make informed decisions on the NorthMet Project Proposed Action. The proposer would be required to provide more detailed information as the project is refined during the permit process, much of which would require additional public review.	
2372	In the SDEIS's evaluation of the underground mining alternative, the North Met Deposit is characterized as a "low- to medium-grade mineral resource," a far cry from the "one of the largest untapped deposits of copper and nickel, and other precious metals" or "world class resource" that is repeated throughout the SDEIS and in media coverage. The distinction is critical, as mining must provide sufficient profit to cover costs for adequate environmental protections and financial assurance.	Information obtained through preliminary exploration in the region show that the area potentially contains one of the largest untapped deposits of copper, nickel, and other precious metals in the world.. The NorthMet Deposit is characterized as a low- to medium-grade mineral resource. These two characterizations are not in conflict as the commenter seems to suggest. One is a regional characterization while the other applies to the specific NorthMet Deposit being proposed by PolyMet to be mined. See the response to theme ALT 01 for more details on the Underground Mining Alternative. FEIS Section 3.2.3.4.1 states that tonnage/volume and grade of rock would not generate enough revenue to pay for costs associated with underground mining. The FEIS Executive Summary and FEIS Section 3.2.2.1.2 states that the NorthMet Deposit is a low- to medium-grade deposit, matching the language in Appendix B. FEIS Section 3.2.2.4 includes available details regarding financial assurance. Additional details on the cost estimates and calculations that would be required for the project would be addressed during permitting. Specific infrastructure timelines and life expectancies of equipment would be accounted for during permitting as well. FEIS Table 3.2-15 provides financial assurance cost estimates for various years of closure, as well as for monitoring and mitigation costs. FEIS Section 3.2.2.4.1 discusses the activities that would be considered in cost estimates, and states that cost estimates would be updated annually under the Permit to Mine. *Minnesota Rules* 6132.1200, Subpart 3 states that cost estimates shall be annually adjusted, using current dollar value at the time of the estimate.	PD 25

Comment ID	Comment	Response	Theme(s)
2373	The financial assurance for long-term treatment presented in the SDEIS, ranging from $3.5 to 6 million appears to be an estimate for monitoring activities only, without any long-term wastewater treatment costs.	FEIS Section 3.2.2.4 provides available details regarding financial assurance. Additional details on the cost estimates, timeframes, contingency plan amounts for unforeseen challenges, and calculations that would be required for the project would be addressed during permitting. Table 3.2-15 provides financial assurance cost estimates for various years of closure, as well as monitoring and mitigation costs. Section 3.2.2.4.1 discusses what activities would be considered in cost estimates, and that cost estimates would be updated annually under the Permit to Mine.	FIN 05
2374	Perpetual operation and maintenance of mechanical wastewater treatment is an additional cost that must be represented in the estimate of financial assurance.	FEIS Section 3.2.2.4 provides available details regarding financial assurance. Additional details on the cost estimates, timeframes, contingency plan amounts for unforeseen challenges, and calculations that would be required for the project would be addressed during permitting. Table 3.2-15 provides financial assurance cost estimates for various years of closure, as well as monitoring and mitigation costs. Section 3.2.2.4.1 discusses what activities would be considered in cost estimates, and that cost estimates would be updated annually under the Permit to Mine. The WWTP and WWTF would undergo continued inspection and maintenance during operations, long-term treatment, and in closure. WWTP and WWTF replacement costs would be included in long-term financial assurance estimates.	FIN 05
2375	The cursory estimate of financial assurance in the SDEIS provides little detail about how the dollar amount was derived. Instead, discussions have been postponed for the permitting phase of this Project. This approach fundamentally contradicts federal and state environmental policy and the SDEIS must be revised, with significant additional study, to appropriately evaluate closure, mitigation, reclamation, and perpetual treatment cost estimates.	FEIS Section 3.2.2.4 provides available details regarding financial assurance as required under NEPA/MEPA. *Minnesota Rules* 6132.1200, Subpart 4 state that the Commissioner shall evaluate all financial assurance cost estimates and adjustments to cost estimates using individuals with documented experience in material handling and construction and mining costs. Additional details on the financial assurance that would be required for the project would be addressed during permitting. The Permit to Mine, which would include financial assurance information, includes an opportunity for public input. Neither NEPA nor MEPA rules require that all financial assurance mechanisms be in place before the EIS is finalized.	FIN 13
2377	Although the SDEIS was revised to reflect the Project proponents' preferred action, still, the only alternative analyzed in any detail concerns the acreage of the proposed land exchange. This failure is a serious violation of NEPA and must be remedied before the SDEIS can be finalized.	The DEIS and SDEIS considered many different alternatives, which are discussed in FEIS Section 3.2.3 for the NorthMet Project and Section 3.3.3 for the Land Exchange. Neither Minnesota Rules nor CEQ regulations required the Co-lead Agencies to identify a preferred alternative in the SDEIS (40 CFR 1502.14(e)). FEIS Section 7.4 includes details regarding the identification of an Agency Preferred Alternative. The USFS has identified a preferred alternative for the Land Exchange in	ALT 01 ALT 02 ALT 03 ALT 04 ALT 20

Comment ID	Comment	Response	Theme(s)
		FEIS Section 3.3.2. The Minnesota Department of Natural Resources (MDNR) is not required to identify a preferred alternative under MEPA.	COE 04
2389	PolyMet proposes to build a reverse osmosis ("RO") wastewater treatment plant near the tailings basin to treat process water and tailings basin seepage. RO is very effective if sized correctly. While RO could successfully treat wastewater to comply with Minnesota WQS, it can only treat polluted water that has been collected. Therefore, the Project is not relying on RO during operations to comply with WQS; instead, it would rely on seepage capture efficiency. But as stated previously, seepage capture rates provided in the SDEIS are not realistic. After operations, the SDEIS contemplates that the RO plant would continue to treat tailings basin seepage and begin treating tailings pond water. The treated water would be used for augmentation of streams near the plant site. Colby Lake water is also proposed for stream augmentation. However, because Colby Lake water exceeds WQS for many pollutants including mercury, it would also need to be RO-treated before being used for augmentation.	Although relatively few containment systems have been built with this degree of pumping, the conceptual hydraulics of this type of system provides evidence that it would achieve complete or nearly complete capture. The FEIS relies on revised cross-section models from the SDEIS to evaluate containment systems on the northern, northwestern, and western sides of the Tailings Basin, which are documented in the revised NorthMet Project Proposed Action Water Management Plan - Plant Site (PolyMet 2015i). These new models consider the presence of an upper more-permeable bedrock zone directly below the slurry wall, with hydraulic properties based on 2014 packer tests conducted in five boreholes along the proposed containment system alignment. Sensitivity analyses have included variable bedrock hydraulic conductivity and different upper bedrock zone thicknesses up to 100 feet. The model results predict that the overall capture efficiencies of the proposed Tailings Basin containment systems would be substantially greater than 90%. This analysis supports the conclusion that the assumption of 90% or greater capture efficiency is justified. Colby Lake water would no longer be directly discharged to the tributaries for augmentation. All augmentation water would be treated with the reverse osmosis water treatment system or equivalent technology that will meet water treatment targets	WR 124 WR 125 WR 189
2391	In order to ensure compliance with Minnesota WQS, and based on the Projects own modeling, adequate financial assurance must be set aside to maintain and operate perpetual RO treatment at both the mine and plant sites.	FEIS Section 3.2.2.4 provides available details regarding financial assurance. Additional details on the cost estimates, timeframes, contingency plan amounts for unforeseen challenges, and calculations that would be required for the project would be addressed during permitting. Table 3.2-15 provides financial assurance cost estimates for various years of closure, as well as monitoring and mitigation costs. Section 3.2.2.4.1 discusses what activities would be considered in cost estimates, and that cost estimates would be updated annually under the Permit to Mine. *Minnesota Rules* 6132.1200, SubpartSubpart 3 state that cost estimates shall be annually adjusted using current dollar value at the time of the estimate. FEIS Sections 3.2.2.1.10, 3.2.2.3.12, and 5.2.2.3.1 provide available information regarding long-term water treatment and maintenance. Temporal aspects of financial assurance are addressed in *Minnesota Rules*	FIN 05 FIN 06

Comment ID	Comment	Response	Theme(s)
		6132.3200 Subpart 2, item E, which state that financial assurance is required for all areas that require continued maintenance following closure, and that no release from the Permit to Mine would be granted for portions of mining areas that require post-closure maintenance until the maintenance activities are no longer necessary.	
2395	While the use of RO is encouraged, further analysis and application is needed.	Reverse osmosis is a well-tested water treatment technology. Pilot-testing results enhance Minnesota's knowledge of its performance relative to the NorthMet Project Proposed Action. Further analysis of the proposed system would occur in permitting.	WR 143
2399	The conclusion that underground mining is not viable, or preferable, remains substantially unjustified, despite repeated requests for further analysis… As the Band already argued in the Tribal Position, significant additional study of the underground mining alternative is mandated, and the SDEIS offers no new discussion of the reasons for rejecting the alternative.	The Underground Mine alternative was first considered but eliminated during the FSDD process. The FEIS Section 3.2.3.4.1 describes how it was reconsidered during the DEIS phase as alternative E7 in response to Cooperating Agency and stakeholder comments, but eliminated from further consideration. The economic feasibility of the Underground Mine alternative was reconsidered during development of the SDEIS. In response to a request from the Co-lead Agencies, PolyMet's consultants prepared an updated economic assessment of underground mining, which the Co-lead Agencies independently evaluated (see FEIS Appendix B). The Co-lead Agencies concluded that an underground mine would not be profitable, regardless of the tonnage extracted. The lower rate of ore production would not meet the Purpose and Need of the project. Though it would offer environmental benefits over the NorthMet Project Proposed Action, it would result in reduced socioeconomic benefits. They accordingly concluded that the Underground Mine alternative was not economically feasible, and would not meet the NorthMet Project's Purpose and Need. A position paper (FEIS Appendix B) was prepared to document the Co-lead Agencies' rationale for eliminating the Underground Mine alternative from further consideration. The FEIS Section 5.2.10.1.4 states, "Neither NEPA nor CEQ requires the cost and benefits of a proposed action to be quantified in dollars or any other common metric; however, this EIS acknowledges that economic costs and loss of non-market value may result from environmental and social effects. Also acknowledged is that the agreement on the value (i.e., the 'cost') of environmental effects is often difficult to achieve. Therefore, the approach of this EIS is to evaluate environmental and social impacts directly, in the appropriate resource-specific section." CEQ regulations for implementing NEPA (40 CFR 1502.23) state that, "for purposes of complying with the Act, the weighing of the merits and drawbacks of the	ALT 01

Comment ID	Comment	Response	Theme(s)
		various alternatives need not be displayed in a monetary cost-benefit analysis and should not be when there are important qualitative considerations."	
2422	Exchanging thousands of acres of diverse, high-quality land--land with some of the few remaining large game corridors in northeastern Minnesota that are available to the Bands to exercise reserved 1854 Treaty rights--for lands that have moderate diversity and lack big-game corridors is inconsistent with the fiduciary responsibilities that are shared by all federal agencies.	The FEIS wildlife sections include an analysis of the wildlife corridors, including their use by various species. The FEIS wildlife sections also include information about NorthMet Project Proposed Action impacts to wildlife habitat types and Minnesota Biological Survey (MBS) Sites of Biodiversity Significance. FEIS Sections 4.2.4 and 4.3.4 provide maps of the MBS Sites (Figures 4.2.4-1, 4.2.4-4, 4.3.4-1, 4.3.4-2). The WCA rules (including those parts applicable to mining projects under *Minnesota Rules* 8420.0930) include a special consideration for wetlands that are rare natural communities (*Minnesota Rules* 8420.0515, Subpart 3). *Minnesota Rules* 6132.2700 requires that a project site be reclaimed once mining has ceased. The goals of such reclamation are to "control erosion, to screen mining areas from non-compatible uses, and to provide for subsequent land uses such as wildlife habitat or timber production." The rules also include requirements about the characteristics and planting schedule for vegetation used in reclamation. The Permit to Mine would address special consideration of wetlands that include rare natural communities. Additional information on rare natural communities would be included in the wetland permit application as part of the Permit to Mine process for further refinement of site-specific conditions.	CR 01 WI 02 WI 03
2655	It is well known that wetlands play an important role in the condition of downstream waters by retaining floodwaters, sediment, nutrients, and other pollutants, thereby benefitting the quality of downstream waters.	This comment has been received and acknowledged by the Co-lead Agencies. The Co-Lead Agencies believe the identification of wetlands at the NorthMet Project area is accurately and adequately depicted in Section 4.2.3 for the purpose of the EIS.	WET 24
2656	Wetlands may also function as thermal refuge for moose when summertime temperatures exceed 14 o C, the point at which moose become thermally stressed. Additionally, wetlands with aquatic vegetation provide an important forage resource for moose during the open-water season.	FEIS Sections 4.2.5, 4.3.5, 5.2.5, and 5.3.5 (Wildlife) have been updated to include the new state endangered, threatened, and special concern (ETSC) status listings from August 19, 2013, as well as new federal status listing changes. The FEIS includes a more robust analysis on effects to moose, including habitat and displacement. The FEIS Section 4.2.5.1.1 discusses the role of wetlands with moose and thermal stress.	WI 01 WI 02
2658	[The SDEIS (Pg 5-643)] underestimates the impacts [to aquatic species due to the decrease of first-order streams to the federal estate]. While greater diversity is desirable, protection of headwater streams is critical because they	Effects of the Land Exchange Proposed Action on headwater streams are discussed in detail in Sections 5.3.6.2.2 and 5.3.6.3.2 of the FEIS. A paragraph in FEIS Section 5.3.6.2.2 has been edited to state "...however, the net reduction to the Superior National Forest of 0.3 miles of first order streams may result in slightly less habitat available for headwater stream	AQ 29

Comment ID	Comment	Response	Theme(s)
	powerfully influence both the character and functions of downstream waters. Headwater streams transport vegetation, woody debris, organic matter, macroinvertebrates, and other organisms downstream, while providing spawning areas for brook trout. Headwaters provide most of the water to rivers, which in turn provides temperature mitigation and oxygenation which are necessary for healthy fish communities.	dependent species". There are no designated trout streams in the Land Exchange Proposed Action parcels or the Federal parcel.	
2660	The loss of critical wildlife corridors, along with high quality and diverse land and water resources, directly connects the federal regulatory agencies' trust responsibilities to the Bands. The land exchange, and the Project, cannot proceed where they require the agencies to approve permits that will have impacts to treaty resources without additional evaluation and mitigation.	The FEIS wildlife sections include an analysis of the wildlife corridors, including their use by various species. The FEIS wildlife sections also include information about NorthMet Project Proposed Action impacts to wildlife habitat types and Minnesota Biological Survey (MBS) Sites of Biodiversity Significance. FEIS Sections 4.2.4 and 4.3.4 provide maps of the MBS Sites (Figures 4.2.4-1, 4.2.4-4, 4.3.4-1, 4.3.4-2). The WCA rules (including those parts applicable to mining projects under *Minnesota Rules* 8420.0930) include a special consideration for wetlands that are rare natural communities (*Minnesota Rules* 8420.0515, Subpart 3). *Minnesota Rules* 6132.2700 requires that a project site be reclaimed once mining has ceased. The goals of such reclamation are to "control erosion, to screen mining areas from non-compatible uses, and to provide for subsequent land uses such as wildlife habitat or timber production." The rules also include requirements about the characteristics and planting schedule for vegetation used in reclamation. The Permit to Mine would address special consideration of wetlands that include rare natural communities. Additional information on rare natural communities would be included in the wetland permit application as part of the Permit to Mine process for further refinement of site-specific conditions.	CR 01 WI 03
2686	Also ignored [in the design of the Project] was experience with the Dunka Pit, located on the old LTVSMC site approximately five miles north and east of the PolyMet Project mine site.	NEPA/MEPA regulations do not require discussion or comparisons to other mining projects, as it is outside the scope of the project (see Minnesota Statutes 116D.04 and 40 CFR 1500). PolyMet would be required to address on-site legacy contamination and would provide financial assurance for the legacy components under a Permit to Mine application. FEIS Section 5.2.2 discusses how the NorthMet Project would address existing water contamination and/or comply with water standards.	PD 26
2689	The cumulative public information regarding risks to area hydrology from mining the PolyMet site cannot be dismissed by inserting extrapolated data	Where field measurements were not available, model assumptions were reviewed and approved for use in impact analyses. The Co-lead Agencies believe that the FEIS contains adequate information and analyses consistent	WR 072 WR 073

Comment ID	Comment	Response	Theme(s)
	in place of measured data, or by cherry-picking measured data. Impacts to surface waters, groundwater, and wetlands for a project of this size and complexity demand a scientific, data-driven approach, rather than one based on opinion and selectively used data.	with the NEPA and MEPA guidance and best practices. Also refer to the response to theme NEPA 09 for more detail.	
2694	Some of the wetlands that will be directly and indirectly impacted at the mine site are part of the 100 Mile Swamp, identified by a United States Fisheries Service biologist in 1997 as "lacking ecosystem representation in protected areas."	FEIS Section 5.2.3, Table 5.2.3-1, indicates that there would be a total of 758.2 acres of direct wetland impacts at the Mine Site. A portion of the approximate boundary for the One Hundred Mile Swamp would be located within the Mine Site boundary. PolyMet would ultimately need to satisfy both the federal and state mitigation requirements for providing compensatory mitigation for impacts to wetlands. The number of mitigation credits to be earned by replacement wetlands would be determined during permitting by the appropriate agencies reviewing the wetland mitigation plan.	WET 19
2700	In response to the Co-Lead Agencies desire to use only analogue data to determine the Project dewatering effects, GLIFWC provided an independent analysis using information from other mine pits located on the Mesabi Range…The only substantial changes in GLIFWC's method of analogue assessment were to use all available drawdown data for the Mesabi Iron Range, and to not automatically exclude wetlands classified as ombrotrophic from being considered impacted by drawdown…All analogue data must be used to estimate wetland impacts, and additional hydrologic data collected from the mine site should be required.	When an agency is evaluating reasonably foreseeable significant adverse effects on the human environment in an EIS and there is incomplete or unavailable information because the overall costs of obtaining it are exorbitant or the means to obtain it are not known, NEPA directs the agency to make it clear that such information is lacking, discuss the relevance of the lacking information, and discuss any information relevant to evaluation of the future impacts. In these cases, NEPA also directs the agency to evaluate these impacts based upon theoretical approaches or research methods generally accepted in the scientific community provided that the analysis of the impacts is supported by credible scientific evidence, is not based on pure conjecture, and is within the rule of reason. The Co-lead Agencies believe this is the case for evaluating indirect wetland effects. The Co-lead Agencies have thoroughly considered throughout the development of the EIS and through the Wetland Impact Assessment Planning Work Group how to assess potential indirect wetland effects. As a result, strengths and weaknesses of the approach used, as well as other suggested approaches, have been carefully considered. The Co-lead Agencies believe that the analog method used in the SDEIS to assess potential indirect effects from mine dewatering is adequate. Further, the FEIS has been revised to address concerns raised by the Bands regarding the assertion that ombrotrophic bogs would not be impacted by mine dewatering. FEIS Section 5.2.3.2.2 applies a more conservative assumption of the potential indirect effects for all bog communities within the 0-1,000-	WET 08

Comment ID	Comment	Response	Theme(s)
		ft analog zone. Specifically, ombrotrophic bogs were reclassified from the "no effect" category to the "low likelihood" category, the same status as that assigned to minerotrophic bogs. The complex mixes of bedrock, surficial deposits, and wetland soils at the Mine Site impede the ability to reasonably model (e.g., using MODFLOW) and accurately assess the potential effect of pit dewatering on wetlands. In light of this modeling limitation, wetlands were divided into zones based on distance from the open pit. The closer a wetland was to the pit during dewatering, the greater the water table drawdown would be and the greater potential there would be for hydrologic effects on overlying wetlands. These impact assessment methodologies are presented in FEIS Sections 5.2.2.3.2 and 5.2.3.1.2. The Co-lead Agencies are not relying solely on the potential impact zones determined in the analog method for the FEIS but are monitoring wetlands for potential indirect effects. In the event that the required wetland monitoring identifies additional indirect effects, permit conditions would likely include a plan for adaptive management practices to be implemented. Additional compensatory mitigation would be required if indirect wetland impacts are identified during monitoring and annual reporting.	
2701	The CWA does not allow a permit when there are practicable alternatives that would have fewer adverse effects, when the Project would lead to a violation of state water quality standards, or when a permit would cause or contribute to significant degradation of waters of the United States.	The USACE is the federal agency responsible for regulating the discharge of dredged or fill material into Waters of the United States, including wetlands under Section 404 of the Clean Water Act. PolyMet has applied for a Section 404 Individual Permit from the USACE for the proposed fill into the Waters of the United States. In addition, if a permit from the USACE is issued, it is not valid until the State has either certified under Section 401 of the CWA that the proposed discharges to aquatic resources comply with the State's water quality standards or waived the 401 certification requirements. When making a decision, the USACE takes into consideration numerous factors. Permit decisions are based on the probable expected effects associated with a proposed project including direct, indirect, and cumulative impacts. Public interest review factors include: conservation, economics, aesthetics, general environment, wetlands, cultural values, fish and wildlife, land use, flood hazards, property ownership, flood plain values, navigation, recreation, shore erosion and accretion, water supply and water quality, energy needs, safety, mineral needs, safety, food and fiber production, and the needs and welfare of the people. The decision to grant or deny a permit by the USACE is explained and described in a ROD. If the permit is issued, a copy of the permit is sent to the project sponsor for their signature, which signifies that they accept the permit requirements. If the USACE decides to deny the permit or the	COE 03

Comment ID	Comment	Response	Theme(s)
		project sponsor does not agree with the conditions contained in the permit, the project sponsor may request an administrative appeal of the permit decision. A decision by the USACE on whether to grant or deny a Section 404 Individual Permit has not yet been made.	
2702	An agency-preferred alternative must be provided in addition to the LEDPA's before wetland impacts resulting from the Project can adequately be assessed, and before a 404 permit can be issued.	Neither Minnesota Rules nor CEQ regulations require the Co-lead Agencies to identify a preferred alternative in the SDEIS (40 CFR 1502.14(e)). The FEIS includes available details regarding the identification of an Agency Preferred Alternative. The FEIS contains sufficient information to identify and substantiate the LEDPA. The USACE is not required to identify a LEDPA in the FEIS; the final determination on the LEDPA would be made in the ROD for the USACE which serves as the USACE's decision document and the basis for the Department of the Army permit decision. The USFS will utilize the FEIS to show the factors relating to how the public interest would be served by the Land Exchange and the ROD would incorporate the findings of those factors and identify the preferred alternative. The MDNR is not required to identify a preferred alternative under MEPA. The FEIS Sections 3.2 and 3.3 further detail this process. The agency preferred alternative and LEDPA process is described in FEIS Sections 7.4 and 7.5. The ROD for the USACE would include the Section 404(b)(1) analysis and the public interest review, and would determine the LEDPA. Furthermore, the ROD for the USACE cannot be finalized until 30 days after release of an FEIS. Any comments received during the 30-day period may be considered in the ROD for the USACE. The ROD for the USACE would recommend issuance, issuance with conditions, or denial of the Project.	COE 04
2707	During the EIS scoping process for the Project, the Co-Leads failed to ever identify any cumulative impact issues associated with cultural resources, and Tribal Cooperating Agencies were not invited to participate in scoping. The Band's and other Tribal Cooperating Agencies' comments on the June 2008 PDEIS, the 2009 CPDEIS, and the 2009 DEIS detailed the nature of these substantial cumulative impacts and the need for further analysis, and are forced to do so yet again here.	Section 6.2.9 of the Final EIS provides a detailed discussion and analysis of the potential cumulative effects on cultural resources from the NorthMet undertaking within a defined cumulative effects analysis area. That discussion includes past, present, and reasonably foreseeable future federal, state, and private actions within that area. The approach to cumulative effects has been informed through consultation between the Co-lead Agencies and the Bands. Section 6.2.9 of the Final EIS acknowledges cumulative effects on cultural resources.	CR 03
2713	This omission [the SDEIS does not determine climate change implications of the proposed	FEIS Sections 4.2.5, 4.3.5, 5.2.5, and 5.3.5 (Wildlife) have been updated to include the new state endangered, threatened, and special concern (ETSC)	WI 01

Comment ID	Comment	Response	Theme(s)
	Project] undermines even the MDNR's own work. The MNDNR's Moose Advisory Committee, which studies the decline of the moose population in northeastern Minnesota, has recommended preserving wetlands as sanctuaries for moose from heat stress related to climate change.	status listings from August 19, 2013, as well as new federal status listing changes. The FEIS includes a more robust analysis on effects to moose, including habitat and displacement. The FEIS Section 4.2.5.1.1 discusses the role of wetlands with moose and thermal stress.	WI 02
2715	A substantial moose population has been identified in the mine site area by aerial and ground surveys. Moose are likely to be impacted by the disturbance of two of the few wildlife corridors remaining along the Mesabi Range, not to mention by the massive wetland impacts of this project…There is no basis to dispute that the Project will have cumulative effects on the moose herd and Tribal harvest in the 1854 Ceded Territory. At a time when moose populations in Minnesota are declining, this analysis is particularly important and should have been done as part of this SDEIS.	The FEIS wildlife sections provide an analysis of wildlife species used for subsistence/harvest, as well as those culturally important to the Bands, such as moose. FEIS Section 4.2.9.3.3 identifies species potentially harvested in the 1854 Ceded Territory, while FEIS Section 5.2.9.2.2 explains that a lack of data regarding use of such species in the NorthMet Project area likely indicates limited present day use in that area due to general inaccessibility. FEIS Section 5.2.5.2.5 discusses the types of potential effects to common and/or game species, which are similar to effects on ETSC species. The FEIS has been revised to include additional detail regarding moose, and this discussion has been moved to the state ETSC species discussion, due to its new state listing status. The response to theme CR 01 also discusses effects to resources important to the Bands.	WI 01 WI 02 WI 03 WI 09
2721	The cumulative impacts assessment deficiencies identified above and within Appendix C are not exhaustive. Instead, they are solely an attempt to illustrate the incredible lack of cumulative effects analysis in the SDEIS. Profound revision is needed to this section.	The Co-lead Agencies considered the information included in the Tribal Cooperating Agencies' cumulative effects assessment and found no compelling information or analysis to change the original approach or conclusions.	CU 12
2723	Additionally, the lead agencies must consult with any tribes that attach "religious or cultural significance to historic properties that may be affected by an undertaking," regardless of the location of the historic property.	The federal Co-lead Agencies have actively consulted with the federally recognized Bands that have expressed an interest in consulting on the NorthMet Project Proposed Action. Historic properties affected by the NorthMet Project Proposed Action have been identified and the impacts to those properties have been assessed. This also includes an assessment of actual use of those historic properties, as well as other resources in the APE, by tribal members. Effects on historic properties would be fully considered prior to the issuance of any permit or land exchange, pursuant to the NHPA and its implementing regulations. Effects on cultural resources and culturally significant natural resources are addressed in the Cultural Resources sections in FEIS Chapters 4, 5, and 6.	CR 06
2729	Mesabe Widjiu is correctly identified as a sacred landform but needs to be considered in its entirety instead of looking at only the area within the	The federal Co-lead Agencies have determined the Partridge River section of the Mesabe Widjiu to be eligible for inclusion in the NRHP under Criterion A for its association with important Ojibwe spiritual and cultural	CR 02 CR 05

Comment ID	Comment	Response	Theme(s)
	Project. The segment that is within the project area is small, but vital to the property. Adverse effects to any portion of the Mesabe Widjiu will negatively impact the entire feature.	practices. In addition, the Co-lead Agencies have determined, in consultation with the Bands, that the Partridge River segment of the Mesabi Widjiu would be adversely affected by the NorthMet undertaking. Although the federal Co-lead Agencies are assessing the effects of the NorthMet Project Proposed Action on only the portion of the Mesabe Widjiu within the APE, it is recognized that the property and its significance extends beyond the APE. The federal Co-lead Agencies have updated the FEIS to include a graphic of the entire Mesabe Widjiu, as provided by the consulting Bands.	
2738	Any increase of methylmercury bioavailability in the Embarrass River, Partridge River, or St. Louis River watersheds constitutes a significant adverse impact to a critical trust resource [(subsistence fisheries)]. Not only must this impact be fully evaluated, but it must be fully mitigated	The Cultural Resources sections in FEIS Chapters 4 and 5 address the federal Co-lead Agencies' federal tribal trust responsibilities under the 1854 Treaty. These sections, along with other relevant natural resources sections of FEIS Chapters 4, 5, and 6, also address effects on and any proposed mitigation for cultural resources and culturally significant natural resources. Effects from mercury deposition on fish, in particular, are addressed in Section 6.2.6.3.3, in the Human Health Impacts summary, Section 7.3.4.4.2, and in responses to Themes HU02, 03 and 04. Mitigation/compensation for effects on cultural resources and culturally significant natural resources is considered to the extent possible within the parameters of the statutes and regulations pertaining to the federal authorities for the NorthMet Project Proposed Action review.	CR 01 HU 02 HU 03 HU 06
2742	Wild rice waters are not only protected under the 1854 Treaty but under Minnesota State law. Given the obviousness of the threatened impact to such wild rice beds, additional analysis and mitigation must be included throughout the SDEIS.	Potential effects and mitigation actions are included in the FEIS. Wild rice beds impacts are addressed from an economic, environmental, and cultural perspective with input from the Bands.	WR 156 WR 157
2745	The Project will certainly do nothing to aid in the recovery of moose and is likely to reduce available habitat, impact travel corridors, and increase greenhouse gases. Impacts on moose and habitat are impacts on the Band's cultural resources and must be analyzed as such in the SDEIS.	FEIS Sections 4.2.5, 4.3.5, 5.2.5, and 5.3.5 (Wildlife) have been updated to include the new state endangered, threatened, and special concern (ETSC) status listings from August 19, 2013, as well as new federal status listing changes. The FEIS includes a more robust analysis on effects to moose, including habitat and displacement. The FEIS Section 5.2.5.2.2 discusses effects to moose due to loss of habitat. The FEIS Sections 5.2.5.2.3 and 6.2.5.4.2 discuss effects to wildlife corridors.	WI 01 WI 02 WI 03 WI 09
2746	The APE for the Project was not determined until August 11, 2009, after tribal cooperators insisted upon it, and tribal consultation is ongoing. Since 2009, the size of the APE has been significantly	The federal Co-lead Agencies have actively consulted with the federally recognized Bands that have expressed an interest in consulting on the NorthMet Project Proposed Action. Historic properties affected by the NorthMet Project Proposed Action have been identified and the impacts to	CR 02 CR 06

Comment ID	Comment	Response	Theme(s)
	diminished to the point of being the Project permitted area and nothing more.	those properties have been assessed. This also includes an assessment of actual use of those historic properties, as well as other resources in the APE, by tribal members. Effects on historic properties would be fully considered prior to the issuance of any permit or land exchange, pursuant to the NHPA and its implementing regulations. Effects on cultural resources and culturally significant natural resources are addressed in the Cultural Resources sections in FEIS Chapters 4, 5, and 6. The APE takes into account both direct and indirect effects using a geographically expansive area that accounts for direct effects as well as visual, audible, atmospheric, hydrological, and water quality effects. The APE is based on extensive modeling and other analysis completed for the NorthMet Mining Project and Land Exchange, and includes an area much broader than the Plant Site and Mine Site. Since the SDEIS, the APE has been revised slightly to include the Dunka Road corridor, several federal parcels included in the Land Exchange Proposed Action, and the Colby Lake Pumphouse and pipeline.	
3039	The land exchange will cause irretrievable losses of resources for the Bands [including loss of the land itself, SDEIS pg 7-10]… Further, the SDEIS provides that the land exchange proposal could have direct and indirect effects on tribal cultural resources by creating noise, impeding access to area that are traditionally or culturally important to the bands and affecting species of importance to the Bands.	The Agency's obligation is to ensure that Band members have ample opportunity to exercise their treaty-reserved usufructuary rights; that federal lands are managed to maintain both the diversity and abundance of natural resources; and to ensure that the Bands' usufructuary rights to treaty resources are not impaired. The Land Exchange Proposed Action was analyzed to understand the potential effects on usufructuary rights. The Co-lead Agencies have consulted, and continue to consult with the Bois Forte Band of Chippewa, the Grand Portage Band of Lake Superior Chippewa, and the Fond du Lac Band of Lake Superior Chippewa, the three principle Bands that retain usufructuary rights in the proposed project area. In addition, the Co-lead Agencies have consulted with the Great Lakes Indian Fish and Wildlife Commission and the 1854 Treaty Authority, the principal natural resource agencies representing the aforementioned Bands. Through consultation, the Co-lead Agencies understand that the Bands' principle interest with regards to the Land Exchange Proposed Action are the following: to retain or increase the amount of public land within the 1854 Treaty Ceded Territory, shoreline wetlands, culturally important natural resources used in exercising treaty rights of hunting, fishing, and gathering, cultural or religious properties, and access to culturally important natural resources and cultural or religious properties. The Co-lead Agencies have a fiduciary obligation to understand and consider the effects that the Land Exchange Proposed Action would have on Band members exercising	CR 01 CR 05

Comment ID	Comment	Response	Theme(s)
		their Treaty rights in the 1854 ceded territory. While the Land Exchange Proposed Action would remove certain lands from federal ownership, this loss is potentially offset by incoming private lands that would become part of the federal estate within the 1854 Ceded Territory. Outside of the Land Exchange Proposed Action, the Co-lead Agencies have also analyzed the potential effects posed by the Proposed Connected Actions. The potential affects posed to natural resources and cultural resources of importance to the Bands have been disclosed and would be considered during the Co-lead Agency decision process. Land exchanges do not include mitigation; instead, the resource values and public objectives of the non-federal lands must equal or exceed the resource values and public objectives of the federal lands. See FEIS Section 1.4.3. Mitigation for cultural resources as a result of the NorthMet Project Proposed Action is discussed in Section 5.2.9 of the FEIS. The NorthMet Project Proposed Action mining activities would result in a loss of bogs; however, as part of the NorthMet Proposed Action, the Applicant is required to provide compensatory mitigation for wetland impacts in accordance with state and federal permits. One of the proposed mitigation sites for wetland impacts (Zim Site) would be a compensation site for the loss of bogs, and would be located within the 1854 Ceded Territory. The Lake County lands were tax forfeit lands that were offered for sale by the County through a public auction. The Lake County lands would still be accessible to the Bands for their use if the exchange took place, because the lands would become part of the SNF managed lands. No heritage surveys were conducted on the non-federal lands. If any cultural resources are located on the non-federal lands, those cultural resources would be transferred to federal ownership. Such transfer would not adversely affect the heritage resource, but would provide greater preservation protection under federal law. The non-federal lands that contain wild rice beds would not be affected as a result of the Land Exchange Proposed Action or Land Exchange Alternative B, because no activities are proposed on these lands and the proposed mining activities would not affect these lands. As noted in the FEIS, the Land Exchange Proposed Action and Land Exchange Alternative B would increase wild rice stands within the federal estate. FEIS Sections 5.3.2 and 5.3.4 clarify that, although the Land Exchange would result in an increase in wild rice stands within the federal estate boundaries, there would be no change to the existing public access to Tract 1 wild rice stands	

Comment ID	Comment	Response	Theme(s)
		via the Pike River. Consequently, there would be no increase in wild rice harvest opportunities for the public. No wild rice stands are known to occur on the federal lands, and suitable habitat is limited. Please refer to the response to theme LAN 01 for more information on the public interest determination.	
2697	[The decision to use an analogue method came from the Wetlands Impact Assessment Planning work group process, in spite of Tribal Cooperating Agency objections. These objections include:] (1) the PolyMet proposed mine pit will be hundreds of feet deeper than any of the "analogue" mine pits;	When an agency is evaluating reasonably foreseeable significant adverse effects on the human environment in an EIS and there is incomplete or unavailable information because the overall costs of obtaining it are exorbitant or the means to obtain it are not known, NEPA directs the agency to make it clear that such information is lacking, discuss the relevance of the lacking information, and discuss any information relevant to evaluation of the future impacts. In these cases, NEPA also directs the agency to evaluate these impacts based upon theoretical approaches or research methods generally accepted in the scientific community provided that the analysis of the impacts is supported by credible scientific evidence, is not based on pure conjecture, and is within the rule of reason. The Co-lead Agencies believe this is the case for evaluating indirect wetland effects. The Co-lead Agencies have thoroughly considered throughout the development of the EIS and through the Wetland Impact Assessment Planning Work Group how to assess potential indirect wetland effects. As a result, strengths and weaknesses of the approach used, as well as other suggested approaches, have been carefully considered. The Co-lead Agencies believe that the analog method used in the SDEIS to assess potential indirect effects from mine dewatering is adequate. Further, the FEIS has been revised to address concerns raised by the Bands regarding the assertion that ombrotrophic bogs would not be impacted by mine dewatering. FEIS Section 5.2.3.2.2 applies a more conservative assumption of the potential indirect effects for all bog communities within the 0-1,000-ft analog zone. Specifically, ombrotrophic bogs were reclassified from the "no effect" category to the "low likelihood" category, the same status as that assigned to minerotrophic bogs. The complex mixes of bedrock, surficial deposits, and wetland soils at the Mine Site impede the ability to reasonably model (e.g., using MODFLOW) and accurately assess the potential effect of pit dewatering on wetlands. In light of this modeling limitation, wetlands were divided into zones based on distance from the open pit. The closer a wetland was to the pit during dewatering, the greater the water table drawdown would be and the greater potential there would be for hydrologic effects on overlying wetlands. These impact assessment	WET 08

Comment ID	Comment	Response	Theme(s)
		methodologies are presented in FEIS Sections 5.2.2.3.2 and 5.2.3.1.2. The Co-lead Agencies are not relying solely on the potential impact zones determined in the analog method for the FEIS but are monitoring wetlands for potential indirect effects. In the event that the required wetland monitoring identifies additional indirect effects, permit conditions would likely include a plan for adaptive management practices to be implemented. Additional compensatory mitigation would be required if indirect wetland impacts are identified during monitoring and annual reporting.	
3098	[The decision to use an analogue method came from the Wetlands Impact Assessment Planning work group process, in spite of Tribal Cooperating Agency objections. These objections include:] (2) PolyMet mine pit walls will be crystalline and sedimentary bedrock versus the analogue mine pits in sedimentary bedrock only;	When an agency is evaluating reasonably foreseeable significant adverse effects on the human environment in an EIS and there is incomplete or unavailable information because the overall costs of obtaining it are exorbitant or the means to obtain it are not known, NEPA directs the agency to make it clear that such information is lacking, discuss the relevance of the lacking information, and discuss any information relevant to evaluation of the future impacts. In these cases, NEPA also directs the agency to evaluate these impacts based upon theoretical approaches or research methods generally accepted in the scientific community provided that the analysis of the impacts is supported by credible scientific evidence, is not based on pure conjecture, and is within the rule of reason. The Co-lead Agencies believe this is the case for evaluating indirect wetland effects. The Co-lead Agencies have thoroughly considered throughout the development of the EIS and through the Wetland Impact Assessment Planning Work Group how to assess potential indirect wetland effects. As a result, strengths and weaknesses of the approach used, as well as other suggested approaches, have been carefully considered. The Co-lead Agencies believe that the analog method used in the SDEIS to assess potential indirect effects from mine dewatering is adequate. Further, the FEIS has been revised to address concerns raised by the Bands regarding the assertion that ombrotrophic bogs would not be impacted by mine dewatering. FEIS Section 5.2.3.2.2 applies a more conservative assumption of the potential indirect effects for all bog communities within the 0-1,000-ft analog zone. Specifically, ombrotrophic bogs were reclassified from the “no effect” category to the “low likelihood” category, the same status as that assigned to minerotrophic bogs. The complex mixes of bedrock, surficial deposits, and wetland soils at the Mine Site impede the ability to reasonably model (e.g., using MODFLOW) and accurately assess the potential effect of pit dewatering on wetlands. In light of this modeling limitation, wetlands were divided into zones based on distance from the	WET 08

Comment ID	Comment	Response	Theme(s)
		open pit. The closer a wetland was to the pit during dewatering, the greater the water table drawdown would be and the greater potential there would be for hydrologic effects on overlying wetlands. These impact assessment methodologies are presented in FEIS Sections 5.2.2.3.2 and 5.2.3.1.2. The Co-lead Agencies are not relying solely on the potential impact zones determined in the analog method for the FEIS but are monitoring wetlands for potential indirect effects. In the event that the required wetland monitoring identifies additional indirect effects, permit conditions would likely include a plan for adaptive management practices to be implemented. Additional compensatory mitigation would be required if indirect wetland impacts are identified during monitoring and annual reporting.	
3099	[The decision to use an analogue method came from the Wetlands Impact Assessment Planning work group process, in spite of Tribal Cooperating Agency objections. These objections include:] (3) data collected from the site would be relatively inexpensive and should be used to inform impact assessment;	When an agency is evaluating reasonably foreseeable significant adverse effects on the human environment in an EIS and there is incomplete or unavailable information because the overall costs of obtaining it are exorbitant or the means to obtain it are not known, NEPA directs the agency to make it clear that such information is lacking, discuss the relevance of the lacking information, and discuss any information relevant to evaluation of the future impacts. In these cases, NEPA also directs the agency to evaluate these impacts based upon theoretical approaches or research methods generally accepted in the scientific community provided that the analysis of the impacts is supported by credible scientific evidence, is not based on pure conjecture, and is within the rule of reason. The Co-lead Agencies believe this is the case for evaluating indirect wetland effects. The Co-lead Agencies have thoroughly considered throughout the development of the EIS and through the Wetland Impact Assessment Planning Work Group how to assess potential indirect wetland effects. As a result, strengths and weaknesses of the approach used, as well as other suggested approaches, have been carefully considered. The Co-lead Agencies believe that the analog method used in the SDEIS to assess potential indirect effects from mine dewatering is adequate. Further, the FEIS has been revised to address concerns raised by the Bands regarding the assertion that ombrotrophic bogs would not be impacted by mine dewatering. FEIS Section 5.2.3.2.2 applies a more conservative assumption of the potential indirect effects for all bog communities within the 0-1,000-ft analog zone. Specifically, ombrotrophic bogs were reclassified from the “no effect” category to the “low likelihood” category, the same status as that assigned to minerotrophic bogs. The complex mixes of bedrock, surficial deposits, and wetland soils at the Mine Site impede the ability to	WET 08

Comment ID	Comment	Response	Theme(s)
		reasonably model (e.g., using MODFLOW) and accurately assess the potential effect of pit dewatering on wetlands. In light of this modeling limitation, wetlands were divided into zones based on distance from the open pit. The closer a wetland was to the pit during dewatering, the greater the water table drawdown would be and the greater potential there would be for hydrologic effects on overlying wetlands. These impact assessment methodologies are presented in FEIS Sections 5.2.2.3.2 and 5.2.3.1.2. The Co-lead Agencies are not relying solely on the potential impact zones determined in the analog method for the FEIS but are monitoring wetlands for potential indirect effects. In the event that the required wetland monitoring identifies additional indirect effects, permit conditions would likely include a plan for adaptive management practices to be implemented. Additional compensatory mitigation would be required if indirect wetland impacts are identified during monitoring and annual reporting.	
3100	[The decision to use an analogue method came from the Wetlands Impact Assessment Planning work group process, in spite of Tribal Cooperating Agency objections. These objections include:] (4) relying on only a partial set of available "analogue" data as the source of information to estimate dewatering impacts is selective and not scientifically robust.	When an agency is evaluating reasonably foreseeable significant adverse effects on the human environment in an EIS and there is incomplete or unavailable information because the overall costs of obtaining it are exorbitant or the means to obtain it are not known, NEPA directs the agency to make it clear that such information is lacking, discuss the relevance of the lacking information, and discuss any information relevant to evaluation of the future impacts. In these cases, NEPA also directs the agency to evaluate these impacts based upon theoretical approaches or research methods generally accepted in the scientific community provided that the analysis of the impacts is supported by credible scientific evidence, is not based on pure conjecture, and is within the rule of reason. The Co-lead Agencies believe this is the case for evaluating indirect wetland effects. The Co-lead Agencies have thoroughly considered throughout the development of the EIS and through the Wetland Impact Assessment Planning Work Group how to assess potential indirect wetland effects. As a result, strengths and weaknesses of the approach used, as well as other suggested approaches, have been carefully considered. The Co-lead Agencies believe that the analog method used in the SDEIS to assess potential indirect effects from mine dewatering is adequate. Further, the FEIS has been revised to address concerns raised by the Bands regarding the assertion that ombrotrophic bogs would not be impacted by mine dewatering. FEIS Section 5.2.3.2.2 applies a more conservative assumption of the potential indirect effects for all bog communities within the 0-1,000-ft analog zone. Specifically, ombrotrophic bogs were reclassified from the	WET 08

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		"no effect" category to the "low likelihood" category, the same status as that assigned to minerotrophic bogs. The complex mixes of bedrock, surficial deposits, and wetland soils at the Mine Site impede the ability to reasonably model (e.g., using MODFLOW) and accurately assess the potential effect of pit dewatering on wetlands. In light of this modeling limitation, wetlands were divided into zones based on distance from the open pit. The closer a wetland was to the pit during dewatering, the greater the water table drawdown would be and the greater potential there would be for hydrologic effects on overlying wetlands. These impact assessment methodologies are presented in FEIS Sections 5.2.2.3.2 and 5.2.3.1.2. The Co-lead Agencies are not relying solely on the potential impact zones determined in the analog method for the FEIS but are monitoring wetlands for potential indirect effects. In the event that the required wetland monitoring identifies additional indirect effects, permit conditions would likely include a plan for adaptive management practices to be implemented. Additional compensatory mitigation would be required if indirect wetland impacts are identified during monitoring and annual reporting.	
3112	The SDEIS also does not provide any rationale for more mercury to be added to a system that is already so high in mercury, only suggesting that a future TMDL should take care of the problem. A more through cumulative effects analysis is required for mercury and the appropriate spatial scale for considering cumulative impacts includes the entire St. Louis River watershed.	This comment was originally presented as part of the Tribal Position Summary included in MDO #2, which was previously addressed in SDEIS Table 8-1. Further explanation is provided below. MPCA's goal is to protect high-quality waters and improve the quality of impaired waters, so water quality standards are met and beneficial uses are maintained and restored, where these uses are attainable. As summarized in FEIS Section 5.2.7.2.5, widespread contamination of fish from atmospheric pollution is why Minnesota established a statewide mercury TMDL. The TMDL seeks to reduce atmospheric deposition everywhere in the state, in order to make the state's lakes and streams fishable, as required by federal regulations, and is intended to provide the long-term framework to reduce mercury in fish. The MPCA published Guidelines for New and Modified Mercury Air Emission Sources, and revised those guidelines in 2012 (MPCA 2012h, as cited in the FEIS). The guidelines were developed to limit the mercury emissions from new and expanding sources in order to meet the TMDL goal of total statewide mercury emissions of 789 lbs/year by 2025. The MPCA has conducted a review of the NorthMet Project Proposed Action mercury emissions, and has determined that it would not impede the reduction goals (MPCA 2013b, as cited in the FEIS). Furthermore, WWTF and WWTP discharges are expected to meet the 1.3 ng/L standard for mercury, and overall the NorthMet Project Proposed	MERC 10 MERC 22

Comment ID	Comment	Response	Theme(s)
		Action is predicted to result in a net decrease of mercury-loading.	
3117	While the incremental risk [of mercury loading] from the Project may be small, the existing risk is large and has not yet been addressed through a total maximum daily load ("TMDL") or other reduction program.	The comments in this theme were originally presented as part of the Tribal Position Summary included in MDO #2, which was previously addressed in Table 8-1 of the SDEIS. Further explanation is provided below. MPCA's goal is to protect high-quality waters and improve the quality of impaired waters, so water quality standards are met and beneficial uses are maintained and restored, where these uses are attainable. As summarized in FEIS Section 5.2.7.2.5, widespread contamination of fish from atmospheric pollution is why Minnesota established a statewide mercury TMDL. The TMDL seeks to reduce atmospheric deposition everywhere in the state, in order to make the state's lakes and streams fishable, as required by federal regulations, and is intended to provide the long-term framework to reduce mercury in fish. The MPCA published Guidelines for New and Modified Mercury Air Emission Sources, and revised those guidelines in 2012 (MPCA 2012h, as cited in the FEIS). The guidelines were developed to limit the mercury emissions from new and expanding sources in order to meet the TMDL goal of total statewide mercury emissions of 789 lbs/year by 2025. The MPCA has conducted a review of the NorthMet Project Proposed Action mercury emissions, and has determined that it would not impede the reduction goals (MPCA 2013b, as cited in the FEIS). Accordingly, no minimization and mitigation plan is required for the NorthMet Project Proposed Action. Based on the results of MPCA's review, the NorthMet Project Proposed Action should not be required to buy mercury offsets at this time. Should an evaluation of the NorthMet Project Proposed Action determine that an additional mercury source has been added, mercury offsets would be sought in accordance with the Implementation Plan for Minnesota's Statewide Mercury Total Maximum Daily Load (MPCA 2009d, as cited in the FEIS). Further, the NorthMet Project Proposed Action is not anticipated to be a major source of mercury into the environment. The RO treatment is expected to discharge mercury at or below the mercury standard of 1.3 ng/L, which includes all surface water that would be discharged at the Plant Site, including water used for flow augmentation. Mercury loadings from the Mine Site are projected to decrease due to the NorthMet Project Proposed Action. The combined contributions from the Embarrass River and Partridge River are unchanged when modeled for the St. Louis River at the Fond du Lac reservation boundary; therefore, further degradation of surface water quality, and by extension increased mercury in fish, is not	MERC 22

Comment ID	Comment	Response	Theme(s)
		expected.	
9007	In the SDEIS, there is no discussion regarding the type of financial assurance that would be used. No detail is provided regarding the estimated amount of financial assurance that would be sufficient for reclamation, closure, mitigation, and remediation of adverse effects from the Project. Even though the MNDNR has stated that PolyMet financial assurance will include clean-up costs for contamination resulting from LTVSMC operations, the SDEIS provides no discussion regarding financial assurance for the existing contamination associated with previous mining activities at the site.	FEIS Section 3.2.2.4 provides available details regarding financial assurance. Additional details on the cost estimates, time frames, contingency plan amounts for unforeseen challenges, calculations that would be required for the project, monitoring, mitigation, and legacy contamination would be addressed during permitting. Table 3.2-15 provides financial assurance cost estimates for various years of closure, as well as monitoring and mitigation costs. Section 3.2.2.4.1 discusses what activities would be considered in cost estimates, and that cost estimates would be updated annually under the Permit to Mine. *Minnesota Rules* 6132.1200, Subpart 3, states that cost estimates shall be annually adjusted using current dollar value at the time of the estimate. To the extent the reclamation plan includes maintenance, mitigation, and cleanup of legacy contamination, those items would be covered by financial assurance.	FIN 01 FIN 05 FIN 08 FIN 11
9008	Mining need not be synonymous with pollution: "In the right place – and with conscientious companies, new technologies and good planning – many of the potential impacts are avoidable. In fact, most mine pollution arises from negligence, not necessity." The NEPA "hard look" requires agencies to "exercise a degree of skepticism in dealing with self-serving statements from the prime beneficiary of a project" when analyzing alternatives. The SDEIS does not evaluate or examine Project alternatives in any substantive way; even the no-action alternative is lacking in detail and analysis. Instead, the SDEIS states: Consistent with the CEQ regulations, the federal Co-lead Agencies are required to identify an agency-preferred alternative in a DEIS, if one exists, and in the FEIS unless another law prohibits the expression of such a preference. At this time, the Co-lead Agencies have not identified a preferred alternative, and for the USACE, Appendix B of 33 CFR Part 325 supersedes the CEQ requirement to identify an agency-preferred alternative.	The original project proposal and alternatives were developed during project scoping in 2005. The NorthMet Project Proposed Action was refined at various points in response to public and agency input. As a result, the NorthMet Project Proposed Action studied in the SDEIS is not identical to the proposed action in the 2009 DEIS. Some alternatives to the proposed action were considered and eliminated during the scoping and DEIS phases of the NorthMet Project Proposed Action, so did not require re-evaluation in the SDEIS. Alternatives were eliminated from detailed evaluation if they did not offer substantial environmental or socioeconomic benefits, were not reasonable (technically or economically feasible), were not available, or would not meet the Purpose and Need. This review—beginning during the scoping process and concluding with the FEIS—is consistent with the alternatives review required by NEPA and MEPA, and with the CEQ rules for analyzing alternatives. Refer to FEIS Section 3.2.3 for a discussion on the process and outcomes for consideration of the NorthMet Project alternatives, and Section 3.3.3 for a discussion on the Land Exchange alternatives. FEIS discusses in section 3.2.3.2 how the Consent Decree under the NorthMet Project No Action Alternative would require Cliffs Erie to complete closure and reclamation activities at the Plant Site. This would include completing activities for the localized affected areas under the Minnesota VIC Program, removal of the former Plant Site facilities that are not going to be reused, and management of seepage at the Tailings Basin embankment. The FEIS mentions in Table 3.2-1 that under the	ALT 01 ALT 03 ALT 14 ALT 20

Comment ID	Comment	Response	Theme(s)
	Part 57(4) of 33 C.F.R. Part 325 at Appendix B, NEPA Implementation, only states: Alternatives. See 40 CFR 1502.14. The Corps is neither an opponent nor a proponent of the applicant's proposal; therefore, the applicant's final proposal will be identified as the "applicant's preferred alternative" in the final EIS. Decision options available to the district engineer, which embrace all of the applicant's alternatives, are issue the permit, issue with modifications or conditions or deny the permit. To the extent this limits USACE's obligation to identify an agency-preferred alternative, which is not clear, nothing there limits the USFS's obligation to do so. Moreover, Part 57(4) of Appendix B does require that "reasonable alternatives" must be considered in detail, along with "geographic alternatives, e.g., changes in location and other site specific variables, and functional alternatives, e.g., project substitutes and design modifications." The Band has long cited this defect in its comments,21 and EPA cited the lack of alternatives as a factor when issuing an EU-3 rating for the DEIS. Although the SDEIS was revised to reflect the Project proponents' preferred action, still, the only alternative analyzed in any detail concerns the acreage of the proposed land exchange. This failure is a serious violation of NEPA and must be remedied before the SDEIS can be finalized.	NorthMet Project No Action Alternative, there would be no mining activities, and that existing management and land use of the federal lands would continue. The NorthMet Project No Action Alternative is also analyzed under each resource area in the FEIS Chapter 5, and summarized in the FEIS Table 7.2-1. Several other alternatives for both the NorthMet Mining Project and Land Exchange were screened before the FEIS (see FEIS Section 3.2.3.3).	
9011	No effort was made to discuss or evaluate the least environmentally damaging practicable alternative ("LEDPA") required before rendering a Clean Water Act Section 404 Permit.	The LEDPA process is described in FEIS Section 7.5. The ROD for the USACE would include the Section 404(b)(1) analysis and the public interest review, and would determine the LEDPA. Furthermore, the ROD for the USACE cannot be finalized until 30 days after release of an FEIS. Any comments received during the 30 day period may be considered in the ROD for the USACE. The ROD for the USACE would recommend issuance, issuance with conditions, or denial of the permit.	COE 04

Comment ID	Comment	Response	Theme(s)
9014	The SDEIS failed to substantively consider many alternatives that may provide mitigation for, or prevent long-term environmental damage. Some of these alternatives include: paste tailings to reduce the project footprint and use less water thus decreasing risk of water pollution; perpetual pumping of the mine pit to prevent a pit lake from forming and by doing so protecting groundwater; back-filling waste rock into the east, central, and west mine pits to reduce the mine foot print and restore wetlands; engineered liners; providing reverse osmosis treatment at the mine site beginning in year one of operations to augment water loss in nearby high quality wetlands in the Partridge River watershed; and underground mining.	A thickened tailings (paste tailings) alternative (A1) was considered but eliminated in the DEIS and post-DEIS as it was determined not to offer significant environmental benefits over the NorthMet Project Proposed Action. See the response to Theme ALT 04, which describes the West Pit Water Elevation Alternative (see also MDNR et al. 2014, as cited in the FEIS). FEIS Section 3.2.2.1.10 states that waste rock would be backfilled into the East Pit starting at year 11 and in the combined East Central Pit starting in year 16. After backfilling is complete, a wetland would be constructed over the combined East Central Pit. See the response to Theme ALT03 for more information about the West Pit backfill alternative. The 2009 DEIS discussed a liner system as part of its consideration of a modified design or layout at the Mine Site. Key aspects of this alternative from the 2009 DEIS were incorporated into the NorthMet Project Proposed Action and studied in the SDEIS. Liners would be installed for stockpiles or areas where there is a potential to generate acid and metal leachate from potentially reactive waste. The Hydrometallurgical Residue Facility would contain a double-liner system. Temporary stockpiles (Category 2/3 and Category 4) and the Ore Surge Pile would contain a liner. The Category 1 Stockpile would have a containment system to collect seepage, which would be pumped to the WWTF. The Overburden Storage and Laydown Area would hold peat soils and unsaturated overburden, which would not be expected to be reactive. During operations, effluent from the WWTF and runoff from the Overburden Storage and Laydown Area would be pumped to the Tailings Basin for reuse. During this time, extensive monitoring would be required, and adaptive management would be used to ensure minimization of effects and compliance into the future. During reclamation, water from the West Pit would be treated at the WWTF, which would be upgraded to include a RO treatment unit. Treatment at this unit would result in an effluent that meets all applicable water quality standards. See the response to Theme ALT01 for more information about the underground mining alternative.	ALT 01 ALT 04 ALT 06 ALT 10 ALT 13
9020	The SDEIS summarily dismissed the possibility of backfilling: The opportunity to reclaim wetlands and vegetation at the Category 1 Stockpile footprint	The West Pit Backfill alternative (E20) was considered but eliminated during the development of the DEIS. It was eliminated from further consideration because it was determined that it would not offer significant environmental or socioeconomic benefits compared to the NorthMet	ALT 03 ALT 06

Comment ID	Comment	Response	Theme(s)
	area would be the only measurable environmental benefit offered by backfilling the Category 1 Stockpile into the West Pit. However, because of the temporal effect that the stockpile would have, those effects would be required to be mitigated regardless of future backfilling or not. Furthermore, the potential environmental benefit is moot or outweighed because encumbrance is not allowed in PolyMet's private mineral leases and because the costs associated with backfilling, additional water treatment (rates), and encumbrance compensation determined in revised lease agreements may affect the ability of PolyMet to secure financing (MDNR et al. 2013b). As such, the option to backfill the West Pit was eliminated from further consideration in the SDEIS. Back-filling all of the mine pits with waste rock would reduce the surface footprint of the mine and make possible 526 acres of wetland restoration where the Category 1 stockpile is now proposed to be stored without a liner in perpetuity.	Project Proposed Action and because backfilling the West Pit would prevent recovery of additional mineral resources. These factors are sufficient to qualify the West Pit Backfill alternative as unreasonable under NEPA, and justify its exclusion under *Minnesota Rules* 4410.2300, Subpart G. It was reconsidered in the SDEIS in response to comments from the Cooperating Agencies. A Co-lead Agency memorandum (MDNR et al. 2013b, as cited in the FEIS) was prepared to summarize the decision-making process, which is referenced in the FEIS Section 3.2.3.4.2. The Co-lead Agencies screened the alternative against criteria used for other alternatives, including Purpose and Need, Technical and Economic Feasibility, Availability, and Environmental or Socioeconomic Benefit. The opportunity to reclaim wetlands and vegetation at the Category 1 Stockpile footprint area would be the only measurable environmental benefit offered by backfilling the Category 1 Stockpile into the West Pit. However, because of the temporal impact that the stockpile would have, these impacts would be required to be mitigated regardless of future backfilling or not.	
9022	Engineered liners for the Category 1 Waste rock Stockpile and the Overburden Storage Layout Area ("OSLA") would ensure that seepage would not migrate into fractures below the storage facilities and increase the effectiveness of seepage capture...If the Category 1 Stockpile were lined, seepage capture efficiency would increase and less water carrying pollution would migrate from the pile into the fractures below the storage area thereby protecting groundwater.	Liners would be installed for stockpiles or areas where there is a potential to generate acid and metal leachate. The Category 1 Stockpile would have a containment system to collect seepage, which would be pumped to the WWTF for treatment. The Category 1 stockpile would contain material that is not expected to produce acidic leachate. The non-acid generating waste was identified using multi-year kinetic tests (humidity cells) on NorthMet rock samples. Waste rock with 0.12 percent sulfide S or less is the threshold for selecting non-acid generation mine waste and is supported by long-term humidity cell tests on NorthMet waste (i.e., 42 samples of Category 1 waste rock, with tests now run for over 450 weeks (Waste Characterization Data Package, Section 4.3 (PolyMet 2015q)) The Overburden Storage and Laydown Area would hold peat soils and unsaturated overburden, which is not expected to be reactive.	PD 16
9025	After operations, the SDEIS contemplates that the RO plant would continue to treat tailings basin seepage and begin treating tailings pond water. The treated water would be used for augmentation	The NorthMet Project Proposed Action described in the FEIS includes treatment of all water that would be discharged at the Plant Site including water used for flow augmentation. The amount of water from Colby Lake used for flow augmentation would be low; however, any water used for	WR 018 WR 124 WR 184

Comment ID	Comment	Response	Theme(s)
	of streams near the plant site. Colby Lake water is also proposed for stream augmentation. However, because Colby Lake water exceeds WQS for many pollutants including mercury, it would also need to be RO-treated before being used for augmentation. RO-treated water should be used to augment stream flow at both the plant site and mine site. Colby Lake water should not be used for stream augmentation unless it is RO-treated first. RO will not cause waters in the vicinity of the plant site to comply with WQS due to low seepage capture efficiency at the tailings basin.	augmentation would be treated prior to discharge. PolyMet recommends that tributaries that extend from the Tailings Basin be monitored, see FEIS Section 5.2.2.3.6 and comment ID 9022.	
9029	The MNDNR and USACE considered underground mining as an alternative to the proposed open pit(s) for the DEIS in 2009, but eliminated it because it would have had "a significantly reduced rate of operation that would not be considered economically feasible, and, therefore, would not meet the Purpose and Need of the Project." Even though underground mining was reconsidered for the SDEIS, the Co-Lead Agencies did not "exercise a degree of skepticism in dealing with self-serving statements from the prime beneficiary of a project" when analyzing alternatives. The Project proponent eliminated the alternative based solely on an economic decision that underground mining would not be as profitable as open pit mining. The co-leads state that "it was not possible to undertake a quantitative, side-by-side assessment of the underground mining alternative."37 An underground mine would have a reduced mining rate and life of mine, employed fewer workers for a shorter period of time, and reduced state and local tax revenues. Conversely, although the underground mining alternative would offer environmental benefits, the SDEIS includes no economic analysis of those benefits. Still, the Co-Lead Agencies determined that underground	The Underground Mine alternative was first considered but eliminated during the FSDD process. The FEIS Section 3.2.3.4.1 describes how it was reconsidered during the DEIS process as alternative E7 in response to Cooperating Agency and stakeholder comments, but eliminated from further consideration. The economic feasibility of the Underground Mine alternative was reconsidered during development of the SDEIS. In response to a request from the Co-lead Agencies, PolyMet's consultants prepared an updated economic assessment of underground mining, which the Co-lead Agencies independently evaluated (see FEIS Appendix B). The Co-lead Agencies concluded that an underground mine would not be profitable, regardless of the tonnage extracted. The lower rate of ore production would not meet the Purpose and Need of the project. Though it would offer environmental benefits over the NorthMet Project Proposed Action, it would result in reduced socioeconomic benefits. They accordingly concluded that the Underground Mine alternative was not economically feasible, and would not meet the NorthMet Project's Purpose and Need. A position paper (FEIS Appendix B) was prepared to document the Co-lead Agencies' rationale for eliminating the Underground Mine alternative from further consideration. FEIS Section 5.2.10.1.4 states, "Neither NEPA nor CEQ requires the cost and benefits of a proposed action to be quantified in dollars or any other common metric; however, this EIS acknowledges that economic costs and loss of non-market value may result from environmental and social effects. Also acknowledged is that the agreement on the value (i.e., the "cost") of environmental effects is often difficult to achieve. Therefore, the approach of this EIS is to evaluate environmental and social impacts directly, in the appropriate resource-specific section." CEQ regulations for implementing	ALT 06

Comment ID	Comment	Response	Theme(s)
	mining would result in reduced socioeconomic benefits, and "PolyMet would not move forward with an unprofitable project, thus any potential environmental or socioeconomic benefits associated with this alternative are moot."	NEPA (40 CFR 1502.23) state that, "for purposes of complying with the Act, the weighing of the merits and drawbacks of the various alternatives need not be displayed in a monetary cost-benefit analysis and should not be when there are important qualitative considerations."	
9031	Although underground mining was considered technically feasible, the Co-Leads provided that: PolyMet is a private sector and for-profit company, the value of the saleable material would need to provide sufficient income to cover operating cost (which includes, but is not limited to, the cost of mining, processing, transportation, and waste management), capital cost (to build and sustain facilities), an adequate return to investors, reclamation, and closure costs and taxes. Using underground mining would result in most of the NorthMet Deposit left unmined because of its low metal value (i.e., less value than the cost of mining and mineral processing). Other material would have to be left in place for safety reasons, to prevent collapse. Therefore: …the Co-lead Agencies found that while underground mining is technically feasible, available, and would offer significant environmental benefits over the proposed NorthMet Project, it would not be economically feasible and would not meet the Purpose and Need. Since the underground mining alternative would not meet all of the screening criteria, it is not considered to be a reasonable alternative. Therefore, the underground mining alternative was eliminated from further evaluation in the SDEIS. In no way does this constitute an appropriate level of detail. The conclusion that underground mining is not viable, or preferable, remains substantially unjustified, despite repeated requests for further analysis. Without considering the economics of perpetual treatment the economic analysis	The Underground Mine alternative was first considered but eliminated during the FSDD process. FEIS Section 3.2.3.4.1 describes how it was reconsidered during the DEIS process as alternative E7 in response to Cooperating Agency and stakeholder comments, but eliminated from further consideration. The economic feasibility of the Underground Mine alternative was reconsidered during development of the SDEIS. In response to a request from the Co-lead Agencies, PolyMet's consultants prepared an updated economic assessment of underground mining, which the Co-lead agencies independently evaluated (see FEIS Appendix B). The Co-lead Agencies concluded that an underground mine would not be profitable, regardless of the tonnage extracted. The lower rate of ore production would not meet the Purpose and Need of the project. Though it would offer environmental benefits over the NorthMet Project Proposed Action, it would result in reduced socioeconomic benefits. They accordingly concluded that the Underground Mine alternative was not economically feasible, and would not meet the NorthMet Project's Purpose and Need. A position paper (FEIS Appendix B) was prepared to document the Co-lead Agencies' rationale for eliminating the Underground Mine alternative from further consideration. FEIS Section 5.2.10.1.4 states, "Neither NEPA nor CEQ requires the cost and benefits of a proposed action to be quantified in dollars or any other common metric; however, this EIS acknowledges that economic costs and loss of non-market value may result from environmental and social effects. Also acknowledged is that the agreement on the value (i.e., the "cost") of environmental effects is often difficult to achieve. Therefore, the approach of this EIS is to evaluate environmental and social impacts directly, in the appropriate resource-specific section." CEQ regulations for implementing NEPA (40 CFR 1502.23) state that, "for purposes of complying with the Act, the weighing of the merits and drawbacks of the various alternatives need not be displayed in a monetary cost-benefit analysis and should not be when there are important qualitative considerations."	ALT 01

Comment ID	Comment	Response	Theme(s)
	provided by the Project proponent concludes that underground mining is "[n]ot economically viable," while simultaneously claiming that backfilling the west pit would create encumbrances not allowed in their lease due to minerals located below the west pit that can only be accessed through underground mining. This is not the appropriate use of a cost-benefit analysis for purposes of analyzing an EIS alternative. The CEQ regulations require that, where a cost-benefit analysis is "relevant to the choice among environmentally different alternatives," there are a variety of additional requirements, including "analysis of un-quantified environmental impacts, values, and amenities,"42 in addition to other CEQ alternatives rules.		
9033	Additionally, the SDEIS does not provide adequate discussion of the adverse effects of the proposed land exchange on wetlands and headwater streams within the St. Louis River	The SDEIS FEIS Section 5.3.3 included a discussion of wetland resources to be gained or lost as part of the proposed action land exchange. The Land Exchange Proposed Action represents a transfer of surface rights of 6,495.4 acres from the SNF to PolyMet to eliminate the conflict between federal surface and private mineral estate. This action, if approved, would remove those acres from SNF management and public use and transfer them to private ownership. Effects to wetland resources as a result of the mining activities are discussed in FEIS Section 5.2.3. SDEIS Section 5.3.6 included a discussion of headwater streams to be gained or lost from the Land Exchange Proposed Action.	WET 14
9036	The SDEIS attempts to diminish the significance of the loss of these high-quality lands by stating that "[g]iven the existing lack of overland public access and actual use of the federal lands, as well as historic use of this area for mineral exploration (see Section 4.2.9), the Land Exchange Proposed Action represents little to no change in the actual level of recent or current use of the federal lands." In fact, historic trails key to both the exercise of treaty rights and of historic significance connect what is now Beaver Bay with Lake Vermillion.	As discussed in FEIS Section 5.3.1.2.1, the only public access to the federal lands is via the Partridge and Embarrass rivers. The remainder of the federal lands is surrounded by private lands (or by other public lands that are themselves surrounded by private lands) (see Figure 4.3.1-1). While members of the public may obtain permission to cross these private lands and access the federal lands, there is no designated land-based access for the federal lands.	CR 05
9037	The Project proponent provides that "three	The SDEIS was based on data generally collected through October 2012.	WR 008

Comment ID	Comment	Response	Theme(s)
	monitoring wells were installed in 2005 and sampled quarterly or less frequently prior to 2011; an additional 21 wells were installed between October 2011 and February 2012 and were sampled monthly through August 2012. All 24 wells are currently sampled three times per year (quarterly, excluding winter (1st) quarter)." But no bedrock monitoring wells were installed near the tailings basin. Only nine bedrock wells were installed for the entire Project, all in the area where the proposed mine pit(s) would be located. Moreover, data collected specifically for the Project was selectively used, with several well and surface water monitoring stations' data completely excluded from the water quality models used to predict Project impacts.	The FEIS relied on new data collected through the end of 2013, which included 12 new monitoring wells at the Mine Site. In addition, the FEIS made use of new geotechnical data collected in 2014 along the north, northwest, and west perimeter of the Tailings Basin, including: geologic logs, ten new surficial aquifer piezometers, slug tests in the piezometers, and ten bedrock packer tests performed in five boreholes advanced into upper bedrock. Hydrogeologic site characterization was sufficient for purposes of environmental review. All publically available and relevant studies were considered in developing the SDEIS and FEIS. These include technical reports prepared by PolyMet, reports from state and federal agencies, technical papers in peer reviewed journals, and technical reports associated with other mine sites. The SDEIS and FEIS preparers drew on these information sources to the degree that they were reliable and relevant to the assessment of potential NorthMet Project Proposed Action impacts. The FEIS record provided a description of data used to assess impacts. It is correct that there are currently no bedrock monitoring wells at the Plant Site. Installation of bedrock monitoring wells would be specified as part of the permitting process, with the results used to assess project performance on an ongoing basis.	WR 071 WR 072
9046	Baseflow is the component of streamflow attributed to groundwater discharge from both deep subsurface and delayed shallow subsurface flow. It is established by measuring the rate of streamflow during low flow conditions; either in the winter months when groundwater continues flowing under the frozen surface, or in warmer months during periods of time when there is no precipitation. Baseflow is used to define the amount of groundwater contribution to streamflow, and helps determine the speed at which groundwater travels. The baseflow rate predicted by XP-SWMM is three times lower than flow data indicates, and implies recharge to the groundwater system from precipitation that is not consistent with published literature.	Groundwater baseflows used in the SDEIS are best-estimate values and should be retained in the FEIS. This is because the SDEIS groundwater baseflow values were based on 1) winter 1986-87 and winter 1987-88 stream gaging in the Partridge River at SW-006 that occurred when there were no discharges from Northshore Mine and 2) 1942 to 1963 gaging data in the Embarrass River, which includes years prior to the LTV tailings basin startup (1957). When expressed as a groundwater baseflow yield per unit area, the similar results for both watersheds (approximately 0.05 cfs per square mile) supports the approach used. The yield per unit area is similar to other watersheds in Northern Minnesota. Studies have shown that streamflow characteristics in this part of Minnesota have not changed systematically over the last 50 years. The only other available gaging data is from a station installed during 2011 at SW-003 on the Partridge River. Interpretation of groundwater baseflow at SW-003 is not reliable for use in the GoldSim modeling of groundwater baseflow due to the complicating effects of Northshore pumped discharges, seepage from the Northshore Western Pond, and complex storage/release	WR 003 WR 175

Comment ID	Comment	Response	Theme(s)
		mechanisms in the wetlands that receive these flows. More broadly, groundwater baseflow discharge varies with time and is a reflection of longer-term weather and climatic conditions. The variability of groundwater baseflow discharge is demonstrated by the examination of estimated values for several years using different methods. Evaluation of these values affirms continued reliance on the 1986-87 USGS data for the FEIS is reliable. To better understand the relationship of groundwater baseflow to the GoldSim model's water quality impact projections, a sensitivity analysis for the Mine Site was conducted to evaluate if predicted NorthMet Project Proposed Action impacts are sensitive to groundwater baseflow values. The sensitivity analysis considered the relationship of various model inputs to groundwater baseflow including hydraulic conductivity, recharge, and surface runoff chemical concentrations. It also reflected consideration of the flow data collected at SW-003 in requiring groundwater baseflows at all locations on the Partridge River be increased by a factor of 4 (e.g., 0.5 to 2 cfs at SW-003). The results indicate that modeled groundwater and surface water concentrations are sensitive to changes in groundwater baseflow. However, the NorthMet Project Proposed Action's ability to meet groundwater quality and surface water quality evaluation criteria is not sensitive to changes in baseflow. Evaluation criteria can be found in Section 5.2.2.	
9051	It is widely acknowledged that "[m]ining can deplete surface and groundwater supplies. Groundwater withdrawals may damage or destroy streamside habitat many miles from the actual mine site." The importance of accurate evaluation of geology cannot be underestimated in modeling: Hydrogeologic characterization studies should include geological descriptions of the site, including descriptions of rock types, intensity and depth of weathering, and the abundance and orientation of faults, fractures, and joints. Although difficult to evaluate, the hydrologic effects of fractures, joints, and faults are especially important to distinguish and characterize. Water moves more easily through faults, fractures, and dissolution zones, collectively termed secondary	Impact assessment modeling relies on site characterization data that indicate the bulk hydraulic conductivity of upper bedrock is two to three orders-of-magnitude lower than the hydraulic conductivity of the surficial aquifer. Thus, groundwater flow and transport at both the Mine Site and Plant Site are dominated by the hydraulics of the surficial aquifer. Bedrock plays a negligible role in transporting site-derived chemicals to the Partridge and Embarrass Rivers. It is acknowledge that there could be some hydraulic connections between bedrock and the surficial aquifer where transport is expected to be negligible. Given these factors, the approach was to not consider this possible connection in the NorthMet Project Proposed Action water quality models, but to recommend extensive monitoring during operations and closure to assess if interactions occur and if they would raise concerns for permitting agencies. If monitoring data indicate trends toward permit non-compliance, adaptive mitigation measures would be implemented to prevent or eliminate what is expected to be a small transport-related	WR 010 WR 012

Comment ID	Comment	Response	Theme(s)
	permeability, than through rock matrices. Secondary permeability can present significant problems for a mining facility because it can result in a greater amount of groundwater discharge to a mine than originally predicted. However, the SDEIS indicates that mine pit dewatering impacts will be very limited or non-existent based on the assumption that there is little or no connection between the bedrock and surficial aquifers. This assumption is not supported by the data used to characterize mine site hydrology; instead, it is based on an unsupported "professional opinion."	bedrock impact relative to surficial flows. See FEIS Section 5.2.2.3.5 for more information on adaptive mitigation measures and Section 5.2.2.3.6 for more information on monitoring. The FEIS further evaluated the possibility of fractures and faults at the Mine Site and Plant Site to determine what (if any) changes need to be made to model assumptions to accurately predict potential environmental effects for purposes of environmental review. Although no change was made to the Plant Site GoldSim model, the FEIS Mine Site GoldSim model was modified to include a flow/transport zone 15 meters thick from that present in the SDEIS. The results of the analysis are included in FEIS Section 5.2.2.3.2. The response to theme WR169 also contains additional information on fractures and faults. The SDEIS disclosed that bedrock is variably fractured. The effects of fracturing are incorporated into the bulk hydraulic conductivity values used to characterize bedrock for the water quality impact assessment modeling. This is common practice in large-scale evaluations of bedrock hydraulics and the Mine Site GoldSim model was updated for the FEIS to better represent the likelihood of an upper zone of more fractured bedrock than deeper in the formation. Background bedrock-related conductivity information was also updated for the FEIS. Structural faults may exist between mine facilities and perennial streams that receive groundwater discharge. Because the landscape is covered with surficial deposits and there are few bedrock outcrops, the existence of faults is conjectural and locations at best can only be inferred. It is unknown if faults (if and where they exist) behave as conduits or barriers to groundwater flow. Given these uncertainties, it is unlikely that any reasonable field program would be able to identify the existence, location, and hydraulic characteristics of faults that may or may not be present at the site. The FEIS documents the need to require a robust monitoring program during operations and closure to provide direct or indirect evidence on the existence of hydrologically significant faults. If significant faults are identified (that is, faults which could lead to violation of water quality standards), then adaptive measures would be employed to mitigate the fault-related effects. See FEIS Section 5.2.2.3.5 and theme WR169 for additional information.	
9052	In fact, information beyond the flow data collected by PolyMet implies that there may be substantial connection between the bedrock and surficial	Tritium and non-ionized ammonia can be indicators of relatively young water. However, when these constituents are identified in water extracted from a borehole, the overriding question is whether or not foreign (young)	WR010 WR011 WR012

Comment ID	Comment	Response	Theme(s)
	aquifers and that groundwater travel time will be exponentially faster than predicted. Water quality data collected from two deep boreholes in the area where the Project mine pit(s) will be located found tritium and un-ionized ammonia nitrogen. Both tritium and un-ionized ammonia indicate a strong connection with surface water. Tritium indicates that the water found in the deep boreholes was on the surface sometime after 1950, during or after nuclear testing when atmospheric deposition of this pollutant occurred. Un-ionized ammonia is produced by ore blasting activities. The bore holes where this pollution was measured are approximately one mile southwest of the Peter Mitchell Pit, which is the closest potential source of this pollution. Therefore, this data indicates that the PolyMet mine site is already hydrologically connected to the Peter Mitchell Pit through fractures. Upon review of the Peter Mitchell pit discharge monitoring data for SD001, the Band found that the average concentration of un-ionized ammonia exceeded the 0.04 mg/l NPDES permit in 2006 and 2008. The distance between the Peter Mitchell pit and the Project proposed pit(s) is approximately one mile, indicating that groundwater travel time through bedrock fractures will be orders of magnitude faster than Project modeling suggests. Such a connection means that dewatering of the mine pits will cause significant drawdown of the water table in the surficial aquifer, potentially dewatering wetlands and ephemeral streams. This also indicates that when the mine pit(s) refill, polluted water will seep and leak out into groundwater surrounding the project.	water was introduced during the drilling process. There are many documented cases where tritium in borehole water could be traced to makeup water introduced during the drilling process to help maintain circulation. Experience indicates that conclusions about the age of groundwater based on tritium and non-ionized ammonia are unreliable unless it can be absolutely verified that no foreign (makeup) water was introduced during the drilling process. Given the isolated occurrences additional verification is not warranted for the EIS. Impact assessment modeling relies on site characterization data that indicate the bulk hydraulic conductivity of upper bedrock is two to three orders-of-magnitude lower than the hydraulic conductivity of the surficial aquifer. Thus, groundwater flow and transport at both the Mine Site and Plant Site are dominated by the hydraulics of the surficial aquifer. Bedrock plays a negligible role in transporting site-derived chemicals to the Partridge and Embarrass Rivers. It is acknowledged that there could be some hydraulic connections between bedrock and the surficial aquifer where transport is expected to be negligible. Given these factors, the approach was to not consider this possible connection in the NorthMet Project Proposed Action water quality models, but to recommend extensive monitoring during operations and closure to assess if interactions occur and if they would raise concerns for permitting agencies. If monitoring data indicate trends toward permit non-compliance, adaptive mitigation measures would be implemented to prevent or eliminate what is expected to be a small transport-related bedrock impact relative to surficial flows. See FEIS Section 5.2.2.3.5 for more information on adaptive mitigation measures and FEIS Section 5.2.2.3.6 for more information on monitoring. The FEIS further evaluated the possibility of fractures and faults at the Mine Site and Plant Site to determine what (if any) changes need to be made to model assumptions to accurately predict potential environmental effects for purposes of environmental review. Although no change was made to the Plant Site GoldSim model, the FEIS Mine Site GoldSim model was modified to include a flow/transport zone 15 meters thick from that present in the SDEIS. The results of the analysis are included in FEIS Section 5.2.2.3.5. The response to theme WR 169 also contains additional information on faults and fractures.	WR 013 WR 061 WR 071 WR 087 WR 099 WR 168 WR 169
9054	Groundwater is an important source of drinking water in the Great Lakes Basin…Glacial aquifers	The Plant Site water quality model (GoldSim) properly accounts for the existence of the LTVSMC tailings that are currently disposed in the	WR 016 WR 030

Comment ID	Comment	Response	Theme(s)
	are commonly thin and limited in their extent and yield. Bedrock aquifers have limited yield, generally from fractures; groundwater movement is difficult to define. There are no large-scale regional aquifers. The Biwabik Iron Formation is the only source of groundwater for many Iron Range cities…Over the decades of operations at the LTVSMC tailings basin, thousands of gallons per minute of polluted tailings basin water were discharged through the bottom of the basin into groundwater…The monitoring wells that do exist near the tailings basin have concentrations of pollutants including iron, sulfate, manganese, aluminum, and fluoride that exceeded drinking water standards. But because of the limited distribution of monitoring wells, the extent of the existing contaminant plume is not known. No bedrock monitoring wells have been drilled in the vicinity of the tailings basin. However, domestic wells near the northern property line show substantial contamination of the groundwater aquifer…Despite this, the SDEIS entirely skirts the question of overall impacts on the groundwater aquifer from putting an already-contaminated [tailings basin] site back into production...Blasting and shoveling ore will increase both the number of fractures and the connectivity of fractures potentially increasing baseflow and pit leakage into the bedrock layers below the bottom of the pit	Tailings Basin. The solute release rates from tailings (NorthMet Project Proposed Action and existing LTVSMC) were based directly on laboratory measurements conducted on representative samples of these two materials, including tailings generated as part of the Proposer's processing and metallurgical pilot-testing. Specific measurements included total concentrations of metals and other elements in the tailings (e.g., based on elements extracted in dissolution by a strong acid "aqua regia" digest), or for the more soluble constituents, the rate at which they leach in multi-year humidity cell tests (Table 1-13 of PolyMet 2015j, as cited in the FEIS). Modeled groundwater concentrations at the Plant Site of the NorthMet Project Proposed Action are described in Section 5.2.2.3.3. This assessment of the GoldSim results provides strong evidence that the NorthMet Project Proposed Action would not cause impacts to Plant Site groundwater quality above and beyond what would occur without the NorthMet Project Proposed Action. Moreover, bedrock monitoring wells are likely to be included in the water quality permit. Case histories of open pit excavations show that effects of blasting and shoveling do not extend very far from the pit walls, extending at most, several tens of meters.	WR 060 WR 071
9056	Project baseline data used for both the Mine Site and the Tailings Basin are insufficient. A comparison of hydrologic data that was collected for two other projects in the region demonstrates that the PolyMet project is data-poor in the area of basic hydrology, much less mitigation. Moreover, given the utility of the many existing studies of area hydrology, it is perplexing that the preparers have continually refused to use them, even as tribal cooperating agencies have repeatedly	The Co-lead Agencies rely upon the expertise and experience of their staff who bring to bear their knowledge of various studies and analyses performed on mine sites in Minnesota and elsewhere. This knowledge is applied in the review of documents prepared to evaluate the NorthMet Project Proposed Action potential effects. It should be noted that the NorthMet Project Proposed Action is different from other mining projects in this part of Minnesota in the following ways: different ore type, designs for groundwater containment systems, and use of long-term mechanical treatment. While experiences gained on other projects are informative, they do not necessarily apply to the NorthMet	WR 023 WR 071

Comment ID	Comment	Response	Theme(s)
	requested that they be used. Just a few publicly available examples include: the Minnamax Project; the LTVSMC Dunka Pit; historic MNDNR fisheries documents; and data required under the Cliffs Erie Consent Decree. All these resources should be used to supplement the hydrologic analysis and fully inform the permitting agencies and the public.	Project Proposed Action. This is particularly true for groundwater containment systems because the NorthMet Project Proposed Action uses a design that differs from those at other Iron Range mine sites. The mitigation designs of the NorthMet Project Proposed Action are unlike measures discussed in the Regional Copper-Nickel Study (MSPA 1979, as cited in the FEIS). The NorthMet Project Proposed Action measures include: long-term mechanical water treatment, uniquely designed groundwater containment systems, subaqueous disposal of reactive waste rock, and synthetic covers and under-liners used at waste rock stockpiles and treatment ponds. In addition, the level of construction QA/QC proposed at the NorthMet Project Proposed Action Site would be much higher than what has historically occurred at older mine sites in the Iron Range. It is erroneous to conclude that operation and closure of the NorthMet Project Proposed Action Site would necessarily entail the same types of failures that have occurred at some historical Iron Range mines. In fact, the unique designs and high-quality construction measures proposed are a response to past events. The detailed and sophisticated modeling work performed to support the FEIS exceed those conducted for some existing mines in Minnesota. The models used for the NorthMet Project Proposed Action represent years of development, with input from PolyMet, Co-lead Agencies and Cooperating Agencies. Based on comments received on the SDEIS, modifications were made to the models to improve FEIS impact evaluations. It is the Co-lead Agency position that incomplete or inaccurate predictions made in the past at historical mining operations do not provide a basis for judging the quality of modeling to be used in the NorthMet FEIS. The FEIS reflects consideration of information pertaining to the Dunka Pit that was directly relevant to the NorthMet Project Proposed Action. It is noteworthy that many aspects of operations at the Dunka Pit are dissimilar to the NorthMet Project Proposed Action in terms of hydrogeology and mine design.	
9059	The proponent's claim that 90 percent of the seepage from this tailings basin can be captured is unrealistic, to say the least. Tribes requested any example of the "90 percent or better" capture efficiency rate to be provided by the Co-Lead Agencies, but they were not able to provide a single example anywhere in the world. In fact, the	The design of the Tailings Basin capture system includes 1) a slurry wall keyed into bedrock, 2) a collection trench on the tailings side, 3) permanent pumping of the collection trench to depress the groundwater level on the tailings side, and 4) a discharge pipe on the downgradient side to raise groundwater levels to near ground surface. As shown by the cross-section MODFLOW models, this design insures a reversal of hydraulic gradients across the slurry wall (complete capture in surficial deposits) and complete	WR 017 WR 018 WR 020

Comment ID	Comment	Response	Theme(s)
	only authority the Co-Leads have ever cited is from an EPA guidance document that provided: Most barriers in the study have been in place for fewer than 10 years; therefore, long-term performance can only be extrapolated… All sites included in the study were existing sites that had vertical barriers and, in many cases, caps. None of the sites has an engineered bottom barrier. Therefore, the effect of leakage through aquitards was not evaluated in this study. That report also indicated that "10% of the containment systems reviewed failed to meet the performance objectives and required corrective action, and 19% of the evaluated facilities did not have sufficient data to conclude whether the containment system was operating successfully or not." In other words, even the Co-Leads' own authority does not support a 90 percent capture efficiency rate here. Actual examples in northeastern Minnesota, from U.S. Steel Minntac and the LTVSMC tailings basin seep SD0026 (the very tailings basin PolyMet proposes to re-use), demonstrate capture rates of less than 60 percent. Elsewhere, and similar to the Project's proposal, the Zortman-Landusky Mine in Montana installed containment and pump-back systems to be used in conjunction with a wastewater treatment facility. However, they "did not capture all surface and subsurface drainage." The Molycorp, Inc. Mine site in New Mexico concluded that "[t]he pathway for contaminant migration is the leaching of tailing seepage downward from the tailing facility to ground water that migrates through fractures to surface water." Therefore, it appears extremely unlikely that PolyMet will be able to capture 97 percent of the shallow seepage and 90 percent of the deep seepage from an unlined, leaking tailings basin.	or very high capture efficiency in bedrock below the slurry wall. The examples cited in the comment for Northeastern Minnesota are very different designs and cannot be compared to the proposed design for the Tailings Basin. Modeling performed for the NorthMet Project Proposed Action capture system indicates that the overall capture efficiency would be substantially greater than 90%.	

Comment ID	Comment	Response	Theme(s)
9062	The SDEIS provides that seepage from the existing LTV tailings basin continues to drain south to Second Creek long after LTVSMC operations have ceased. Because the seepage will continue to be pumped back under the PolyMet Proposed Action, it "is not considered further in this discussion." In Chapter 5, the SDEIS ensures the reader that the seepage collection system installed at the south side of the existing tailings basin has "essentially eliminated the flow of Tailings Basin seepage into Second Creek." However, the Project proponent is well aware that that the seepage pump-back system is not nearly as effective as claimed in the SDEIS. Because the pump-back system hasn't created the water quality improvements that were needed, the current owner of the tailings basin, Cliffs Erie, now offers two proposed modifications: (1) dewater the pond that is an additional source of water contributing to water quality concerns (pending an EPA wetlands determination); or (2) create another barrier (dam) for collection and pump back between the existing dam and monitoring station SD026. Contrary to SDEIS claims, all of the seepage from SD026 is not being captured and therefore must be considered further in the SDEIS and project modeling. In fact, most of the tailings basin seepage flowing to SD026 is not being captured. Additional work will have to be done to achieve desired water quality improvements. It is unknown at this time if the modifications to the seepage capture system that have been proposed for SD026 will result in the required water quality improvements, or substantially increase capture efficiency. Contrary to SDEIS claims, all of the seepage from SD026 is not being captured and therefore must be considered further in the SDEIS and project modeling.	It is acknowledged that there is currently incomplete capture of impacted water at SD-026. The FEIS has been modified to reflect this fact. Cliffs Erie is currently addressing this issue by upgrading the performance of the existing capture system and, if necessary, constructing new systems to enhance capture. If 100% capture is not attained by the Cliffs Erie upgrades, PolyMet has committed to installing additional systems in Second Creek to achieve this level of performance regardless of the types of measures required.	WR 117
9063	The SDEIS provides that construction of a	The FEIS relies on revised cross-section models from the SDEIS to	WR 010

Comment ID	Comment	Response	Theme(s)
	groundwater containment system along the north, northwest, and west sides of its unlined tailings basin "would capture virtually all of the Tailings Basin seepage"…without installing a single monitoring well in the bedrock to test this assumption...the SDEIS's conclusion that the method would be effective essentially is unsupported.	evaluate containment systems on the northern, northwestern, and western sides of the Tailings Basin, which are documented in PolyMet 2015j (as cited in the FEIS). These new models consider the presence of an upper more permeable bedrock zone directly below the slurry wall, with hydraulic properties based on 2014 packer tests conducted in five boreholes along the proposed capture system alignment. Sensitivity analyses have included variable bedrock hydraulic conductivity and different upper bedrock zone thicknesses up to 100 feet. The model results predict that the overall capture efficiencies of the proposed Tailings Basin capture systems would be substantially greater than 90%. This analysis supports the conclusion that the assumption of 90% or greater capture efficiency is justified. The FEIS describes a 2014 field program that investigated bedrock along the alignment of the proposed capture system on the northern, northwestern, and western sides of the Tailings Basin in FEIS Section 4.2.2.3.1. This investigation provided field data on bedrock hydraulic conductivity, Rock Quality Designation, and depth to top of bedrock. This information was used to develop MODFLOW cross-section models at three locations on the alignment to assess capture efficiency. The models included bedrock below the slurry wall.	WR 018 WR 061 WR 071 WR 079 WR 090 WR 099 WR 108
9069	Moreover, the tailings basin model uses storage coefficients that are not found anywhere in peer-reviewed scientific literature. This is significant because how much groundwater a geologic formation can contain (storativity or storage coefficient) and the rate of flow (hydraulic conductivity) is a function of the amount of open-pore spaces or fractures/faults in rock, the amount of water that infiltrates from the surface, and the groundwater gradient. The storage coefficients claimed for the entire plant site including the tailings basins is 0.20 for bedrock and 0.0002 for the surficial deposits, meaning that the bedrock contains orders of magnitude more water than the surficial deposits. When questioned about these extraordinary storage coefficients the explanation was that the model was calibrated to match predicted and measured groundwater levels. In sum, this model simulates a bedrock storage tank where lots of water goes in and virtually nothing	In response to these issues, the Plant Site MODFLOW model was modified and recalibrated as follows: 1) Updated areal distribution of surficial deposits and bedrock outcrops, 2) established surficial deposits below and adjacent to the East Embankment, 3) used drain and river cells along the East Embankment to allow surface seepage of tailings water, 4) incorporated the hydrologic effects of the future swale to drain surface water from the East Embankment area, 5) recalibrated model material properties and boundary conditions using all available data through 2013 (this is mostly new hydraulic head information), and 6) expanded the use of river and drain cells to provide a more accurate representation of wetlands outside the Tailings Basin. As a result of these changes, the FEIS Plant Site MODFLOW model no longer has a no-flow boundary condition at the toe of the East Embankment, and river and drain cells in surficial deposits are in place to allow the potential for surface seepage along the embankment toes (See Attachment A, Plant Site Water Modeling Data Package [PolyMet 2015j, as cited in the FEIS]). The model was checked to ensure that hydraulic heads in the tailings and adjacent surficial deposits were not well above ground surface. In the FEIS Plant Site MODFLOW model, storage	WR 018 WR 019 WR 093 WR 095 WR 097

Comment ID	Comment	Response	Theme(s)
	comes out. Because this is not possible, these modeled hydraulic conductivity and/or modeled storage coefficients cannot reliably estimate the amount of seepage that will bypass the seepage capture system, nor the amount of time before seepage upwells in nearby wetlands or in the Embarrass River. Additionally, the model, although using "artesian" coefficients, does not allow the artesian water to surface, even in an area east of the tailings basin where head pressure suggests that the water would be 150 feet above the ground surface.	coefficients for the surficial deposits and bedrock outcrops were assigned and/or calibrated to be more in line with literature values for these types of materials.	
9073	There is unquestionably a need for a slurry wall at the existing tailings basin if it is to be re-used by PolyMet - but in order to work even reasonably well, it would have to be flawlessly "keyed" into the bedrock without creating new fractures, and operate at an unrealistically high efficiency, in order to capture most of the seepage from the surficial aquifer. As noted previously, "[t]he pathway for contaminant migration is the leaching of tailing seepage downward from the tailing facility to ground water that migrates through fractures to surface water, and even though the SDEIS states that 90% of the seepage from the surficial aquifer will be captured there are no plans to capture any seepage flowing through bedrock fractures. In fact, bedrock is the part of this seepage capture system that is supposed to prevent seepage from escaping from the east side of the tailings basin. At the Plant Site, most groundwater flow occurs in an unconfined surficial groundwater system composed of unconsolidated sands, silts, and clays, and has a saturated thickness on the order of 7 meters. Below the surficial groundwater system is a low-permeability fractured bedrock unit consisting of several rock types. Groundwater flow rates in the bedrock unit are much less than flow in the overlying surficial groundwater	The design of the Tailings Basin capture system includes 1) a slurry wall keyed into bedrock, 2) a collection trench on the tailings side, 3) permanent pumping of the collection trench to depress the groundwater level on the tailings side, and 4) a discharge pipe on the opposite side to raise groundwater levels to near ground surface. As shown by the cross-section MODFLOW models, this design insures a reversal of hydraulic gradients across the slurry wall (complete capture in surficial deposits) and complete or very high capture efficiency in bedrock below the slurry wall. The model results predict that the overall capture efficiencies of the proposed Tailings Basin capture systems would be substantially greater than 90%. The design and modeling analysis supports the conclusion that the assumption of 90% or greater capture efficiency is justified.	WR 019 WR 020 WR 102

Comment ID	Comment	Response	Theme(s)
	system.		
9074	"Semi-analytical flowpaths" for the tailings basin have been constrained in the Modflow model so that water cannot seep out of the east side of the tailings basin. However, winding underneath the east side of the tailings basin is a bedrock valley that used to be the headwaters of Trimble Creek…More water likely flows out of the east side of the tailings basin than does out the southern toe at monitoring site SD026. Therefore, without constructing the slurry wall containment system around the east end of the tailings basin, hundreds of gallons per minute of polluted water will drain into the Embarrass River watershed.	The water quality modeling has been updated for the FEIS to include the potential for water to seep from the east side of the Tailings Basin. The FEIS Section 5.2.2.3.3 describes that a containment system would be constructed around a portion of the east side of the Tailings Basin for seepage collection.	WR 102 WR 104 WR 133
9077	Even though the PolyMet project proposes to use a double-liner to prevent leakage from the [HRF], head pressure from the existing seeps and springs at this site mean that the liners, even installed perfectly will not last long before rupturing.	Monitoring and maintenance would include routine inspections of the Hydrometallurgical Residue Facility, including the liners and collection system. The Residue Management Plan (PolyMet 2014r) presents the monitoring and maintenance plan proposed for the Hydrometallurgical Residue Facility at this time. Additional monitoring and maintenance requirements would be outlined by the responsible regulatory agency as part of facility permitting. The liner system components have been selected specifically to perform well, given the characteristics of the residue, which consists primarily of gypsum. The liner system components selected for the Hydrometallurgical Residue Facility are routinely used for similar facilities in other industries and have demonstrated the expected levels of performance. The design produces a liner system with virtually no leakage due to the system's ability to maintain a very low hydraulic head on the composite liner portion of the overall liner system. The two liner layers on the Hydrometallurgical Residue Facility would be separated by a leakage collection system, which is designed to collect any potential leakage from the bottom of the cell, as well as leakage from LTVSMC Cell 2W. Each liner layer would consist of a geomembrane layer above a geosynthetic clay layer. A drainage collection system would also be installed during reclamation to collect drainage above the upper liner. The cap would consist of a geotextile fabric, overlain by a clay barrier layer, and a 40-mil low-density polyethylene layer. This would be covered with additional LTVSMC coarse tailings or common borrow and cover	PD 17

Comment ID	Comment	Response	Theme(s)
		soils to sustain a vegetated cover. During reclamation and long-term closure, leakage would be routed and cycled through the Plant Site WWTP. The FEIS includes additional details from the updated Residue Management Plan.	
9081	20 feet of pit wall will never be submerged and as such constitutes a perpetual source of mine related contaminants. Because of continued inputs from the stockpiles, the tailings basins, and the pit walls, the pit lake could exceed surface water quality standards for thousands of years. Therefore, it is likely that the wastewater treatment facility ("WWTF") would need to operate for thousands of years in order to treat leachate from the tailing basin, stockpiles, and contaminated pit water.	When the West Pit Lake water level reaches the outlet elevation (between 1573 and 1578 ft amsl), ~200,000 ft^2 of wall rock would remain above the water level and exposed to the atmosphere, including some Category 1, Category 2/3, Category 4 Duluth Complex, and ore (See Figure 1-4 and Figure 1.3b, respectively, in Barr 2012c, as cited in the FEIS). The load to the West Pit Lake produced by oxidation in this wall rock above the lake surface is incorporated explicitly in the GoldSim model of the Mine Site. The model estimates for loads from each wall rock type (along with other sources to the West Pit) are presented in Attachment I, figures I-02-01.2 through I-02.27.2 in PolyMet 2015m (as cited in the FEIS). The estimate of load from exposed wall rock in the West Pit Lake decreases over time in the GoldSim Mine Site model, reflecting the depletion of sulfide minerals in wall rock by oxidation. Wall-rock loading continues beyond mine-year 40, when the West Pit would be full; but for most solutes the predicted wall rock loading is much smaller than the load expected for water flow to the West Pit Lake from the East Pit wetland. Thus results presented in the FEIS, including predicted solute concentrations in the West Pit Lake, the West Pit groundwater flowpath, and the Partridge River, do include the load from wall rock exposed above the pit lake surface. Water quality modeling performed in support of the FEIS indicates that water treatment systems in some form and at some scale would be needed at the Mine Site and Plant Site indefinitely. The water models constructed to assess the potential effects from the NorthMet Project Proposed Action were not designed to predict the duration of treatment nor do they capture all the factors that influence the duration of treatment, for example potential future regulatory and technological changes. Therefore, the models cannot be used to predict a year treatment would end. Actual treatment requirements would be assessed on a reoccurring basis throughout operations and closure based on results of ongoing discharges, performance and water resource monitoring ensuring continuous protection of ground and surface water quality and compliance with applicable water quality standards. This reassessment process would rely on measured monitoring results (evaluated through modeling) rather than the results of the	WR 035 WR 036 WR 173

Comment ID	Comment	Response	Theme(s)
		predictive modeling included in the FEIS. Regardless of the precise duration of effects or water treatment at either the Mine Site or Plant Site, there are adaptive and contingency mitigation measures available to address unexpected impacts to water resources.	
9083	As stated previously, many mitigation measures were not identified in the SDEIS, including the LEDPAs, nor are they evaluated using the required NEPA "hard look." There is no agency-preferred alternative identified in the SDEIS either. Combined, this makes it exceptionally difficult, and meaningless, to provide any input on the 404 permit or the corresponding 401 certification.	Neither Minnesota Rules nor CEQ regulations require the Co-lead Agencies to identify a preferred alternative in the SDEIS (40 CFR 1502.14(e)). The FEIS includes available details regarding the identification of an Agency Preferred Alternative. The FEIS contains sufficient information to identify and substantiate the LEDPA. The USACE is not required to identify a LEDPA in the FEIS; the final determination on the LEDPA would be made in the ROD for the USACE, which serves as the USACE's decision document and the basis for the Department of the Army permit decision. The USFS would utilize the FEIS to show the factors relating to how the public interest would be served by the Land Exchange and the ROD for the USFS would incorporate the findings of those factors and identify the preferred alternative. The MDNR is not required to identify a preferred alternative under MEPA. The FEIS Sections 3.2 and 3.3 further detail this process. The agency preferred alternative and LEDPA process is described in FEIS Sections 7.4 and 7.5. The ROD would include the Section 404(b)(1) analysis and the public interest review, and would determine the LEDPA. Furthermore, the ROD for the USACE cannot be finalized until 30 days after release of an FEIS. Any comments received during the 30 day period may be considered in the ROD for the USACE. The ROD would recommend issuance, issuance with conditions, or denial of the Project. The USACE is not anticipating the need to re-issue the Section 404 public notice for the NorthMet Project Proposed Action. However, MPCA would need to re-issue the Section 401 public notice for the Project. Under the provisions of the Clean Water Act, the MPCA has one year from the public notice (December 3, 2014) to act upon an application for 401 Certification. However, the MEPA (Minn. Stat. 116.04, subd. 2b) and rules regarding environmental review (Minn. R. 4410.3100) prohibit final agency decisions, such as the Section 401 Certification, until all environmental review steps are completed. The environmental review process being undertaken by the Co-lead Agencies would not be completed within the one year time frame for issuance of the Section 401 Certification. Therefore, PolyMet has made a procedural decision to withdraw the Section 401 application before MPCA and resubmit it in the near future to allow for	COE 04

Comment ID	Comment	Response	Theme(s)
		processing of the application.	
20089	After an agency preferred alternative and the LEDPAs are identified, the USACE should re-notice the 404 permit and MPCA should re-notice the 401 certification.	The agency preferred alternative and LEDPA process is described in FEIS Sections 7.4 and 7.5. The ROD for the USACE will include the Section 404(b)(1) analysis is and the public interest review, and would determine the LEDPA. Furthermore, the ROD for the USACE cannot be finalized until 30 days after release of an FEIS. Any comments received during the 30 day period may be considered in the ROD. The ROD for the USACE will recommend issuance, issuance with conditions, or denial of the Project. The USACE is not anticipating the need to re-issue the Section 404 public notice for the NorthMet Project Proposed Action. However, MPCA will need to re-issue the Section 401 public notice for the Project. Under the provisions of the Clean Water Act, the MPCA has one year from the public notice (December 3, 2014) to act upon an application for 401 Certification. However, the MEPA (Minn. Stat. 116.04, subd. 2b) and rules regarding environmental review (Minn. R. 4410.3100) prohibit final agency decisions, such as the Section 401 Certification, until all environmental review steps are completed. The environmental review process being undertaken by the Co-lead Agencies will not be completed within the one year time frame for issuance of the Section 401 Certification. Therefore, PolyMet has made a procedural decision to withdraw the Section 401 application before MPCA and resubmit it in the near future to allow for processing of the application.	COE 04
9091	There has been no analysis of the 1854 Ceded Territory as a discrete area of impact. The Band continues to ask that it be included. Tribal Cooperating Agencies believe the Cumulative Effects Analysis for land use should encompass the 1854 Ceded Territory	The Co-lead Agencies have previously consulted with the Bands on the 1854 Ceded Territory as a discrete area of impact (i.e., traditional cultural property) and its use as an expanded area for determination of potential resource-specific Project effects. With regards to the 1854 Ceded Territory as a discrete area of impact, the Cultural Resources sections of FEIS Chapters 4 and 5 address the Co-lead Agencies' consideration of the 1854 Ceded Territory as a traditional cultural property. With regards to the 1854 Ceded Territory's use as the cumulative effects analysis area for land use, the vast majority of the 1854 Ceded Territory, along with the potential resources that may be within these areas, would not be directly or cumulatively affected by the Proposed Connected Actions. At this time, the Co-lead agencies believe that additional identification and evaluation efforts within these areas would be outside of the scope of this review. The Land Use section of FEIS Chapters 4, 5, and 6 address the Co-lead Agencies' determination of the NorthMet Project Proposed Action's direct, indirect, and cumulative areas of potential effect.	PER 08

Comment ID	Comment	Response	Theme(s)
9093	Tribal Cooperating Agencies consider a 216,300 acre area bounded by the St. Louis River, Lake Superior, Lake Vermilion and the Beaver Bay to Vermilion Trail to be a Tribal Historic District, and the pertinent area for consideration of cumulative effects to cultural resources.	The historic district proposed by the Grand Portage Band in a June 27, 2013 letter was addressed. The federal Co-lead Agencies have considered an expanded area for analysis of cumulative effects on cultural resources and natural resources of significance to the Bands, including use of the 1854 Ceded Territory as the CEAA. Use of the 1854 Ceded Territory as the CEAA for cultural resources would actually diminish the significance of any cumulative effects. By evaluating the effects of the NorthMet Project Proposed Action along with other past, present, and reasonably foreseeable future projects in the context of a much larger area with a much larger number of resources similar to those affected by the NorthMet Project Proposed Action, the effect of the NorthMet Project Proposed Action on those resources is diminished. The cumulative effects analysis focuses on the specific resources, or types of resources, affected by the NorthMet Project Proposed Action within an area that is geographically meaningful considering the project under review. Cumulative effects are discussed and addressed differently based on the affected resource. Discussions related to socioeconomics, for instance, use an expanded analysis area compared to other resources. Such expanded analysis areas are used as appropriate. The Cultural Resources sections in FEIS Chapters 4, 5, and 6 address the Co-lead Agencies' determination of the NorthMet Project Proposed Action's direct, indirect, and cumulative areas of potential effect.	CR 04
9097	The SDEIS also fails to analyze cumulative effects on water quality and quantity. The relevant spatial scale for water quality and hydrologic cumulative effects analysis is the entire St. Louis River watershed.	The cumulative effects section in the FEIS (Section 6.1.1.1) describes the rationale for the identification of Cumulative Effects Assessment Areas (CEAAs). The CEAAs for individual resource areas vary based on the potential for cumulative effects, and not on a single overall assessment area. FEIS Table 6.1.1-2 summarizes the spatial areas used for each resource area. Please also refer to Section 8.3, MDO 12 for the Co-lead Agencies' rationale for the CEAA identified for water resources.	CU 01
9101	Also missing is cumulative-impacts analysis of culturally-important plant and animal species that are listed as "Species of Concern." There is no basis to dispute that the Project will have cumulative effects on the moose herd and Tribal harvest in the 1854 Ceded Territory. At a time when moose populations in Minnesota are declining, this analysis is particularly important	The FEIS wildlife sections provide an analysis of wildlife species used for subsistence/harvest, as well as those culturally important to the Bands. FEIS Section 4.2.9.3.3 identifies species potentially harvested in the 1854 Ceded Territory, while FEIS Section 5.2.9.2.2 explains that a lack of data regarding use of such species in the NorthMet Project area likely indicates limited present day use in that area due to general inaccessibility. FEIS Section 5.2.5.2.5 discusses the types of potential effects to common and/or game species, which are similar to effects on ETSC species. The FEIS has	WI 03

Comment ID	Comment	Response	Theme(s)
	and should have been done as part of this SDEIS.	been revised to include additional detail regarding moose, and this discussion has been moved to the state ETSC species discussion, due to its new state listing status.	
9104	The Cumulative Effects Assessment Area defined by the Co-Leads for impacts to aquatic species is overly limited. It includes only the Partridge and Embarrass Rivers...The appropriate spatial scale for considering cumulative impacts to aquatic species is the entire St. Louis River watershed and Lake Superior Basin.	The NorthMet Project Proposed Action is not considered to have the potential for cumulative effects on hydrology and water quality in the lower St. Louis River Watershed (below the confluence with the Embarrass River). As a result, the Cumulative Effects Assessment Area (CEAA) for aquatic species is defined by the Partridge River and Embarrass River watersheds.	AQ 26
9105	The SDEIS states that the current fish tissue concentration in five local lakes results in Hazard Quotients ("HQs") that exceed 1, but gives no further information...In fact, Barr Engineering's July 2012 "Cumulative Impacts Analysis, Local Deposition and Bioaccumulation in Fish" showed modeled contributions from both the Mesabi Nugget Large Scale Demonstration Plant ("LDSP") on the site and PolyMet. And the Barr report further provides the actual HQs, rather than just saying "they exceed 1." ...This information should be explicitly included in the SDEIS for public review.	Information pertaining to the specific Hazard Quotients summarized in Barr 2012b (as cited in the FEIS) has been included in FEIS Section 6.2.6, summarizing the cumulative effects assessment for mercury deposition.	MERC 02
9107	Meeting ambient noise standards is a different question than assessing impacts. Impacts should be fully characterized and contour maps showing overlapping noise pollution from different projects provided. Without this information, it is not possible to review the cumulative impacts of noise.	FEIS Section 6.2.8 has been updated, and provides more detailed analysis on the cumulative noise and vibration impacts on nearby residents and recreational visitors. In addition, see the response to theme N 03.	N 03
9109	The cumulative risk analysis of transportation of hazardous materials has not been analyzed. This should include rail car spills, pipeline ruptures, and truck transport accidents.	FEIS Section 5.2.13.2.1 addresses transportation and incident response of hazardous materials. Accidental spills or incidents resulting from rail or truck transportation of hazardous material or any materials would initially be assessed by the nearest local community fire department or other emergency responder, using the 2012 Emergency Response Guidebook (PHMSA 2012, as cited in the FEIS), if necessary. The NorthMet Project Proposed Action would not involve the use of pipelines for hazardous materials. Depending on the severity of the local responder's initial assessment, additional resources	HAZ 06

Comment ID	Comment	Response	Theme(s)
		may be requested via the State Duty Officer and/or the National Response Center. If needed, the Homeland Security and Emergency Management Division of the Minnesota Department of Public Safety, along with other appropriate state and federal agencies and the carrier company, among others, would be notified. Additional emergency resources would come from the City of Duluth-based HazMat team.	
9111	Post-closure impacts should also be included in the cumulative effects analysis because some mine features (e.g., pit lakes) would become permanent features of the landscape.	The FEIS describes the cumulative effects of the NorthMet Project Proposed Action, including those expected during closure and post-closure. The FEIS discloses post-closure effects in Section 6.2.	CU 16
9115	A key piece of the work that still has not been completed, despite some progress, is the traditional cultural property ("TCP") studies...An appropriate investigation of the Project site using this standard, and in cooperation with all involved THPOs, must be performed and properly documented. As noted in the chapter, consultation is underway on this topic, but is far from complete.	The federal Co-lead Agencies have made a reasonable and good-faith effort to identify cultural resources potentially affected by the NorthMet Project Proposed Action. The federal Co-lead Agencies have actively consulted with the federally recognized Bands that have expressed an interest in consulting on the NorthMet Project Proposed Action. Historic properties affected by the NorthMet Project Proposed Action have been identified and the impacts to those properties have been assessed through the traditional Section 106 methods/process. This also includes an assessment of actual use of those historic properties, as well as other resources in the APE, by tribal members. In addition to traditional methods, elder interviews were conducted in 2010 and 2011 with members of the Bois Forte, Fond du Lac, and Grand Portage. Elders recalled that some Band members had utilized the general NorthMet Project area for hunting, fishing, and plant gathering of wild rice, maple-sugar, berries, and birch bark; however, they could not provide specific locations or uses within the NorthMet Project area. The federal Co-lead Agencies also conducted reconnaissance of trail corridors with participation from the Bands. The purpose of the traditional research and survey was to provide historic documentation and context for and to identify places important to the Bands. The elder interviews were to be used to further identify and understand tribal use areas and places of importance. The field investigation component was informed by the results of those efforts.	CR 05 CR 06
9117	The SDEIS must include language to the effect that the Band continues to take the position that the Ceded Territory is itself a TCP and does not agree with the USACE's determination that it is not.	FEIS Section 4.2.9.2.3 states that the "the consulting Bands [have] proposed the 1854 Ceded Territory as a historic property."	CR 02 CR 05 CR 06
9120	The Project Area of Potential Effect ("APE") for	FEIS Section 4.2.9.2.3 provides a detailed discussion and analysis of the	CR 02

Comment ID	Comment	Response	Theme(s)
	cultural resources is divided into two separate sections surrounding the proposed mine site and the proposed plant site. These areas do not encompass the true extent of the APE...Until the cumulative effects analysis of the Project is better represented, the agency preferred alternative is defined, and the LEDPAs identified, it is premature to delineate the APE.	area in which cultural resources may be affected by the NorthMet Project Proposed Action. The APE takes into account both direct and indirect effects using a geographically expansive area that accounts for direct effects, as well as visual, audible, atmospheric, hydrological, and water quality effects. The APE is based on extensive modeling and other analysis completed for the NorthMet Mining Project and Land Exchange and includes an area much broader than the Plant Site and Mine Site. Since the SDEIS, the APE has been modified to encompass the proposed Mine Site and Plant Site, the Dunka Road Corridor, several federal parcels included in the Land Exchange Proposed Action, and the Colby Lake Pumphouse and pipeline.	CR 03
9124	The Beaver Bay to Lake Vermilion Trail ("BBLVT")... is "associated with the lives of persons significant in our past"...To date, the BBLVT has not been fully researched or rigorously field-verified within the project area. Additional fieldwork should be conducted in the spring or fall when ephemeral features such as foot trails are less easily concealed by vegetation and more easily discerned.	The federal Co-lead Agencies believe that the work to justify consideration of the BBLV Trail Segment as an historic property is complete. There has been sufficient background research and fieldwork completed to date as discussed in FEIS Section 4.2.9.2.3. Additional research and fieldwork may be part of any resolution of adverse effect.	CR 05
9132	Wild rice is a culturally significant resource for the tribes in Minnesota. From historical reports, Band member accounts, and current MNDNR and tribal reports, wild rice has declined significantly throughout Minnesota, and in southern Minnesota wild rice has virtually disappeared. The Embarrass River, Second Creek, the Partridge River, and the St. Louis River all contain wild rice beds downstream of the Project...The MPCA has determined that the 10 mg/l standard can be applied seasonally, only when wild rice is in its growing season…Correspondingly, the SDEIS provides: PolyMet is not seeking application of the seasonal component of this standard for the NorthMet Proposed Action as currently proposed and evaluated in this SDEIS. During closure, PolyMet has indicated a desire to transition to non-mechanical treatment once pilot-testing and	The FEIS recognizes the MPCA is overseeing a variety of studies on wild rice beds. At applicable surface water locations, the FEIS evaluated impacts using an impact criteria based on the current MPCA 10 mg/L standard for sulfate concentration in waters used for the production of wild rice. This impact assessment metric is keyed to the current regulation and does not rely upon a seasonal application of the standard for the mechanical or non-mechanical treatment options. It is recognized that MPCA is currently evaluating the current wild rice sulfate water quality standard and as part of that process, new information on potential contributing factors on the growth of wild rice has been generated. However, that information has not yet been holistically reviewed in the context of its possible influence on the wild rice standard. Future change to the wild rice sulfate standard, if any, is speculative and outside the scope of the FEIS; applying research findings outside the basis of the current rule is not appropriate. The FEIS includes descriptions of the Plant Site WWTP and Mine Site WWTF, both of which would be capable of discharging treated wastewater at concentrations at or below 10 mg/L as demonstrated by pilot-testing	VEG 04 WR 152 WR 153 WR 157

Comment ID	Comment	Response	Theme(s)
	modeling indicate water quality standards could be met, which potentially could include application of the wild rice seasonal standard, but these are beyond the scope of this SDEIS…Several other sections indicate that the Project closure goal is to transition from mechanical water treatment to passive water treatment systems…The Band fundamentally disagrees with any seasonal sulfate release in wild rice waters, whether now or later. There is no scientific basis for stating that seed is not affected by high sulfate levels while it lays dormant over the winter, or that the effects of high-sulfate water would not remain or continue into the summer…Field data collected by Barr Engineering in 2011 indicates that mining effluent has already impacted the Embarrass River, exceeding the Minnesota WQS criteria for the protection of wild rice by orders of magnitude. Any language casting doubt on the current applicability of this standard, or suggesting that seasonal discharge is acceptable, should be removed. Wild rice in the Embarrass River endures despite degraded water quality…Impacts to wild rice in the vicinity of the Project must be more rigorously analyzed and reported, and cumulative impacts to wild rice in the 1854 Ceded Territory also need to be addressed. The Project must also provide mitigation for impacts to wild rice.	already conducted. More detailed information on these treatment systems would be available as part of the permitting process. However, should a more stringent standard be developed in the future, operation of the reverse osmosis treatment systems can be adjusted to meet a more stringent effluent limit. FEIS Sections 5.2.2 and 5.2.4 includes a description of the NorthMet Project Proposed Action's effects on wild rice beds. The response to themes WR 152, WR 156, and WR 157 discuss wild rice beds and the sulfate standard for wild rice beds. FEIS Section 5.2.2 states that for MPCA-recommended wild rice beds, the proposed engineering controls would prevent an increase in sulfate concentrations in the Partridge River and would decrease sulfate concentrations in the Embarrass River.	
9135	There still has not yet been sufficient evaluation of Band member use of vegetation and other usufructuary resources in the APE, and there is no permissible basis to omit such evaluation where the USACE and other federal permitting agencies have a trust responsibility to the Band to maintain treaty resources in the 1854 Ceded Territory.	The Cultural Resources sections of FEIS Chapters 4 and 5 address the federal Co-lead Agencies' federal tribal trust responsibilities under the 1854 Treaty. These sections, along with other relevant natural resources sections of FEIS Chapters 4, 5, and 6 also address effects on, and any proposed mitigation for effects on cultural resources and culturally significant natural resources. Mitigation/compensation for effects on cultural resources and culturally significant natural resources is considered to the extent possible within the parameters of the statutes and regulations providing the federal authorities for the review of the NorthMet Project Proposed Action.	CR 01

Comment ID	Comment	Response	Theme(s)
		The federal Co-lead Agencies have made a reasonable and good-faith effort to identify natural resources of cultural importance to the federally recognized Bands potentially affected by the NorthMet Project Proposed Action. The federal Co-lead Agencies have actively consulted with the federally recognized Bands that have expressed an interest in consulting on the NorthMet Project Proposed Action. This included an assessment of actual use of historic properties, as well as other resources in the APE, by tribal members. Elder interviews were conducted in 2010 and 2011 with members of the Bois Forte, Fond du Lac, and Grand Portage. Elders recalled that some Band members had utilized the general NorthMet Project area for hunting, fishing, and plant gathering of wild rice, maple-sugar, berries, and birch bark; however, they could not provide specific locations or uses within the NorthMet Project area. The elder interviews were to be used to further identify and understand tribal use areas and places of importance.	
9138	in the SDEIS Socioeconomics chapter, none of the issues identified [in Executive Order 12898] Executive Order have been addressed...It is the Band's position that any impacts to natural resources will disproportionately affect tribes due to their subsistence consumption of wild rice, fish, and other wildlife, and gathering of traditional plants and medicines within the 1854 Ceded Territory.	FEIS section 5.2.10.2.6 discusses the NorthMet Project Proposed Action's potential Environmental Justice (EJ) impacts, as required by EO 12898. The NorthMet Project Proposed Action is within the 1854 Ceded Territory. FEIS Section 4.2.10.1.6 as well as Table 4.2.9-1 in FEIS Section 4.2.9 summarize available information about subsistence patterns and resources within the 1854 Ceded Territory. Construction of the NorthMet Project Proposed Action would make the Mine Site unavailable for subsistence use. The degree to which construction of the NorthMet Project Proposed Action would affect individual subsistence resources (i.e., fish, game, and plant species) outside of the Mine Site, Transportation and Utility Corridor, and Plant Site is discussed in FEIS Section 5.2.9 (Cultural Resources). FEIS Section 5.2.10.2.6 discusses consumption of fish. Increased mercury concentrations and associated increases in mercury bioaccumulation in fish tissue could constitute an EJ impact for Band members and other subsistence consumers of fish.	SO 09
17731	Furthermore, the tailings basin seepage capture rate of 90 percent assumed in the preferred alternative has not been demonstrated anywhere in the U.S. and is simply not possible because the tailings basin was built without a liner. In fact, at the Project site, the existing seepage capture system that was installed as a requirement of the Cliffs Erie Consent Decree for SD026 is so	The FEIS relies on revised cross-section models from the SDEIS to evaluate containment systems on the northern, northwestern, and western sides of the Tailings Basin, which are documented in PolyMet 2015j (as cited in the FEIS). These new models consider the presence of an upper more permeable bedrock zone directly below the slurry wall, with hydraulic properties based on 2014 packer tests conducted in five boreholes along the proposed capture system alignment. Sensitivity analyses have included variable bedrock hydraulic conductivity and different upper bedrock zone	PD 08 WR 018

Comment ID	Comment	Response	Theme(s)
	ineffective that Cliffs Erie is proposing to build an additional dam and capture system further downstream.	thicknesses up to 100 feet. The model results predict that the overall capture efficiencies of the proposed Tailings Basin capture systems would be substantially greater than 90%. This analysis supports the conclusion that the assumption of 90% or greater capture efficiency is justified. The FEIS describes a 2014 field program that investigated bedrock along the alignment of the proposed capture system on the northern, northwestern, and western sides of the Tailings Basin in FEIS Section 4.2.2.3.1. This investigation provided field data on bedrock hydraulic conductivity, Rock Quality Designation data, and depth to top of bedrock. This information was used to develop MODFLOW cross-section models at three locations on the alignment to assess capture efficiency. The models included bedrock below the slurry wall.	
17732	In fact, at the Project site, the existing seepage capture system that was installed as a requirement of the Cliffs Erie Consent Decree for SD026 is so ineffective that Cliffs Erie is proposing to build an additional dam and capture system further downstream. Therefore, paste tailings placed on a liner and covered could have a profound, minimizing effect on pollution reaching the Embarrass River watershed wetlands and the Embarrass River. The SDEIS does not even mention this modern technique used by many mines in U.S. and around the world, without justification. Converting to paste tailings technology from conventional slurry tailings at most mines makes sense both environmentally and economically. Paste tailings use less water; require less land; do not require engineered containment dams; generate less acid and contaminants; reduce long-term costs and allow for early reclamation. Slurry tailings use and discharge large volumes of water, require dust control measures, require large land areas and containment dams for disposal, and create contaminated water that must be captured and treated.	A thickened tailings (paste tailings) alternative (A1) was considered but eliminated in the DEIS and post-DEIS as it was determined not to offer significant environmental benefits over the NorthMet Project Proposed Action. A co-disposal of waste rock and tailings on a lined Tailings Basin alternative (E14) was considered but eliminated in the DEIS because the technical feasibility and cost of doing so were uncertain. Several different Tailings Basin alternatives (TB2-TB6) were reconsidered but eliminated since the DEIS. These Tailings Basin alternatives did not afford meaningful environmental benefits compared to the enhanced engineering controls (seepage collection and RO mechanical water treatment) built into the NorthMet Project Proposed Action. Dry cap seepage was predicted to result in substantially higher concentrations, which would make the future transition from mechanical to non-mechanical water treatment more difficult during post-closure.	ALT 06 ALT 16
17733	Perpetual pumping of the mine pits to prevent formation of a pit lake is required by the	An interagency memorandum was prepared regarding the West Pit Water Elevation Alternative (MDNR et al. 2014, as cited in the FEIS). This	ALT 04

Comment ID	Comment	Response	Theme(s)
	State of New Mexico, Office of Natural Resource Trustee, for the Chino and Tyrone copper mines expressly to protect groundwater and waterfowl.29 Numerous western mines have discharged plumes of polluted water into the bedrock aquifer from leaking mine pits, tailings basins and waste rock piles, a problem that is not only difficult but expensive to fix. Requiring perpetual pump out of the mine pit would minimize leakage of contaminated water into the surrounding bedrock aquifer thereby protecting groundwater that the State is required to protect as source of drinking water.	alternative includes both the option to maintain a dry West Pit through perpetual pumping and maintaining pit water levels below the elevation of the Partridge River. The alternative was screened against criteria used for other alternatives, including Purpose and Need, Technical and Economic Feasibility, Availability, and Environmental or Socioeconomic Benefit. The screening level assessment concluded that the alternative would meet all criteria except for the environmental or socioeconomic benefit criterion. Continuous dewatering of the West Pit would keep the pit walls exposed instead of covered by a pit lake as in the NorthMet Project Proposed Action. This exposure would potentially result in increased solute loading to a smaller pit lake volume, and thus higher concentrations of pollutants than under the NorthMet Project Proposed Action. Consequently, treatment would be required for a longer period of time. The Co-lead Agencies recommend that the alternative be considered as an adaptive mitigation measure in the event that monitoring during operations and reclamation indicate that implementing this action is better able to meet future environmental objectives compared to the NorthMet Project Proposed Action.	
17734	This alternative would prevent the need for a separate seepage capture system around an unlined waste rock pile, as proposed in the preferred alternative, that would have to work at an above optimum capture rate in perpetuity. Capping and re-vegetating the mine pits after backfilling with waste rock would prevent deep infiltration of precipitation. In combination, perpetual pumping and backfilling the Category 1 waste rock pile would substantially reduce the risk of polluting groundwater and wetlands in the Partridge River watershed.	The two alternatives are not fully compatible together, as backfilling of the Category 1 waste rock into the West Pit would eliminate the opportunity to perpetually pump the West Pit lake. The West Pit Backfill alternative (E20) was considered but eliminated during the development of the DEIS. It was eliminated from further consideration because it was determined that it would not offer significant environmental or socioeconomic benefits compared to the NorthMet Project Proposed Action and because backfilling the West Pit would prevent recovery of additional mineral resources. These factors are sufficient to qualify the West Pit Backfill alternative as unreasonable under NEPA, and justify its exclusion under *Minnesota Rules* 4410.2300, Subpart G. It was reconsidered in the SDEIS in response to comments from the Cooperating Agencies. A Co-lead Agency memorandum (MDNR et al. 2013b, as cited in the FEIS) was prepared to summarize the decision-making process, which is referenced in the FEIS Section 3.2.3.4.2. The Co-lead Agencies screened the alternative against criteria used for other alternatives, including Purpose and Need, Technical and Economic Feasibility, Availability, and Environmental or Socioeconomic Benefit. The opportunity to reclaim wetlands and vegetation at the Category 1 Stockpile footprint area would be the only measurable environmental benefit offered by backfilling the Category 1 Stockpile into the West Pit. However,	ALT 04 ALT 06 ALT 13

Comment ID	Comment	Response	Theme(s)
		because of the temporal impact that the stockpile would have, these impacts would be required to be mitigated regardless of future backfilling or not. An interagency memorandum was prepared regarding the West Pit Water Elevation Alternative (MDNR et al. 2014, as cited in the FEIS). This alternative includes both the option to maintain a dry West Pit through perpetual pumping and maintaining pit water levels below the elevation of the Partridge River. The alternative was screened against criteria used for other alternatives, including Purpose and Need, Technical and Economic Feasibility, Availability, and Environmental or Socioeconomic Benefit. The screening level assessment concluded that the alternative would meet all criteria except for the environmental or socioeconomic benefit criterion. Continuous dewatering of the West Pit would keep the pit walls exposed instead of covered by a pit lake as in the NorthMet Project Proposed Action. This exposure would potentially result in increased solute loading to a smaller pit lake volume, and thus higher concentrations of pollutants than under the NorthMet Project Proposed Action. Consequently, treatment would be required for a longer period of time. The Co-lead Agencies recommend that the alternative be considered as an adaptive mitigation measure in the event that monitoring during operations and reclamation indicate that implementing this action is better able to meet future environmental objectives compared to the NorthMet Project Proposed Action.	
17735	The OSLA will contain peat that has sequestered mercury. When water flows through the OSLA the seepage will transport some of the mercury from the peat.	This comment was originally presented as part of the Tribal Position Summary included in MDO 2, which was previously addressed in SDEIS Table 8-1. Further explanation is provided below. Any mercury released from the peat decomposition process is thought to occur relatively rapidly. The mercury released from organic matter decomposition and in solution would have the potential to move with precipitation that falls on the Overburden Storage and Laydown Area. The Overburden Storage and Laydown Area would be unlined; therefore, there would be some potential for seepage to enter the groundwater system from peat that has decomposed and released as a pulse of mercury. Water contacting the Overburden Storage and Laydown Area is considered to be process water and would be routed to Pond PW-OSLA. In years 1 to 11, the water from Pond PW-OSLA would be routed to the Tailings Basin, and any mercury in the routed water would have the chance to be sequestered in the tailings. In years 12 to 20, some of the water from Pond PW-OSLA would be used to backfill the East Pit. Any mercury in the water	MERC 24

Comment ID	Comment	Response	Theme(s)
		routed to the East Pit would mix with waste rock and become sequestered at depth in the East Pit. In addition, any contributions of water in years 21 to 65 from the East Pit to the West Pit would reflect water from the East Pit and its associated watershed runoff, and would not reflect process water from Pond PW-OSLA. Because peat removal from the areas to be mined would be completed between years 5 and 11, any potential release of mercury from stored peat materials would have occurred, or be ending, by the time water is routed from Pond PW-OSLA to the East Pit beginning in year 12. All water that is discharged would be meet the GLI mercury standard of 1.3 ng/L.	
17736	As the Project is currently proposed, after operations, the mine site wastewater treatment plant will be converted to RO to treat the west mine pit lake and Category 1 stockpile seepage for discharge to the west pit outlet creek that flows into the Partridge River. An alternative that was not considered in the SDEIS would use RO at the plant site to begin with to treat storm water, mine infiltration, and waste rock pile seepage. Using RO treated water for stream and wetland water augmentation in the Partridge River watershed would provide mitigation for the some of the adverse effects of mine pit dewatering.	The WWTP would include an RO treatment unit that would provide mechanical treatment of Tailings Basin seepage during operations and closure and tailings pond water in closure. Some of this treated effluent would ultimately be discharged to several Embarrass River tributaries to augment flow. During operations, water from the mine pits and Waste Rock stockpiles would be treated at the WWTF. Effluent from the WWTF and runoff from the Overburden Storage and Laydown Area would be pumped to the Tailings Basin for reuse. During this time, extensive monitoring would be required, and adaptive management would be used to ensure minimization of effects and compliance into the future. During reclamation, water from the West Pit would be treated at the WWTF, which would be upgraded to include an RO treatment unit. Treatment at this unit would result in an effluent that meets all applicable water quality standards. This effluent would ultimately be discharged to the Partridge River.	ALT 13
17737	As the Band already argued in the Tribal Position, significant additional study of the underground mining alternative is mandated, and the SDEIS offers no new discussion of the reasons for rejecting the alternative. The economic viability of an underground mine depends on a variety of factors including ore grade, market prices, cost of tailings, and waste rock disposal. A study of this particular deposit was performed by the prior owner of the site, U.S. Steel, which actually recommended underground mining.43 PolyMet is well aware of this study, given that the company included it in a 2003 filing with the	The Underground Mine alternative was first considered but eliminated during the FSDD process. FEIS Section 3.2.3.4.1 describes how it was reconsidered during the DEIS process as alternative E7 in response to Cooperating Agency and stakeholder comments, but eliminated from further consideration. The economic feasibility of the Underground Mine alternative was reconsidered during development of the SDEIS. In response to a request from the Co-lead Agencies, PolyMet's consultants prepared an updated economic assessment of underground mining, which the Co-lead Agencies independently evaluated (see FEIS Appendix B). The Co-lead Agencies concluded that an underground mine would not be profitable, regardless of the tonnage extracted. The lower rate of ore production would not meet the Purpose and Need of the project. Though it would offer environmental benefits over the NorthMet Project Proposed Action, it	ALT 01

Comment ID	Comment	Response	Theme(s)
	Securities and Exchange Commission. In fact, by examining cross-sections showing the distribution of ore by depth,45 it appears that there are substantial ore reserves at depths that likely could not be accessed by the proposed open-pit mine. The ecological costs of open-pit mining and above-ground disposal of tailings and waste rock are immense. This ecological cost, combined with the most current understanding of deposit ore grades and reasonably possible metals prices, and the costs associated with perpetual treatment must be evaluated to determine the viability of [the underground] alternative.	would result in reduced socioeconomic benefits. They accordingly concluded that the Underground Mine alternative was not economically feasible, and would not meet the NorthMet Project's Purpose and Need. A position paper (FEIS Appendix B) was prepared to document the Co-lead Agencies' rationale for eliminating the Underground Mine alternative from further consideration. The FEIS Section 5.2.10.1.4 states, "Neither NEPA nor CEQ requires the cost and benefits of a proposed action to be quantified in dollars or any other common metric; however, this EIS acknowledges that economic costs and loss of non-market value may results from environmental and social effects. Also acknowledged is that the agreement on the value (i.e., the "cost") of environmental effects is often difficult to achieve. Therefore, the approach of this EIS is to evaluate environmental and social impacts directly, in the appropriate resource-specific section." CEQ regulations for implementing NEPA (40 CFR 1502.23) state that, "for purposes of complying with the Act, the weighing of the merits and drawbacks of the various alternatives need not be displayed in a monetary cost-benefit analysis and should not be when there are important qualitative considerations."	
17738	the SDEIS does not disclose appraisal information [for the Land Exchange]	Appraisal reports completed in 2013 indicate that the Land Exchange Proposed Action would meet federal value requirements if all five non-federal land tracts (6,722.5 (GLO) acres) offered by PolyMet would be exchanged for 6,650.2 (GLO) acres of federal land. The appraisal reports indicate that Land Exchange Alternative B would meet the federal value requirements if non-federal Tract 1, Hay Lake (4,651.5 (GLO) acres), would be exchanged for a smaller federal parcel of 4,887.34 (GLO) acres. If the ROD approves the Land Exchange, a current appraisal, approved by the USFS, will be required to verify equal value. Copies of appraisal reports and appraisal review reports are not released to parties outside the USFS, except through the Freedom of Information Act (FOIA) process and only after a preferred alternative is selected or a decision is made.	LAN 03
17739	Of the approximately 6,025 acres of MCBS Sites of High Biodiversity Significance under the Land Exchange Proposed Action, nearly 2,000 acres of coniferous bog wetlands will be lost to the federal estate, and therefore effectively lost to the Bands, if the proposed land exchange takes place. This is significant because many tribally harvested	FEIS Sections 4.2.4 and 4.3.4 discuss and provide maps of MBS Sites (Figures 4.2.4-1, 4.2.4-2, 4.2.4-5, 4.3.4-1, and 4.3.4-2) to provide clarity on the location and extent. FEIS Sections 5.2.4 and 5.3.4 include information about the impacts to MBS sites and native plant communities. The vegetation analysis cross-references the cultural resources section (5.2.9) to ensure consistency and to discuss potential impacts on tribally harvested resources. FEIS Section 5.2.3 discusses restoration of coniferous bogs in	CR 01 WET 05 WET 14 VEG 02

Comment ID	Comment	Response	Theme(s)
	resources are only available in coniferous bogs (e.g. cranberries, labrador tea, creeping snowberry), and restoration of coniferous bogs is a very difficult and long process that has extremely low success rates.	mitigation wetlands. *Minnesota Rules* 6132.2700 requires that a project site be reclaimed once mining has ceased. The goals of such reclamation are to "control erosion, to screen mining areas from non-compatible uses, and to provide for subsequent land uses such as wildlife habitat or timber production." The rules also include requirements about the characteristics and planting schedule for vegetation used in reclamation. The WCA rules (including those parts applicable to mining projects under *Minnesota Rules* 8420.0930) include a special consideration for wetlands that are rare natural communities (*Minnesota Rules* 8420.0515, Subpart 3). The Permit to Mine would address special consideration of wetlands that include rare natural communities. Additional information on rare natural communities would be included in the wetland permit application as part of the Permit to Mine process for further refinement of site-specific conditions.	
17740	The proposed action land exchange would trade water resources within the Lake Superior Basin for wetlands and surface water outside the Lake Superior Basin [resulting in] a loss of 3,791 acres of federally-managed wetlands within the Lake Superior Basin under the proposed exchange.	The proposed land exchange non-federal lands are not mitigation sites and are not required to be exchanged within the same watershed. The non-federal lands being considered are all lands that are located within the proclamation boundary of the SNF and would consolidate land ownership management.	WET 15
17741	Furthermore, the SDEIS acknowledges that the Land Exchange Proposed Action would create a "net increase of third-order streams and decrease in first- and second-order streams which would likely add more habitat diversity to the Superior National Forest." But the SDEIS underestimates the impact of this increase: "Headwater streams are the smallest parts of river and stream networks, but make up the majority of river miles in the United States. Many headwater streams have been lost or altered due to human activities … and this can impact species and water quality downstream." The SDEIS states that the decrease of first-order streams to the federal estate would "slightly reduce the amount of available spawning habitat for some aquatic species as headwater streams provide specialized spawning habitat for	The SDEIS and FEIS acknowledge a possibility that habitat could be affected from water chemistry changes resulting from the Land Exchange Proposed Action. Habitat loss from flow changes or riparian activities is not expected as a result of the NorthMet Project Proposed Action. It is noted that under the Land Exchange, the net reduction to the Superior National Forest of 0.3 miles of first order streams may result in slightly less habitat available for headwater stream dependent species.	WR 114 AQ29

Comment ID	Comment	Response	Theme(s)
	some species." Again, this underestimates the impacts. While greater diversity is desirable, protection of headwater streams is critical because they powerfully influence both the character and functions of downstream waters. Headwater streams transport vegetation, woody debris, organic matter, macroinvertebrates, and other organisms downstream, while providing spawning areas for brook trout. Headwaters provide most of the water to rivers, which in turn provides temperature mitigation and oxygenation which are necessary for healthy fish communities.		
17742	The SDEIS also erroneously concludes that no known cultural resources exist on the nonfederal lands, despite impacts to wild rice waters, and the proposed exchange will not sufficiently compensate for the loss. The Land Exchange Proposed Action would result in additional wild rice beds by the acquisition of Tract 1. Tract 1 contains Little Rice Lake, which supports a continuous population of wild rice. Wild rice also grows along the Pike River south of Little Rice Lake and in isolated populations on Hay Lake. The wild rice waters in Tract 1 are accessible to the Bands via the Pike River. Therefore, adding Tract 1 to the federal estate does not provide additional wild rice harvesting opportunities to Band members in the 1854 Ceded Territory.	No heritage surveys were conducted on the non-federal lands. If any cultural resources are located on the non-federal lands, those cultural resources would be transferred to federal ownership. Such transfer would not adversely affect the heritage resource, but would provide greater preservation protection under federal law. The non-federal lands that contain wild rice beds would not be affected as a result of the Land Exchange Proposed Action or Land Exchange Alternative B, because no activities are proposed on these lands and the proposed mining activities would not affect these lands. As noted in the FEIS, the Land Exchange Proposed Action and Land Exchange Alternative B would increase wild rice stands within the federal estate. The Land Exchange Proposed Action would result in the public ownership of additional wild rice beds by the acquisition of Tract 1. Tract 1 contains Little Rice Lake, which supports a continuous population of wild rice. Wild rice also grows along the Pike River south of Little Rice Lake and in isolated populations on Hay Lake. Section 4.3.4.2.5 provides further discussion of wild rice beds on Tract 1. As a result, the public would have better opportunities for wild rice harvesting on Tract 1, where there is currently no opportunity to harvest wild rice directly on the federal lands (i.e., no known wild rice populations) despite the public water access onto the federal lands. A carry-down boat launching access is located on Tract 1, which may provide private access for wild rice harvesting on the Tract 1 lands. Access to wild rice beds on the federal lands would not be lost as a result of the Land Exchange Proposed Action, but access to wild rice beds on Tract 1 would be gained. FEIS Sections 5.3.2 and 5.3.4 clarify that, although the Land Exchange	LAN 05 VEG 08 WR 155

Comment ID	Comment	Response	Theme(s)
		would result in an increase in wild rice stands within the federal estate boundaries, there would be no change to the existing public access to Tract 1 wild rice stands via the Pike River. Consequently, there would be no increase in wild rice harvest opportunities for the public. No wild rice stands are known to occur on the federal lands, and suitable habitat is limited.	
17743	It is commonly acknowledged that "[w]ater has been called 'mining's most common casualty'.... Mining affects fresh water through heavy use of water in processing ore, and through water pollution from discharged mine effluent and seepage from tailings and waste rock impoundments." Acid mine drainage ("AMD") is one of the greatest environmental liabilities associated with mining, especially in pristine environments like the Project mine site, that have economically and ecologically valuable natural resources. There are no hardrock surface mines that exist today that can demonstrate that AMD can be stopped once it occurs on a large scale. Inaccurate pre-mining characterization and interpretation often results in a failure to recognize or predict impacts to water quality and aquatic life. Evidence from literature and field observations suggests that permitting large scale surface mining in sulfide-hosted rock with the expectation that no degradation of surface water will result due to acid generation imparts a substantial and unquantifiable risk to water quality and fisheries. In a report comparing predicted and actual water quality at hardrock mines, there were two types of characterization failures that were key to explaining differences between the predicted water quality in EIS documents and the actual water quality either during or after mining began. These included: 1. Insufficient or inaccurate characterization of the hydrology: The authors reported primary causes of hydrologic characterization failures as overestimations of	The Co-Lead Agencies have requested additional hydrologic and geochemical data and the incorporation of those data into EIS analyses periodically throughout the environmental review process. The criteria the Co-Lead Agencies used to determine what data is included in the FEIS are as follows. Is the updated data: • Significantly different than the data already used in the model? • An integral component of a calibrated variable? • Linked to other data such that updating one necessitates updating the other? • Considered background information important to assessing the project's impacts? • Part of a greater dataset such that updating all of the dataset is necessary for consistency? • A type of input variable where GoldSim is sensitive? • Necessary for permitting-level analyses? Data collection and use in the FEIS are summarized in various data sufficiency documents. Nevertheless, a degree uncertainty in the predictions of environmental effects remains, as it would for any study of this type. The Co-Lead Agencies have addressed this uncertainty is several ways. Water quality modeling results (concentrations) are presented in terms of a probability, which communicates the likelihood actual concentrations could be higher or lower than best estimate modeling results. Sensitivity analyses were performed on temperature and precipitation inputs, baseflows in the Partridge River and other inputs to provide greater certainty in the model results. The FEIS identifies monitoring and reliable mitigation measures that have been incorporated in the NorthMet Project Proposed Action, possible improvements to these measures and additional mitigation that could be implemented if effects to water quality are worse than predicted. Additionally, on-going monitoring would be used in modeling to help	AQ 01 AQ 08 WR 071 WR 126 WR 128 WR 134 WR 136

Comment ID	Comment	Response	Theme(s)
	dilution, lack of hydrological characterization, overestimations of discharge volumes, and underestimations of storm size. 2. Insufficient or inaccurate geochemical characterization of the proposed mine: The primary causes of geochemical characterization failures were identified as lack of adequate geochemical characterization, in terms of sample representativeness and sample adequacy. The primary causes of mitigation failures were that mitigation measures were not identified, were inadequate, or were not implemented; waste rock mixing and segregation was not effective; liners leaked; tailings were spilled; or embankments failed, and land application discharge was not effective. The SDEIS suffers from all of these characterization failures. An egregious lack of hydrologic characterization allows PolyMet to pretend that there will be no water pollution resulting from the Project. In fact, the SDEIS arbitrarily concludes water quality will actually improve as a result of the Project. The following is a short list of the problems with water modeling in the SDEIS.	predict any issues before they occur. The Co-Lead Agencies have been working to produce accurate predictions of water quality impacts of the NorthMet Project Proposed Action for nearly a decade. A decrease of concentrations of some water quality parameters at some evaluation locations is not a surprise and PolyMet is adding environmental mitigation measures at an existing tailings basin that has seepage with elevated levels of some water quality parameters. The FEIS considers the release of acidity from proposed NorthMet facilities in that leachate from all acid-generating material (Waste Rock and pit wall rock composed of Category 2/3 and Category 4 material) would be captured and treated prior to discharge. The permanent surficial waste facilities (Category 1 Stockpile and Tailings Basin) would contain material that is not expected to produce acidic leachate. The non-acid generating waste was identified using multi-year kinetic tests (humidity cells) on NorthMet rock samples. Waste rock with 0.12 percent sulfide S or less is the threshold for selecting non-acid generation mine waste and, is supported by long-term humidity cell tests on NorthMet waste (i.e., 42 samples of Category 1 waste rock, with tests now run for over 450 weeks; and 33 humidity cell tests run between 84 and 304 weeks [see Section 4.3 and Attachment E, respectively, of PolyMet 2015q, as cited in the FEIS]). These tests demonstrate that tailings and Category 1 waste rock materials do not generate acidic leachate, and acid generation rates decreases over time as sulfide S minerals are depleted. The NorthMet Project Proposed Action design thus prevents the introduction of acidic leachate to surface water that could affect fisheries. A detailed financial assurance analysis would be part of the permitting phase. The financial assurance process would fully consider long-term monitoring and periodic replacement of equipment including, but not limited to, water treatment hardware and synthetic liners/covers. The Financial Assurance package for the NorthMet Project Proposed Action would insure that future funding would be available if and when adaptive mitigation measures or component replacements are needed to achieve performance specifications. Taking the data, modeling, proposed monitoring, mitigation, adaptive management and financial assurance together, the NorthMet EIS sufficiently discloses and accurately predicts to the degree necessary potential effects to water quality for purposes of environmental review.	

Comment ID	Comment	Response	Theme(s)
17744	Moreover, data collected specifically for the Project was selectively used, with several well and surface water monitoring stations' data completely excluded from the water quality models used to predict Project impacts. Specifically, all data collected from groundwater monitoring wells GW008 (13 sampling events), GW009 (12 sampling events), and GW010 (9 sampling events), were excluded from the models. These monitoring wells are northeast and north of the tailings basin between the tailings basin and the Embarrass River. Furthermore, none of the nine surface water quality sampling events collected at PM 11, a sampling station on unnamed creek located northwest of the tailings basin half-way between the tailings basin and the Embarrass River, were used in the Projects models. Also excluded from the models were data from nine sampling events collected at Station PM 12.1 in the Embarrass River upstream of the tailings basins. Instead, the model includes 53 sampling events in the Embarrass River at PM-13.85 PM-13 is 7.3 river miles downstream of the northwest corner of the tailings basin, and 16.2 river miles from monitoring location PM-12.2 - long past the first water quality compliance points in the Embarrass River.	Data at GW-008, GW-009 and GW-010 were not used for water quality modeling because these wells were not considered useful for developing probabilistic distributions for background surficial groundwater quality or establishing concentration targets for the calibration of existing conditions. For example, GW-009 and GW-010 are out in the adjacent watershed away from the tailings basin, impacted both by tailings basin seepage and background surficial groundwater. GW-008 is located essentially at the toe of the tailings basin, but the water quality data suggests it is not primarily tailings basin seepage but a mixture. Chloride data is around 0.8 mg/L to 1 mg/L. Chloride data in background wells is generally less than 1 mg/L if not non-detect at less than 0.5 mg/L. Chloride data in wells composed of seepage show concentrations closer to 20 mg/L. Therefore GW-008 is closer to background water quality with respect to chloride. However, sulfate data in GW-008 does not appear to show concentrations as low as is observed in the other background wells (GW-002 or GW-015 for example). In GW-008, sulfate concentrations are middle teens to nearly 20 mg/L, whereas sulfate data in the background wells is generally below 10 mg/L and closer to 5 mg/L. Therefore, though this well is close to the tailings basin, it appears to be a mix of seepage and background water, and therefore not useful for characterizing one or the other. Model results were checked against the observed data at PM-11, PM-13, PM-19, and MLC-2 in the validation step which had been presented earlier on in the modeling process. The report "Corroboration of Existing Conditions at the Plant Site", dated June 2012, includes a comparison of the model results to the observed water quality data and was reviewed by the agencies and used in the initial reviews of the modeling work to approve the modeling. Data at PM-12.1 was not used because the major sources of water contributing to this location are the natural contributing watershed and outflow at SD033. The water quality data at PM-12 was used to calibrate the water quality of the natural watershed, and the observed data at SD033 was used to define the water quality input to the model. The observed data at PM-12.1 was not needed to define any additional inputs to the model, but perhaps may have been used to validate the model if this specific location had been modeled. However, this location was not included as one of the modeled surface water locations.	WR 072 WR 076

Comment ID	Comment	Response	Theme(s)
17745	An additional problem is that the models intended to predict impacts from the Project were not calibrated to existing water quality in Colby Lake. Most of the data used to represent Colby Lake in the model was extrapolated from sampling sites well upstream in the Partridge River.	The Mine Site GoldSim model used for the SDEIS (Barr 2013f, as cited in the FEIS) was modified for the FEIS (Mine Site GoldSim model) (PolyMet 2014v, as cited in the FEIS) include a new chemical loading source in Colby Lake and was calibrated to the measured chemical concentrations in the lake. This calibration considered new surface water chemistry data collected through the end of 2013. The same chemical loading source was applied to both the Continuation of Existing Conditions model and Proposed Action model (PolyMet 2014v, as cited in the FEIS). The chemical loading source was constant and did not exhibit seasonal or long-term variations for future conditions. Incorporation of the loading source addressed the issue by providing predicted chemical concentrations in Colby Lake for existing conditions that are similar to currently measured concentrations. The average arsenic concentration based on 33 samples in Colby Lake is 0.95 µg/L. The GoldSim Continuation of Existing Conditions modeling scenario (PolyMet 2014v, as cited in the FEIS) predicts an average concentration of 0.80 µg/L at P50 over the 200 year modeling period.	WR 046
17746	Despite this selective use of water modeling data, the SDEIS claims "[t]he NorthMet Project Proposed Action is also not predicted to result in any significant changes to groundwater and surface water flows when compared to existing conditions." To achieve this prediction, the hydrologic models for the Project were built using modeled inputs rather than actual measurements or estimates from scientific literature. This makes the Project models unable to accurately characterize groundwater flow direction, water tables, potentiometric surface in the aquifers, fluxes to rivers and streams drawdown mounding impacts to the water tables or surface waters, or to predict water quality impacts. The models for the Project must be re-calibrated using all available measured data and scientifically credible basic model inputs.	The GoldSim models are informed by a combination of groundwater flow (MODFLOW) models, surface water runoff (XP-SWMM) models, and direct field measurements (groundwater levels, field borehole tests, groundwater and surface water sampling, and laboratory geochemical tests). For the FEIS, virtually all models (except XP-SWMM) were re-calibrated based on new field data obtained through the end of 2013. Where field data were not available, GoldSim inputs were based on a combination of literature values, experience at similar field sites, and best professional judgment. Reliance on site-level data provides a finer scale of resolution than afforded by regional assessments and associated estimates from scientific literature. Potentially important factors that are captured using site-level data include geologic, topographic, and hydrologic characteristics of the Partridge and Embarrass Rivers' basins respectively. The hydrologic assessments reflect: 1) the thin, discontinuous glacial drift; 2) the shallow depth to bedrock; 3) the low, hummocky topography; 4) the extensive wetlands; and 5) the generally shallow groundwater table. The re-calibration step allows for the modeling to achieve the most reasonable range of model inputs and outputs as the basis of impact assessment.	WR 056 WR 071 WR 086 WR 105
17747	Chapter 5 of the SDEIS acknowledges that "[t]he NorthMet Project Proposed Action would have the	The GoldSim models are informed by a combination of groundwater flow (MODFLOW) models, surface water runoff (XP-SWMM) models, and	WR 003 WR 052

Comment ID	Comment	Response	Theme(s)
	potential to affect groundwater and surface water hydrology and quality in both the Partridge River and Embarrass River watersheds." However, the hydrology model that was developed to determine Project impacts relied on outdated data collected too far from the site. Because the Project proponent was not required to install stream gauges at the site, they used a model (XP-SWMM) to extrapolate baseflow far upstream from where the data was collected to the areas where the proposed mine pit(s) and tailings basin would be located. The extrapolated baseflow used twenty-year-old stream gauging data collected seventeen miles downstream of the mine site in the Partridge River, and stream gauging data that is more than fifty years old collected eleven miles downstream of the plant site in the Embarrass River... Therefore, the results are highly unlikely to be representative of current conditions at the mine or plant site.	direct field measurements (groundwater levels, field borehole tests, groundwater and surface water sampling, and laboratory geochemical tests). For the FEIS, virtually all models (except XP-SWMM) were re-calibrated based on new field data obtained through the end of 2013. Where field data were not available, GoldSim inputs were based on a combination of literature values, experience at similar field sites, and best professional judgment. Reliance on site-level data provides a finer scale of resolution than afforded by regional assessments and associated estimates from scientific literature. Potentially important factors that are captured using site-level data include geologic, topographic, and hydrologic characteristics of the Partridge and Embarrass Rivers' basins respectively. The hydrologic assessments reflect: 1) the thin, discontinuous glacial drift; 2) the shallow depth to bedrock; 3) the low, hummocky topography; 4) the extensive wetlands; and 5) the generally shallow groundwater table. The re-calibration step allows for the modeling to achieve the most reasonable range of model inputs and outputs as the basis of impact assessment.	WR 071 WR 073 WR 086 WR 091
17748	During subzero temperatures January 25-26 and February 15-16, 2011, the minimum baseflow measured by the MNDNR in the Partridge River at the point nearest the proposed mine pits was of 3.4 cubic feet per second (cfs). Values calculated by staff from Great Lakes Indian Fish and Wildlife Commission ("GLIFWC") and MNDNR from low flow stream gauge data in the Partridge River ranged from 1.2 to 1.8 cfs, while the XP-SWMM model predicted a baseflow of 0.5 cfs. Not only is the Project modeled baseflow inconsistent with published literature, none of the measured data supports the baseflow predicted by XP-SWMM at SW003 of 0.5 cfs. XPSWMM's extrapolation of unrealistically low baseflows was used to calibrate the MODFLOW model and therefore influences virtually all aspects of the Project water quality and quantity characterization and impact prediction, including: groundwater flow rates and	The GoldSim models are informed by a combination of groundwater flow (MODFLOW) models, surface water runoff (XP-SWMM) models, and direct field measurements (groundwater levels, field borehole tests, groundwater and surface water sampling, and laboratory geochemical tests). For the FEIS, virtually all models (except XP-SWMM) were re-calibrated based on new field data obtained through the end of 2013. Where field data were not available, GoldSim inputs were based on a combination of literature values, experience at similar field sites, and best professional judgment. Reliance on site-level data provides a finer scale of resolution than afforded by regional assessments and associated estimates from scientific literature. Potentially important factors that are captured using site-level data include geologic, topographic, and hydrologic characteristics of the Partridge and Embarrass Rivers' basins respectively. The hydrologic assessments reflect: 1) the thin, discontinuous glacial drift; 2) the shallow depth to bedrock; 3) the low, hummocky topography; 4) the extensive wetlands; and 5) the generally shallow groundwater table. The re-calibration step allows for the modeling to achieve the most reasonable range of model inputs and outputs as the basis of impact assessment. The only other available gaging data is	WR 003 WR 004 WR 091

Comment ID	Comment	Response	Theme(s)
	pit inflow, dewatering impacts to the rivers and wetlands, water treatment needs, contaminant transport times and concentrations, and contaminant dilution. Higher baseflows in the Partridge River indicate that the wetlands and river are connected to the groundwater aquifer, that mine pit inflow will be greater; and that groundwater will travel through the aquifer will occur at a much faster rate. During subzero temperatures January 25-26 and February 15-16, 2011, the minimum baseflow measured by the MNDNR four miles south of the LTVSMC tailings basin 13.9 to 15 cfs in the Embarrass River. Model estimated the average annual baseflow for the Embarrass River, based on data more than 50 years old, at 8.7 cfs.	from a station installed during 2011 at SW003 on the Partridge River. Interpretation of groundwater baseflow at SW-003 is not reliable for use in the GoldSim modeling of groundwater baseflow due to the complicating effects of Northshore PMP pumped discharges, seepage from the Northshore Western Pond, and complex storage/release mechanisms in the wetlands that receive these flows. A sensitivity analysis for the Mine Site was also conducted to evaluate if predicted NorthMet Project Proposed Action impacts are sensitive to groundwater baseflow values. The sensitivity analysis considered the relationship of various model inputs to groundwater baseflow including hydraulic conductivity, recharge, and surface runoff chemical concentrations. It also reflected consideration of the flow data collected at SW003 in requiring groundwater baseflows at all locations on the Partridge River be increased by a factor of 4 (e.g., 0.5 to 2.0 cfs at SW-003). The results indicate that modeled groundwater and surface water concentrations are sensitive to changes in groundwater baseflow. However, the NorthMet Project Proposed Action's ability to meet groundwater quality and surface water quality evaluation criteria is not sensitive to changes in baseflow. Evaluation criteria can be found in Section 5.2.2.	
17749	Surface water quality at the Project remains insufficiently characterized or left uncharacterized, and the defects in analysis in this area are profound. The limited data the SDEIS uses indicates that surface waters have already been adversely impacted by mining activity--which should give rise to more scrutiny, not less. Contaminant transport modeling suggests that the Project will cause manganese, aluminum, and sulfate to exceed Minnesota Water Quality Standards ("MN WQS"). Mercury, sulfate, and specific conductance have already exceeded surface water criteria in surface water samples collected near the tailings basin at nearby Area Pit 5, and mercury and aluminum exceed surface water criteria in the Partridge River downstream of Colby Lake. Aluminum, iron, manganese, and mercury all exceed MN WQS in Colby Lake. Contaminants from the Project will likely contribute additional loading to these existing	The FEIS identifies potential impacts to water resources and measures available to anticipate and control these same impacts. It is a fundamental regulatory premise that water resources are ruled to not be negatively impacted if water quality criteria are met at applicable evaluation locations. If water quality criteria are not met under current non-project conditions, it is ruled that project is not creating an impact if the range and average concentrations are not greater for project compared to non-project conditions and the frequency of exceedances are not greater for project compared to non-project conditions. Surface water quality criteria apply instream after the groundwater discharge has mixed with ambient surface water (independent of proximity to the NorthMet Project Proposed Action property boundary). The evaluation criteria that are used in the FEIS are based on a combination of health-based water quality standards for drinking water sources (such as groundwater and Colby Lake) and mercury in surface water (fish consumption) and on aquatic life-based standards for surface waters. Evaluation criteria can be found in Section 5.2.2. Groundwater evaluation criteria apply to groundwater at the project property boundary and the GoldSim models predict that these criteria	WR 064 WR 075 WR 109 WR 123 WR 197

Comment ID	Comment	Response	Theme(s)
	exceedances of MN WQS in the Embarrass River, Colby Lake, and the Partridge River. And, as a result of the Project, it appears that arsenic will exceed drinking water standards in Colby Lake. No water samples have been collected from lakes near the tailings basin (including Hiekkilla, Mud, Kaunonen, or Hay Lakes) to determine if the pollutants found in the surface and groundwater at the existing tailings basin have caused contamination of those waterbodies. The SDEIS even acknowledges current exceedances: "…the existing LTVSMC Tailings Basin is not lined and currently releases seepage with elevated concentrations of sulfate, TDS, and hardness, among other constituents." It just does not propose any effective means of remediating them.	would be met. For the different flowpaths, groundwater travel times to groundwater evaluation locations and surface water discharge points are presented in the FEIS, including the times for initial change in chemical concentrations and the times to reach peak concentrations. Once chemicals discharge from groundwater to surface water, it is assumed that migration is instantaneous to surface water evaluation locations. Regarding the lakes listed, sampling of them would not have added substantially to the overall Plant Site characterization for the purpose of impacts assessment. It should be noted that Spring Mine Lake is located upstream of the east side of the Tailings Basin and has been sampled for water quality.	
17800	The Band is profoundly concerned at the preparers' refusal to consider past state agency experience with this site that had disastrous consequences for water quality. The Band has located an MPCA document from the Minnamax Exploration Project, a test shaft drilled into the Duluth Complex, the rock formation where the mine would be sited, by AMAX Corporation in the 1970s, approximately three miles from the Project mine site. This document states that water was encountered 147 feet below the surface infiltrating into the test shaft at approximately 14 gallons per minute and identified another potentially water bearing fracture zone at 900 feet below the surface. This means that the volume of bedrock groundwater that may be encountered by the Project mine pit has been vastly underestimated.	Comments cite MPCA 1976a (Office Memorandum: AMAX Exploration, Incorporated Salt Water Spill. From Curtis Sparks, EIS Coordinator, to Louis Breimhurst, Director. September 8, 1976), which pertains to the historical Minnamax/Amax exploration project located 1 to 2 miles east of the NorthMet project sites. The relevant text in this memo is as follows: "The depth of the [exploration] shaft, at the time of the inspection was approximately 520 feet. At the 147 foot level, a fracture zone was encountered. Approximately 14 gallons a minute of water was infiltrating into the shaft. The fracture was grouted and sealed. In the core drilling operation, the fracture was noted, however, it was not identified as a water bearing fracture. In the core drilling, another fracture zone was identified at the 900 foot level. It is possible that additional water would be encountered at 900 feet." It is uncertain if the observations made during this shaft excavation can be realistically applied to bedrock at the NorthMet Project Proposed Action site. The historical Minnamax/Amax project was located many miles away from the NorthMet Project Proposed Action and it is uncertain if geologic units and structures penetrated by the shaft are similar to those in the location of the NorthMet Project Proposed Action. Further, it is not stated in the memo if the 14 gpm inflow was a sustained flow or if it decreased over time as commonly occurs in fractured rocks. The comments do not indicate if the fracture zone identified by core drilling at 900 feet caused	WR 007

Comment ID	Comment	Response	Theme(s)
		significant inflows when the shaft reached that depth. It would be speculative to characterize the NorthMet Project Proposed Action Site using observations made in the referenced MPCA memorandum.	
17802	Other MPCA documents detail an unexpected saline water discharge that resulted as part of the AMAX Exploration Project from a water pocket 1,391 feet below the surface. The large quantities of saline water discharged, as much as 275 gallons per minute to Langley Creek, killed much of the vegetation en route. Data show severe impacts to wetlands in the vicinity of the project. Water from stockpiles that were minuscule in comparison to the stockpiles proposed for the PolyMet Project drained water with very high concentrations of nickel, cobalt, copper, zinc, and sulfate, and discharged that water into Langley Creek and the Partridge River. The project polluted streams, groundwater, and a large wetland complex in its vicinity in order for the MNDNR to study potential impacts and mitigation strategies for non-ferrous mining. Yet the data collected from the AMAX project was not used to predict water quality or wetlands impacts presented in the PolyMet SDEIS.	The comment cites MPCA 1976b. (Office Memorandum: Minnamax Exploration Project Tour. From Curtis Sparks, EIS Coordinator, to Louis Breimhurst, Director. November 24, 1976), which discusses saline water encountered in an air-driven downhole hammer borehole at the Minnamax/Amax site. The relevant text in this memorandum is as follows: The [saline] discharge began after hitting a confined pocket of water at the 1391 foot level on July 13, 1976. Although large quantities of water, as much as 275 gallons a minute, were being discharge, the drilling operation was continued to July 15. It is uncertain if observations described in the MPCA memorandum are relevant to the NorthMet Project Proposed Action Site including bedrock types and hydrogeologic conditions. The maximum depths of NorthMet Project Proposed Action pits (approximately 700 feet) would be far less than the 1,391-ft depth at which saline water was encountered at the Minnamax/Amax site. It is also uncertain if the 275 gpm flow rate was short-term or maintained for an extended period of time. Note that inflows to the PolyMet mine pits would be treated by the WWTF during operations, reclamation, and closure, so if saline water were encountered, it would be treated and discharged at concentrations meeting applicable water quality standards. See FEIS Section 5.2.2.3.2 for a discussion of potential impacts from saline waters. The FEIS relies on AMAX-derived data in a variety of circumstances. Examples include: 1) assessment of pH-dependent concentration caps for Category 1 waste rock; 2) use of exploratory shaft data on stockpile hydrology for estimating evapotranspiration rates; and 3) comparison of modeled sulfate release to observed released values in collected drainage from AMAX stockpiles.	WR 007
17807	Also ignored was experience with the Dunka Pit, located on the old LTVSMC site approximately five miles north and east of the PolyMet Project mine site. In the Dunka Pit, LTVSMC contacted the Duluth Complex and the Virginia Formation while mining for taconite in the Biwabik Iron Formation. By 1991, LTVSMC had removed about 50 million tons of Duluth Complex material	The Co-lead Agencies rely upon the expertise and experience of their staff who bring to bear their knowledge of various studies and analyses performed on mine sites in Minnesota and elsewhere. This knowledge is applied in the review of documents prepared to evaluate the NorthMet Project Proposed Action potential effects. It should be noted that the NorthMet Project Proposed Action is different from other mining projects in this part of Minnesota in the following ways:	CU 06 WR 023

Comment ID	Comment	Response	Theme(s)
	from the Dunka pit and placed it in "gabbro" stockpiles. Monitoring of the drainage from these stockpiles beginning in 1976 revealed a decrease in pH and an increase in trace metals. Copper and nickel concentrations as high as 1.7 and 40 mg/l respectively were observed in seepage/run-off from the Duluth Complex waste rock stockpiles and pH was observed as low as 5.0 at seep 1 between 1976 and 1980. Most of the seepage from waste rock piles at the Dunka site was discharged to Bob's Bay in Birch Lake via Unnamed Creek. A 1976-1977 study of trace metals in Bob's Bay found that concentrations of copper, nickel, cobalt, and zinc in the water of the Bay were higher than regional average concentrations and decreased with distance from the mouth of Unnamed Creek. Additionally, it was determined that Unnamed Creek contributed more than 90 percent of the trace metals to Bob's Bay load. The October 2001 NPDES permit for this discharge expired in 2005 and another variance request is expected. The 2001 Dunka mine area permit has a variance provision allowing toxic pollutants to exceed the final acute value. A Waste Water Treatment Facility ("WWTF") located at the site has been inactive because Cliffs Erie, LLC, the owner after LTVSMC, declared bankruptcy and claims it is simply too expensive to continue running. Unfortunately, the passive wetland treatment system did not function well enough to remove nickel and copper in waters still discharging from the mine pit and stockpiles to a concentration that comports to comply with Minnesota WQS, and was rebuilt in 2010. Unfortunately, by 2012, copper, nickel, zinc, sulfate, and hardness concentrations from the treatment wetlands discharges (SD 8 and SD 9), were exceeding WQS. In accordance with a Consent Decree with the MPCA, Cliffs Erie is required to submit a plan	different ore type, designs for groundwater containment systems, and use of long-term mechanical treatment. While experiences gained on other projects are informative, they do not necessarily apply to the NorthMet Project Proposed Action. This is particularly true for groundwater containment systems because the NorthMet Project Proposed Action uses a design that differs from those at other Iron Range mine sites. The mitigation designs of the NorthMet Project Proposed Action are unlike measures discussed in the Regional Copper-Nickel Study. The NorthMet Project Proposed Action measures include: long-term mechanical water treatment, uniquely designed groundwater containment systems, subaqueous disposal of reactive waste rock, and synthetic covers and under-liners used at waste rock stockpiles and treatment ponds. In addition, the level of construction QA/QC proposed at the NorthMet Project Proposed Action Site would be much higher than what has historically occurred at older mine sites in the Iron Range. It is erroneous to conclude that operation and closure of the NorthMet Project Proposed Action Site would necessarily entail the same types of failures that have occurred at some historical Iron Range mines. In fact, the unique designs and high-quality construction measures proposed are a response to past events. The detailed and sophisticated modeling work performed to support the FEIS exceeds that conducted for some existing mines in Minnesota. The models used for the NorthMet Project Proposed Action represent years of development, with input from PolyMet, Co-lead Agencies and Cooperating Agencies. Based on comments received on the SDEIS, modifications were made to the models to improve FEIS impact evaluations. It is the Co-lead Agency position that incomplete or inaccurate predictions made in the past at historical mining operations do not provide a basis for judging the quality of modeling used in the NorthMet FEIS. The FEIS reflects consideration of information pertaining to the Dunka Pit that was directly relevant to the NorthMet Project Proposed Action (including Dunka Mine field data that was used to develop scaling factors for the Category 1 Stockpile. It is noteworthy that many aspects of operations at the Dunka Pit are dissimilar to the NorthMet Project Proposed Action in terms of hydrogeology and mine design.	

Comment ID	Comment	Response	Theme(s)
	for compliance with toxicity final concentration limits at SD008 and SD009 without a variance. Water quality impacts from prospecting and mining operations that have contacted the Duluth Complex are well known to the MNDNR and MPCA. The State of Minnesota spent $4.3 million over three years in the late 1970s to produce the Regional Copper-Nickel Study, a 5-volume compilation of technical information regarding the potential impacts of copper-nickel mining in the Duluth Complex. Nevertheless, predicted water quality impacts and ineffective mitigation methods referenced in the Study were ignored when the technical documents and SDEIS were drafted for PolyMet. Therefore, water quality impacts have likely been underestimated and the mitigations proposed may not be effective.		
17811	Similarly, the Mining Simulation Project (funded in part by a Minnesota Legislative appropriation of $185,000 to the MNDNR and MPCA) was a cooperative study to identify and resolve environmental issues associated with non-ferrous mining and to anticipate industry and government data needs to address those issues before commercial development occurred in Minnesota. The study clearly identified those state ground and surface water quality regulations that would apply to copper-nickel mining operations in Minnesota, including applying the 10 mg/l sulfate criterion to effluent discharges where wild rice is present, and prioritized nondegradation of both surface and groundwater and protection of groundwater as a drinking water source, and rejected using natural wetlands for mine effluent treatment ("as a toxic metals dumping ground").	Evaluation criteria are based on applicable water quality standards. Evaluation criteria can be found in Section 5.2.2. Where a water body is classified as Domestic Consumption (1B) or for groundwater, USEPA primary drinking water standards apply. The USEPA primary drinking water standards set mandatory maximum contaminant levels for drinking water to protect the public from consuming water that presents a risk to human health. For purposes of the FEIS, the MPCA has provided guidance as to what waters in the Embarrass River and Partridge River are waters used for production of wild rice to which the current 10 mg/L wild rice sulfate standard applies. The MPCA reviewed all available relevant information in making their recommendation; however, that recommendation in itself is a policy decision of the MPCA that is not part of the EIS process Water treatment using natural wetlands is not included in the NorthMet Project Proposed Action project description. The NorthMet Project Proposed Action would rely upon mechanical treatment for as long as necessary. During operations and closure, the use of wetland treatment may be considered as an adaptive management measure if pilot and other studies indicate that this method has potential utility and is cost-effective.	WR 110 WR 154
17812	Finally, the SDEIS lists the sulfur concentrations of Project waste rock ranging between 0.01-5.0%	From November 2005 to January 2006 information was gathered on the hydrogeologic characteristics of the Virginia Formation at the Mine Site	WR 173

Comment ID	Comment	Response	Theme(s)
	with an average mass-weighted concentration of 0.15%. The Virginia Formation has the highest concentrations of sulfur 0.4 - 5.0%, and the Duluth Complex 0.13 – 0.6% sulfur. These concentrations are much higher than in Montana's Zortman-Landusky Mine waste rock (0.2% sulfur) that has required perpetual wastewater treatment. And, like Zortman-Landusky, the Project proponent has suggested that "most (70 percent) of the NorthMet waste rock would be the low-sulfur, non-acid-generating" and will never cause acid mine drainage. However, the north wall of the east pit is composed of the Virginia Formation meaning that it will be exposed to both air and water and will likely contribute a substantial load of sulfate and metals to mine pit water.	and the chemical characteristics of the groundwater within the formation because the Virginia Formation is anticipated to make up a portion of the north wall of the East Pit. Field activities included installing four pumping wells (and six observation wells targeting the Virginia Formation along the north boundary of the East Pit. Another investigation was conducted from October 2006 to November 2006 to evaluate the possible effects of mine dewatering on the wetland areas in the vicinity of the Mine Site, to gather additional specific capacity data from wells completed in the Virginia Formation, and to gather additional water-quality data for groundwater within the unconsolidated deposits, the Virginia Formation, and the Duluth Complex. The investigation consisted of conducting a 30-day pumping test. Water levels during the pumping test were monitored in five wetland piezometers located north of the pumping well. In addition, specific capacity tests were conducted at in two wells which are open exclusively to the Virginia Formation. Information gathered during this field work was used in FEIS water modeling (PolyMet 2015m).	
17867	The USACE has not developed a monitoring plan to assess after-the-fact Project impacts to lands, but claims that will be the way to best determine and mitigate indirect wetland impacts...So the SDEIS simply lacks sufficient detail even to comply with NEPA, and contains much less detail than is required to permit sufficient evaluation of potential wetland impacts.	When an agency is evaluating reasonably foreseeable significant adverse effects on the human environment in an EIS and there is incomplete or unavailable information because the overall costs of obtaining it are exorbitant or the means to obtain it are not known, NEPA directs the agency to make it clear that such information is lacking, discuss the relevance of the lacking information, and discuss any information relevant to evaluation of the future impacts. In these cases, NEPA also directs the agency to evaluate these impacts based upon theoretical approaches or research methods generally accepted in the scientific community provided that the analysis of the impacts is supported by credible scientific evidence, is not based on pure conjecture, and is within the rule of reason. The Co-lead Agencies believe this is the case for evaluating indirect wetland effects. The Co-lead Agencies have thoroughly considered throughout the development of the EIS and through the Wetland Impact Assessment Planning Work Group how to assess potential indirect wetland effects. As a result, strengths and weaknesses of the approach used, as well as other suggested approaches, have been carefully considered. The Co-lead Agencies ultimately decided the use of the analog method and the 20% metric described in Section 5.2.3 as factors considered in identifying potential indirect effects to wetlands is a credible and reasonable approach consistent with the requirements of NEPA.	COE 02

Comment ID	Comment	Response	Theme(s)
		FEIS Section 5.2.3.3 has been revised to include more information on the monitoring and mitigation plan for the indirect wetland effects.	
17870	the mitigation measures that the SDEIS does identify are inadequate as to wetlands, just as they are for purposes of water modeling.	FEIS Section 5.2.3.3 has been revised to include more information on the monitoring and mitigation plan for the potential indirect wetland effects. The indirect effects analyses performed for the FEIS were not performed to characterize impacts but were done to inform where monitoring should take place for those areas that were identified as having a potential for indirect wetland effects. As a result of these analyses performed to determine where monitoring should occur, quantification of wetland types and acres of potential indirect wetland effects were also generated. FEIS Section 5.2.3 provides these quantitative values of potential indirect wetland effects. The identification of specific mitigation for indirect effects and a monitoring plan is not a requirement for an EIS; however, the FEIS has been updated with additional information on the approach for determining mitigation if the monitoring shows indirect effects are occurring. The monitoring and mitigation for potential indirect effects would be determined during permitting. FEIS Section 5.2.3.3 has been revised to include more information on the monitoring and mitigation plan for the potential indirect wetland effects. The proposed wetland impact, avoidance, minimization, mitigation and monitoring plan presented in the FEIS would be reviewed, modified as required, and approved during permitting; therefore, this information could change during permitting.	WET 01 WET 04
17873	The SDEIS's failure to properly model and mitigate seepage and baseflow rates could result in profound impacts on wetlands. The estimates of groundwater drawdown are currently based on anecdotal and limited observations. Because of the generally flat topography and extensive wetlands, mine pit dewatering would likely cause substantial dewatering in nearby wetlands. Estimated indirect impacts to wetlands due to groundwater drawdown at the mine site are summarized in SDEIS, but without the use of a reliable groundwater model. Instead, dewatering impacts are assessed using an analogue method where wetlands impacted by another "equivalent" site are compared with wetlands surrounding the Project to provide an estimate of both the depth and distance from the	Monitoring well response to pit dewatering at the Canisteo Pit, located approximately 65 miles west of the NorthMet Project Proposed Action area in similar surficial geology, indicated significant aquifer heterogeneity. Modeling of aquifer response at the Canisteo site using MODFLOW resulted in differences between simulated and measured water levels ranging from +28 ft to -4 ft (Jones 2002, as cited in the FEIS). The model clearly could not accurately estimate water level changes of a few feet or less as would be desirable for assessing potential effects on nearby surface water features such as wetlands. Therefore, it was concluded that it was not reasonable to attempt to quantify drawdown at the Mine Site using the MODFLOW model. In lieu of using MODFLOW to estimate pit drawdown at the Mine Site, an analog approach was developed using available well data from the Canisteo Pit, which is the only mine pit within the Mesabi Iron Range that has an associated water balance study with well data that could be used to assess potential drawdown effects. Sixteen Canisteo wells were used for the	WR 071 WR 120

Comment ID	Comment	Response	Theme(s)
	mine pit(s) that dewatering occurs. The decision to use an analogue method came from the Wetlands Impact Assessment Planning work group process, in spite of Tribal Cooperating Agency objections. These objections include:(1) the PolyMet proposed mine pit will be hundreds of feet deeper than any of the "analogue" mine pits; (2) PolyMet mine pit walls will be crystalline and sedimentary bedrock versus the analogue mine pits in sedimentary bedrock only; (3) data collected from the site would be relatively inexpensive and should be used to inform impact assessment; and (4) relying on only a partial set of available "analogue" data as the source of information to estimate dewatering impacts is selective and not scientifically robust. Without a quantitative assessment of the mine-related drawdown of the regional water table, there is no mechanism to develop an adequate indirect impact assessment method for wetlands. Based on the vegetation data collected from wetland delineations, it appears that groundwater-supported wetlands are common in the Project area. The hydraulic conductivity in the unconsolidated deposits around the mine site ranges between 0.012 to 31 feet per day, indicating significant water movement within the surficial aquifer. In spite of the range of conductivities provided, however, the SDEIS states that perched wetlands cover over 50% of wetlands at the mine site.	analog evaluation. An additional shallow well near Kinney, Minnesota, adjacent to Minntac's West Pit, and one deep bedrock well, also near Kinney, were also used for the evaluation. A comparison of the hydrogeologic conditions at the Canisteo Mine Pit, the Kinney area wells, and the Mine Site concluded that the geologic and hydrogeologic settings of the Mine Site are relatively similar to the Canisteo and Minntac sites (Barr 2011i, as cited in the FEIS). The Canisteo Pit is not as deep as the proposed NorthMet mine pits. However, the surficial deposits at the Canisteo site ranges from 50 to 100 ft thick, while the surficial deposits at the Mine Site average only about 14 ft thick. Also, the underlying bedrock at the Canisteo site is composed exclusively of the Biwabik Iron Formation, which generally has a higher hydraulic conductivity than the Duluth Complex, Virginia Formation, and Giants Range Granite that underlie surficial deposits at the Mine Site. Despite the difference in pit depths, it is interpreted that there is potential for greater drawdown at the Canisteo site compared to the Mine Site. Overall, the Canisteo data are believed to provide a reasonably conservative estimate of the maximum extent of surficial aquifer drawdown that would result from the proposed PolyMet mine pits.	
17874	the Co-Lead Agencies suggest ombrotrophic bogs (meaning wetlands that receive all of their water and nutrients from precipitation) have no connection to groundwater, and therefore assume that drawdown will not affect these wetlands. But data supports at least a partial connection between ombrotrophic wetlands and groundwater Therefore, if groundwater under these "perched" wetlands was drawn down by several feet, the new	The FEIS has been revised to address concerns raised by the Bands regarding the assertion that ombrotrophic bogs would not be impacted by mine dewatering. FEIS Section 5.2.3.2.2 applies a more conservative assumption of the potential indirect effects for all bog communities within the 0-1,000-ft analog zone. Specifically, ombrotrophic bogs were reclassified from the "no effect" category to the "low likelihood" category, the same status as that assigned to minerotrophic bogs. The complex mixes of bedrock, surficial deposits, and wetland soils at the Mine Site impede the ability to reasonably model (e.g., using MODFLOW) and accurately assess	WET 09 WR 058 WR 071 WR 166 WR 167 WR 177

Comment ID	Comment	Response	Theme(s)
	head pressure would lead to impacts to the wetlands because water would seep out of ombrotrophic wetlands in areas where there was a hydrologic connection to the saturated layer. Even the SDEIS acknowledges that saturated conditions exist within the unconsolidated deposits and the underlying bedrock, and that that recharge to the bedrock comes from leakage from the overlying surficial aquifer. Given these statements describing vertical movement of water in the mine site area, a vertical hydrologic connection between ombrotrophic wetlands and the surficial aquifer is likely and the extent of the hydrologic connection should be investigated.	the potential effect of pit dewatering on wetlands. In light of this modeling limitation, wetlands were divided into zones based on distance from the open pit. The closer a wetland was to the pit during dewatering, the greater the water table drawdown would be and the greater potential there would be for hydrologic effects on overlying wetlands. These impact assessment methodologies are presented in FEIS Sections 5.2.2.3.2 and 5.2.3.1.2. Using an observational approach based on data from similar nearby mine sites (i.e., analog method), the Co-lead Agencies concluded that drawdowns in the surficial aquifer would not be expected to extend very far from the mine pits. This is explained by the following factors: 1) the surficial aquifer is thin and moderately permeable, 2) the surficial aquifer is subject to aerial recharge, and 3) the surficial aquifer is underlain by low-permeability bedrock that limits downward leakage from the surficial unit. These factors support the conclusion that wetland drawdown did not need to be included in the Mine Site GoldSim model. See FEIS Section 5.2.2.3.2 for more information on the analog method. It is acknowledged that there is some degree of hydraulic interaction between wetlands and the surficial aquifer at the Mine Site. However, attempts to quantitatively model the effects of these interactions on drawdown and water quality would be highly uncertain and potentially misleading. The FEIS approach was to not model hydraulic connections between wetlands and the surficial aquifer in the Mine Site GoldSim model, but rely on future monitoring and adaptive mitigation measures in the event that some wetlands are affected by the NorthMet Project Proposed Action. See FEIS Sections 5.2.2.3.6 and 5.2.2.3.5 for more information on Closure monitoring and adaptive mitigation.	
17875	Despite specific and repeated requests from tribal cooperating agencies, the Co-Leads did not elect to utilize a tool developed in 2011 by the EPA in cooperation with tribes, Applying Cumulative Impact Analysis Tools to Tribes and Tribal Lands, in order to discern potential cumulative effects to resources important to the tribes who retain usufructuary rights within the 1854 Ceded Territory.	The Co-lead Agencies consulted a wide range of sources to conduct the cumulative effects assessment of the NorthMet Project Proposed Action and Land Exchange Proposed Action. In addition, the Co-lead Agencies followed USEPA (USEPA 1999b) and CEQ (CEQ 1997 and Connaughton 2005) guidance on how to conduct the cumulative effects analysis. FEIS Section 6.1.1.1 describes the cumulative effects analysis approach. The cumulative effects analysis meets the requirements of MEPA/NEPA. Please also refer to the response to theme CR 08.	CU 03
17877	The SDEIS failed to take into account most of the issues cited [in Appendix C of the SDEIS].	The Co-lead Agencies considered the information included in the Tribal Cooperating Agencies' cumulative effects assessment and found no compelling information or analysis to change the original approach or	CU 12

Comment ID	Comment	Response	Theme(s)
		conclusions.	
17899	It is reasonably foreseeable that an additional 3,000 acres of wetlands within the watershed will be directly impacted by proposed new mining projects and expansions that are in active permitting and/or environmental review: the Project, U.S. Steel Minntac mine expansion; U.S. Steel Keetac expansion; United Taconite Tailings Basin 3 construction; and Cliffs Erie's mine pit expansion.	The following projects were not considered in the wetland resources cumulative analysis, because they are outside the Partridge and Embarrass River watersheds: U.S. Steel Minntac mine expansion, U.S. Steel Keetac expansion, United Taconite Tailings Basin, and Cliffs Erie's mine pit expansion. Those projects that were considered reasonably foreseeable and within the Partridge and Embarrass River watersheds were considered in the wetland cumulative analysis. Please refer to the responses to themes CU 02 and WET 18, as well as Section 8.3, MDO 12 for more information on the spatial boundary of the CEAA for water resources.	CU 02
17900	The SDEIS also fails to adequately analyze cumulative impacts to the water quality of the Partridge and Embarrass Rivers, much less the St. Louis River.	Section 5.2.2 of the FEIS discloses in-stream water quality concentrations as a result of the NorthMet Project Proposed Action which is added to existing impacted conditions from past projects. The FEIS goes on to discuss loading of sulfate and mercury from future projects in Section 6.2.2. The SDEIS and FEIS provide a rationale for not including the St. Louis River Basin in the cumulative effects analysis in Section 6.2.2.1.1. The SDEIS and FEIS considered in the cumulative effects analysis for water resources all of the facilities identified in FEIS Table 6.2-1. standards.	WR 024
17901	In fact, in Colby Lake (the community water supply for the City of Hoyt Lakes), aluminum, iron, copper, and mercury concentrations already exceed Minnesota WQS. Modeled concentrations of arsenic also exceed Minnesota WQS. This existing, large number of water-quality exceedances and the suite of constituents, particularly trace metals, that exceed WQS not only confirm the total lack of remediation for the previous mining activities at the LTVSMC site, but demonstrate the importance of evaluating the cumulative losses to water quality. Community drinking water wells, wetland degradation resulting from dewatering, and pollution of community and private drinking water aquifers by previous mining activity must be assessed throughout the St. Louis River watershed as part of this Project, as well as for all the other mining projects currently underway.	Groundwater and surface water flow models predict that the NorthMet Project Proposed Action would have a minimal effect on drinking water standard-based evaluation criteria in the groundwater at the project area boundaries or in Colby Lake (the locations at which drinking water standards apply). Based on this, it is therefore expected that the NorthMet Project Proposed Action would not have any significant impacts on water quality downstream of the proposed NorthMet Project area or significantly contribute to any cumulative effects on drinking water resources.	WR 042

Comment ID	Comment	Response	Theme(s)
17903	The SDEIS does not determine climate change implications of the proposed Project. But the Project has proposed the largest direct wetland fill ever permitted in this region and would disturb extensive areas of peat, which is known to be an important carbon and methane sink. Wetlands in general are recognized as important carbon sinks and areas where wildlife seeks refuge as the climate warms. Nevertheless, to date, virtually all required wetland mitigation for mining impacts has been implemented out of the basin, representing a permanent loss of high quality ecological resources and functions. This omission undermines even the MNDNR's own work. The MNDNR's Moose Advisory Committee, which studies the decline of the moose population in northeastern Minnesota, has recommended preserving wetlands as sanctuaries for moose from heat stress related to climate change.	Estimates of monthly and annual rainfall amounts were based on best available data obtained from weather stations near the Proposed Action site. In the GoldSim models, these parameters were treated as uncertain inputs and assigned probability distributions to capture the range of possible future conditions. While climate change may occur in the future, it cannot be stated at this time if in the long term there would be more or less rainfall. Thus, the probabilistic approach to rainfall used in GoldSim represents a technically defensible method for dealing with this issue. Individual storm events and frequency are not incorporated into the GoldSim models. Rainfall inputs are monthly and annual rainfall amounts. The effects of individual storms are considered by designing facilities to handle a 100-year, 24-hour storm event based on current data. If over time, climate change causes a gradual increase in annual rainfall, the 100 year storm event would be redefined to a larger precipitation value and mine facilities would be upgraded to handle a larger storm. For the Mine Site, a GoldSim sensitivity analysis was conducted to assess the possible effects of future climate change on groundwater and surface water impacts. It was concluded that reasonably foreseeable climate change would have little effect on pit inflows, pit lake water quality, groundwater chemical concentrations, and surface water chemical concentrations. These results are reported in the Water Modeling Data Package - Mine Site (Barr; December 2014). By analogy, the Plant Site is also expected to be minimally affected by possible future climate change. The NorthMet Project Proposed Action would not result in the release of methane (CH4) from the proposed loss of wetland habitats. Wetlands act as carbon sinks that sequester carbon dioxide (CO2). As a result of carbon cycling through the wetland system, a portion of sequestered carbon is mineralized to gaseous end products resulting in the production of CH4, which is released to the atmosphere. As such, the assumption that the NorthMet Project Proposed Action would result in an increase of methane stored in the peat bogs is incorrect. The loss of wetland habitat at the NorthMet Project area would result in a one-time release of 12,535 metric tons per year of greenhouse gas emissions (i.e., CO2-equivalents approximately stored carbon within those habitats (Barr 2012l, as cited in the FEIS). It is important to note that the loss of carbon sequestration capacity is fundamentally different from emission rates since it represents a loss of greenhouse gas absorptive capability (i.e., how effective the system is at absorbing carbon) and capacity (i.e., the amount of carbon able to be	WR 077 WR 180

Comment ID	Comment	Response	Theme(s)
		absorbed) as opposed to an actual contributing emission. However, Barr (2012l, as cited in the FEIS) also noted that the net effect of the loss of carbon sequestration capacity is essentially the same as emissions. The Barr report also noted that the projected calculated release of CO2-equivalents is a one-time event; however, it should not be assumed that all aboveground forest carbon would necessarily be released over a short timescale and that net carbon cycle impacts are highly dependent on the end-use of the cleared vegetation. For example, timber harvested for boards manufactured into furniture or buildings which is typically maintained for an extended period of years or decades, will degrade and decompose (i.e., release their stored carbon) at a much slower pace than timber that is utilized for firewood or woodchips which will ultimately decompose at a much faster rate. Harvested timber is typically utilized for a multitude of purposes dependent on numerous variables including market value, stand quantity and quality, tree species, demand, among others. As such, predetermining the end-use of an entire stand of timber is unfeasible. Additionally, the assumption that the NorthMet Project Proposed Action would result in the destruction of the carbon storage potential of the region is erroneous. That assumption discounts the contributions of the proposed compensatory wetland mitigation. The NorthMet Project Proposed Action would result in the loss of approximately 913.8 acres of directly impacted wetlands whereas the NorthMet Project Proposed Action would result in 1,799.7 acres of wetland mitigation (an impact to mitigation ratio of approximately 2:1). The NorthMet Project Proposed Action would be located within the St. Louis River Watershed (#3) (8-digit HUC) within the Great Lakes Basin (4-digit HUC). The Zim Site is located within the same watershed as the NorthMet Project Proposed Action; however, the Aitkin and Hinckley sites are located within the Mississippi River Basin (4-digit HUC) and 8-digit HUC watersheds of Elk-Nokasippi #10 and Snake River #36, respectively. See also responses to themes WET 05, WET 15, and WET 24.	
17905	Furthermore, underestimation of storm size and frequency is a serious problem for capture and treatment of polluted water from the Category 1 wasterock pile and tailings basin, tailings basin stability, stormwater run-off from the Overburden Storage and Layout Area ("OSLA"), and mine pit dewatering. Storm size and frequency is known to	Information in FEIS Section 5.2.7.2.4 addresses the potential for climate change impacts in the area, including the frequency and duration of severe weather events. GHG issues have been assessed in a manner consistent with USEPA and MPCA guidance, as well as CEQ 2010 (as cited in the FEIS). Estimates of monthly and annual rainfall amounts were based on best available data obtained from weather stations near the NorthMet Project	AIR 01 WR 180

Comment ID	Comment	Response	Theme(s)
	be changing. These and other cumulative effects of climate change must be addressed.	area from 1981 to 2010, which is the Climate Normal period. In the GoldSim models, these parameters were treated as uncertain inputs and assigned probability distributions to capture the range of possible future conditions. While climate change may occur in the future, it cannot be stated at this time if in the long term there would be more or less rainfall. Thus, the probabilistic approach to rainfall used in GoldSim represents a technically defensible method for dealing with this issue.. The effects of individual storms are considered by designing facilities to handle a 100-year, 24-hour storm event based on current data. If over time, climate change causes a gradual increase in annual rainfall, the 100 year storm event would be redefined to a larger precipitation value and mine facilities would be upgraded to handle a larger storm. For the Mine Site, a GoldSim sensitivity analysis was conducted to assess the possible effects of future climate change on groundwater and surface water impacts. It was concluded that reasonably foreseeable climate change would have little effect on pit inflows, pit lake water quality, groundwater chemical concentrations, and surface water chemical concentrations. These results are reported in the Water Modeling Data Package - Mine Site (Barr; December 2014). By analogy, the Plant Site is also expected to be minimally affected by possible future climate change. The NorthMet Project Proposed Action facilities would be designed with excess storage to handle large storm events. If climate change gradually increases the frequency and size of storms, there would be ample time to identify the issue and increase storage and treatment requirements at the site.	
17916	Section 106 consultation between the USACE and Tribes is ongoing. Therefore, despite significant changes through recent, increased consultation with tribal cooperators, the Cultural Resources chapter of the SDEIS is still incomplete, and the requirements of the National Historic Preservation Act ("NHPA") have not yet been fulfilled. The Project cannot proceed until they are.	The federal Co-lead Agencies have actively consulted with the federally recognized Bands that have expressed an interest in consulting for the NorthMet Project Proposed Action. Historic properties affected by the NorthMet Project Proposed Action have been identified and the impacts to those properties have been assessed. This also includes an assessment of actual use of those historic properties, as well as other resources in the APE, by tribal members. Effects on historic properties would be fully considered prior to the issuance of any permit or land exchange pursuant to the NHPA and its implementing regulations. Effects on cultural resources and culturally significant natural resources are addressed in the Cultural Resources sections in FEIS Chapters 4, 5, and 6.	CR 06
17919	Where, as here, there are historic properties affected, then there is an entirely separate level of	The federal Co-lead Agencies have made a reasonable and good-faith effort to identify cultural resources potentially affected by the NorthMet Project	CR 03

Comment ID	Comment	Response	Theme(s)
	adverse-effects assessment that must be performed, again in coordination with consulting agencies.207 In light of these rules, and as the chapter itself acknowledges, it is apparent that far more consultation and site work must be done to comply with Section 106.	Proposed Action and determine which resources qualify for inclusion in the NRHP as historic properties. Impacts to historic properties have been appropriately assessed and the federal Co-lead Agencies are actively consulting with the federally recognized Bands, the SHPO, and other consulting parties to develop appropriate mitigation measures. Effects on resources significant to the Bands that do not qualify as historic properties, as well as general effects on natural resources have been considered within the parameters of the statutes that shape this review. Effects on cultural resources and culturally significant natural resources are addressed in the Cultural Resources sections in FEIS Chapters 4, 5, and 6.	
17925	The Bands remain skeptical of the Co-Lead Agencies' claim that there will be no adverse effect to the Spring Lake Mine Sugarbush from the Project. Indirect effects, through dust deposition and unauthorized collection of historic objects, are anticipated because the sugarbush is situated immediately adjacent to the proposed plant site.	As discussed in FEIS Section 5.2.9.2.1, the federal Co-lead Agencies have determined that the NorthMet Project Proposed Action would adversely affect the Spring Mine Lake Sugarbush. As part of an MOA, the federal Co-lead Agencies would ensure the avoidance, minimization, and/or mitigation of impacts to cultural resources that may be encountered, such as unauthorized collection, during construction or operation of the NorthMet Project Proposed Action. The federal Co-lead Agencies, in consultation with the Bands, SHPO, and PolyMet, are currently working to resolve adverse effects on this property.	CR 02 CR 05
17929	The three properties would benefit from additional investigation. The sugarbush has not been formally recorded. The trail has been adequately documented within the SNF proposed land exchange, but requires additional survey in the upland areas of the project area. Mesabe Widjiu should be considered in its entirety. All three should be formally nominated to the National Register of Historic Places.	The federal Co-lead agencies have officially documented the Spring Lake Mine Sugarbush with SHPO. The federal Co-lead Agencies believe that there has been sufficient background research and fieldwork to justify consideration of the BBLV Trail Segment as an historic property. Additional research and fieldwork may be part of any resolution of adverse effect. The federal Co-lead Agencies have determined the Partridge River section of the Mesabe Widjiu and the Partridge River section of the BBLV Trail Segment eligible for inclusion in the NRHP under Criterion A; however, the federal Co-lead Agencies are assessing the effects of the NorthMet Project Proposed Action on only the portion of those properties within the APE. The federal Co-lead Agencies recognize that the two properties discussed above extend beyond the APE. All three historic properties have been determined eligible for the NRHP. The federal Co-lead Agencies, in consultation with the Bands, SHPO, and PolyMet, are currently working to resolve adverse effects on these properties. National Register Nomination of these properties may be part of an MOA; however, the federal Co-lead Agencies are currently in the process of considering what mitigations may be appropriate.	CR 02 CR 05
17932	The Project is predicted to increase mercury	Colby Lake water would not be directly discharged to tributaries north or	MERC 12

Comment ID	Comment	Response	Theme(s)
	loadings in the Embarrass River, but decrease mercury loadings in the Partridge River: Treated effluent would be used to augment flow in several Embarrass River tributary streams and Second Creek in the Partridge River watershed that would otherwise experience reduced flow because of the groundwater containment system. Additional water for flow augmentation in the nearby tributaries would be pumped from Colby Lake at periods during mine operations and reclamation. On the face of it, stream augmentation mitigation seems like a good idea. Unfortunately, Colby Lake water has high mercury concentrations that exceed the Minnesota WQS for wildlife. Colby Lake water used for augmentation will add mercury to the Embarrass River watershed both directly and indirectly by drying and re-wetting peat.	south of the Tailings Basin under the NorthMet Project Proposed Action, as described in the FEIS. The NorthMet Project Proposed Action includes treatment of all water that would be discharged at the Plant Site, including water used for flow augmentation. Additional information has been included in FEIS Section 5.2.2.3.6. The FEIS recommends that tributaries be monitored that extend from the Tailings Basin. In the event that the monitoring identifies the potential for any water quality standard exceedances, the Proposer would be obligated to take action to ensure compliance. Potential mitigation measures are included in FEIS Section 5.2.2.3.5.	WR 184
17933	High mercury concentrations in fish is a significant concern in the Embarrass River now, and mercury will only increase if the Project is allowed to use Colby Lake water for stream augmentation.	Colby Lake water would not be directly discharged to tributaries north or south of the Tailings Basin under the NorthMet Project Proposed Action, as described in the FEIS. The NorthMet Project Proposed Action described in the FEIS includes treatment of all water that would be discharged at the Plant Site, including water used for flow augmentation. The amount of water from Colby Lake used for flow augmentation would be low; however, any water used for augmentation would be treated prior to discharge. The FEIS recommends that tributaries be monitored that extend from the Tailings Basin. In the event that the monitoring identifies the potential for any water quality standard exceedances, the Proposer would be obligated to take action to ensure compliance. Potential mitigation measures are included in FEIS Section 5.2.2.3.5.	MERC 02 WR 184
17934	Dewatering peatlands will also amplify water table fluctuations because peat has high water storage capacity and releases water more slowly than other surficial deposits. Drying and re-wetting peat will increase mercury methylation and release. Peatlands store methane and carbon that will be released into the environment when overburden is removed from the mine pits or during periods of dewatering. This is important in the context of	Any mercury released from the decomposition of excavated peat temporarily stored in the Overburden Storage and Laydown Area (OSLA) is thought to occur relatively rapidly. The mercury released from organic matter decomposition would have the potential to move with precipitation that falls on the OSLA. However, water coming in contact with materials in the OSLA is considered to be process water and would not be directly discharged, but rather would be routed to pond PW-OSLA. In years 1 to 11 the water from pond PW-OSLA would be routed to the tailings basin and any mercury in the routed water would have the chance to be sequestered in	AQ 16 AQ 28 WET 03 WR 086

Comment ID	Comment	Response	Theme(s)
	subsistence fisheries and climate change because the temperature of water directly affects the oxygen content and defines what fish can survive. Mercury is also known to bioaccumulate in fish at a faster rate in warmer water.	the tailings. In years 12 to 20 some of the water from pond PW-OSLA would be used to backfill the East Pit. Any mercury in the water routed to the East Pit would have the chance to mix with waste rock and become sequestered at depth in the East Pit. In addition, any contributions of water in year 21 to 65 from the East Pit to the West Pit would reflect water from the East Pit and its associated watershed runoff, and would not reflect process water from pond PW-OSLA. Because peat removal from the areas to be mined would be completed between years 5 and 11, most of the potential release of mercury from stored peat materials would likely have already occurred, or be ending, by the time water is routed from pond PW-OSLA to the East Pit beginning in year 12. The hydrology of the wetlands outside the containment system would be maintained within an established range through flow augmentation so that wetlands would not experience substantial inundation or desiccation. Wetland hydrology is a complex mix of precipitation, surface runoff, and, in some cases, groundwater. Current understanding of how these factors interact at the project site is limited, making it beyond the current ability of the FEIS to predict site-specific changes in wetland hydrology. The FEIS recommends monitoring of wetland water quality at the Mine Site between Dunka Road and the Partridge River as well as the Partridge River itself. Effects of climate change on aquatic species were not identified as a concern during scoping, and are beyond the scope of the FEIS analysis, because the effects to aquatic species under future climate scenarios are speculative. A preliminary qualitative assessment of water resources impacts due to climate change is provided in Attachment W of the NorthMet Project Air Data Package, Version 5. January 15, 2015 (PolyMet 2015e, as cited in the FEIS). In aquatic systems, there is generally a positive correlation between warmer water temperatures and accumulation of heavy metals. However, studies on the relationship between temperature and bioaccumulation of mercury in aquatic life are ongoing. Therefore, the degree to which the NorthMet Project Proposed Action could potentially affect aquatic species due to changes in temperature cannot be determined. Water monitoring would ensure that water quality standards would be met with engineering controls and adaptive management. Specific monitoring details would be addressed in permitting. In addition, spill prevention plans would be implemented.	
17935	Several lakes and the Partridge River watershed are likely to be negatively affected, which will	The Cultural Resources sections of FEIS Chapters 4 and 5 address the federal Co-lead Agencies' federal tribal trust responsibilities under the	CR 01

Comment ID	Comment	Response	Theme(s)
	impact fish species and thus the Band's 1854 Treaty rights to harvest fish in those water bodies. The SDEIS as written fails to mitigate the costs to fisheries and wildlife species that are protected under the 1854 Treaty...Treaty-reserved fishing rights cannot be fully exercised when fish consumption must be restricted for health reasons to one or two meals per week.	1854 Treaty. These sections, along with other relevant natural resources sections of FEIS Chapters 4, 5, and 6 also address effects on, and any proposed mitigation for effects on cultural resources and culturally significant natural resources. Mitigation/compensation for effects on cultural resources and culturally significant natural resources is considered to the extent possible within the parameters of the statutes and regulations providing the federal authorities for the review of the NorthMet Project Proposed Action.	
17937	The SDEIS does not adequately address the potential impacts to Band members of a significant increase in mercury in fish harvested both on-Reservation and in Ceded Territory waters...Yet the SDEIS offers no mitigation for these known losses. The SDEIS must be revised to include sufficient analysis and mitigation.	Based on the results of water quality modeling, the water quality of the West Pit Lake, East Pit wetland, and Tailings Basin pond is predicted to be at concentrations not injurious to wildlife. On-site monitoring of waterbodies within facility boundaries would likely be a part of a monitoring program. Monitoring details would be finalized in the permitting process. FEIS Section 5.2.5.2.3 discusses potential impacts to wildlife from incidental contact with the Tailings Basin pond and pit lakes. FEIS Section 7.3.4 discusses potential human health impacts. FEIS Section 5.2.2.3.6 discusses on-site monitoring. FEIS Section 5.2.2.3.4 discusses bioaccumulation of methylmercury.	CR 01
17939	Minnesota's mercury TMDL process will not adequately address the fish consumption impairment in these waterbodies, and any new discharges that would result in further degradation to waters with an existing water quality impairment are not be legally permittable under the CWA.	This comment was originally presented as part of the Tribal Position Summary included in MDO #2, which was previously addressed in SDEIS Table 8-1. Further explanation is provided below. The MPCA's goal is to protect high-quality waters and improve the quality of impaired waters, so water quality standards are met and beneficial uses are maintained and restored, where these uses are attainable. As summarized in FEIS Section 5.2.7.2.5, widespread contamination of fish from atmospheric pollution is why Minnesota established a statewide mercury TMDL. The TMDL seeks to reduce atmospheric deposition everywhere in the state, in order to make the state's lakes and streams fishable, as required by federal regulations, and is intended to provide the long-term framework to reduce mercury in fish. The MPCA published Guidelines for New and Modified Mercury Air Emission Sources, and revised those guidelines in 2012 (MPCA 2012h, as cited in the FEIS). The guidelines were developed to limit the mercury emissions from new and expanding sources in order to meet the TMDL goal of total statewide mercury emissions of 789 lbs/year by 2025. The MPCA has conducted a review of the NorthMet Project Proposed Action mercury emissions, and has determined that it would not impede the reduction goals (MPCA 2013b, as cited in the FEIS).	MERC 11

Comment ID	Comment	Response	Theme(s)
		Further, the NorthMet Project Proposed Action is not anticipated to be a major source of mercury into the environment. The RO treatment plant is expected to discharge mercury at or below the mercury standard of 1.3 ng/L, which includes all surface water that would be discharged at the Plant Site including water used for flow augmentation. Mercury loadings from the Mine Site are projected to decrease due to the NorthMet Project Proposed Action and the combined contributions from the Embarrass River and Partridge River are unchanged when modeled for the St. Louis River at the Fond du Lac reservation boundary. Therefore, further degradation of surface water quality, and by extension increased mercury in fish, is not expected.	
17940	The cumulative effects of invasive species, mining, and Project effects on sturgeon must be considered and the SDEIS revised.	The NorthMet Project Proposed Action is not considered to have the potential for cumulative effects on lake sturgeon, because recent MDNR and Fond du Lac Band of Lake Superior Chippewa sturgeon data provided since the SDEIS indicated sturgeon are not known to occur within the Project Area (see Section 4.2.6).	AQ 02 AQ 26
17944	Although the permitted area is significantly disturbed and will be for the foreseeable future, the closure and reclamation plans will have a significant effect on native vegetation as it is reintroduced. The prevalence of invasive, non-native species and their ability to outcompete native plants in disturbed areas, coupled with PolyMet's plan to introduce non-native and invasive species to this area, would result in significant impacts to cultural resources that have not been discussed in the SDEIS.	The FEIS vegetation sections include new details from the updated Reclamation Plan (PolyMet 2015g, as cited in the FEIS). In particular, invasive species would not be permitted in the seed mix. Some non-native species (e.g., oats, winter wheat) that are commonly used in seed mixes to temporarily stabilize soils in order to reduce erosion or dust potential could be planted. The species to be used for reclamation would be finalized during permitting. The FEIS Section 3.2.2.1.10 describes how the NorthMet Project area facilities would be operated to allow for progressive reclamation during operations. After mining ceases, PolyMet would finish reclamation activities under the Reclamation Plan, which is a required portion of the Permit to Mine. *Minnesota Rules* 6132.2700 states that the establishment of vegetation shall begin during the first normal planting period after site features are determined by the Permit to Mine to be no longer scheduled to be disturbed. Reclaimed areas would be monitored and maintained as needed in the Spring and Fall or as required under the Permit to Mine. Any areas damaged by erosion or that lost vegetation would be identified, and plans to repair or reseed would be developed and implemented.	VEG 09
17945	While the SDEIS provides that displaced wildlife will face increased competition for resources, no mention is made whether the displaced animals may cause populations in adjoining territory to	The FEIS wildlife sections include an analysis of wildlife displacement effects due to the NorthMet Project Proposed Action. FEIS Section 5.2.5.2.3 discusses the potential effects to species based on habitat preferences, and uses available scientific literature to analyze displacement	WI 05

Comment ID	Comment	Response	Theme(s)
	approach or exceed carrying capacity. The SDEIS fails to assess cumulative effects of wildlife population changes, not only in the project area, but the entire region.	effects on local and regional ecology due to noise or increased human activities.	
17948	the value of natural resources maintained in good condition is simply not represented in the SDEIS. Nor is the economic value of clean water provided or assessed.	EIS Section 5.2.10.1.4 states, "Neither NEPA nor CEQ requires the cost and benefits of a proposed action to be quantified in dollars or any other common metric; however, this EIS acknowledges that economic costs and loss of non-market value may results from environmental and social effects. Also acknowledged is that the agreement on the value (i.e., the "cost") of environmental effects is often difficult to achieve. Therefore, the approach of this EIS is to evaluate environmental and social impacts directly, in the appropriate resource-specific section." CEQ regulations for implementing NEPA (40 CFR 1502.23) state that, "for purposes of complying with the Act, the weighing of the merits and drawbacks of the various alternatives need not be displayed in a monetary cost-benefit analysis and should not be when there are important qualitative considerations." The socioeconomic analysis provided in the FEIS satisfies NEPA and MEPA requirements. The NorthMet Project Proposed Action would take place in an area that has experienced mining previously. As discussed in FEIS Section 5.2.11.2.1, the presence of the NorthMet Project Proposed Action would not substantially affect regional recreation or visual resources, nor would it substantially affect air or water quality or increase noise levels in popular regional recreation lands such as the BWCAW (see FEIS Section 5.2.12).	SO 04
17949	The SDEIS also speculates that the tribes will benefit economically from the Project through additional visitation to Band-operated Casinos, but provides no data to back up the statement: "Increased employment and income associated with the NorthMet Project Proposed Action could increase visitation and revenues at [area tribal gaming] facilities." This statement is entirely unsupported by any market analysis and must be deleted from the socioeconomic assessment of the Project.	No change made.	EDIT 01

Comment ID	Comment	Response	Theme(s)
Comments from the Fond du Lac Band (Submission ID 42920)			
2768	The land Exchange Proposed Action, as described in the SDEIS, serves to confirm our concerns for permanent, unmitigated impacts to treaty resources in the 1854 Ceded Territory. The Band submitted comments on the Feasibility Analysis… including: A full consideration of the fair market value and future use of the federal land in the proposed PolyMet land Exchange would recognize a private windfall instead of an equal exchange, in violation of federal statutes, rules and policies. …The Band is also concerned that most of the non-federal land proposed in the PolyMet land Exchange has a divided mineral estate. Divided ownership raises uncertainties about future benefits that that the non-federal surface could afford to the public, further diminishing the value of the non-federal lands, and is not consistent with Forest Service Conveyance policy (36 CFR 254.15)…..Further, any proposed federal land exchange that is not consistent with forest resource management plans must be rejected under 36 CFR. 254.3….The Band expects that the U.S. Forest Service, in facilitating the PolyMet land Exchange, would coordinate with the policies expressed in our plans to protect natural resources on the Reservation and in the Ceded Territories. … The Band is extremely concerned about the loss of high quality, even exceptional, wetlands within the federal estate, without sufficient information to understand whether the proposed non-federal parcels provide equivalent functions and values. Access to treaty-protected resources is of prime importance to Band members. Loss of access to or use of public lands within the Ceded Territory can significantly impact exercise of treaty rights, and this issue should be thoroughly evaluated in the SDEIS process.	The Agency's obligation is to ensure that Band members have ample opportunity to exercise their treaty-reserved usufructuary rights; that federal lands are managed to maintain both the diversity and abundance of natural resources; and to ensure that the Bands' usufructuary rights to treaty resources are not impaired. The Land Exchange Proposed Action was analyzed to understand the potential effects on usufructuary rights. The Co-lead Agencies have consulted, and continue to consult with the Bois Forte Band of Chippewa, the Grand Portage Band of Lake Superior Chippewa, and the Fond du Lac Band of Lake Superior Chippewa, the three principle Bands that retain usufructuary rights in the proposed project area. In addition, the Co-lead Agencies have consulted with the Great Lakes Indian Fish and Wildlife Commission and the 1854 Treaty Authority, the principal natural resource agencies representing the aforementioned Bands. Through consultation, the Co-lead Agencies understand that the Bands' principle interest with regards to the Land Exchange Proposed Action are the following: to retain or increase the amount of public land within the 1854 Treaty Ceded Territory, shoreline wetlands, culturally important natural resources used in exercising treaty rights of hunting, fishing, and gathering, cultural or religious properties, and access to culturally important natural resources and cultural or religious properties. The Co-lead Agencies have a fiduciary obligation to understand and consider the effects that the Land Exchange Proposed Action would have on Band members exercising their Treaty rights in the 1854 ceded territory. While the Land Exchange Proposed Action would remove certain lands from federal ownership, this loss is potentially offset by incoming private lands that would become part of the federal estate within the 1854 Ceded Territory. Outside of the Land Exchange Proposed Action, the Co-lead Agencies have also analyzed the potential effects posed by the Proposed Connected Actions. The potential affects posed to natural resources and cultural resources of importance to the Bands have been disclosed and would be considered during the Co-lead Agency decision process. Land exchanges do not include mitigation; instead, the resource values and public objectives of the non-federal lands must equal or exceed the resource values and public objectives of the federal lands. See FEIS Section 1.4.3. Mitigation for cultural resources as a result of the NorthMet Project Proposed Action is discussed in Section 5.2.9 of the FEIS. The NorthMet Project Proposed Action mining activities would result in a loss of bogs;	LAN 03 LAN 04 LAN 05 WET 14

Comment ID	Comment	Response	Theme(s)
		however, as part of the NorthMet Proposed Action, the Applicant is required to provide compensatory mitigation for wetland impacts in accordance with state and federal permits. One of the proposed mitigation sites for wetland impacts (Zim Site) would be a compensation site for the loss of bogs, and would be located within the 1854 Ceded Territory. The Lake County lands were tax forfeit lands that were offered for sale by the County through a public auction. The Lake County lands would still be accessible to the Bands for their use if the exchange took place, because the lands would become part of the SNF managed lands. No heritage surveys were conducted on the non-federal lands. If any cultural resources are located on the non-federal lands, those cultural resources would be transferred to federal ownership. Such transfer would not adversely affect the heritage resource, but would provide greater preservation protection under federal law. The non-federal lands that contain wild rice beds would not be effected as a result of the Land Exchange Proposed Action or Land Exchange Alternative B, because no activities are proposed on these lands and the proposed mining activities would not affect these lands. As noted in the FEIS, the Land Exchange Proposed Action and Land Exchange Alternative B would increase wild rice stands within the federal estate. FEIS Sections 5.3.2 and 5.3.4 clarify that, although the Land Exchange would result in an increase in wild rice stands within the federal estate boundaries, there would be no change to the existing public access to Tract 1 wild rice stands via the Pike River. Consequently, there would be no increase in wild rice harvest opportunities for the public. No wild rice stands are known to occur on the federal lands, and suitable habitat is limited. Please refer to the response to theme LAN 01 for more information on the public interest determination.	
2782	Wetlands also function as thermal refuge for moose when summertime temperatures exceed 14oC, the point at which moose become thermally stressed, and wetlands provide an important forage resource for moose during the open water season.	FEIS Sections 4.2.5, 4.3.5, 5.2.5, and 5.3.5 (Wildlife) have been updated to include the new state endangered, threatened, and special concern (ETSC) status listings from August 19, 2013, as well as new federal status listing changes. The FEIS includes a more robust analysis on effects to moose, including habitat and displacement. The FEIS Section 4.2.5.1.1 discusses the role of wetlands with moose and thermal stress.	WI 01 WI 02
2788	In the co-lead agency evaluation of the underground mining alternative, the North Met Deposit is described as a "low- to medium-grade	Information obtained through preliminary exploration in the region has indicated the area potentially contains one of the largest untapped deposits of copper, nickel, and other precious metals. The NorthMet Deposit is	PD 25

Comment ID	Comment	Response	Theme(s)
	mineral resource" which is somewhat at odds with its description as "one of the largest untapped deposits of copper and nickel, and other precious metals" or "world class resource" as it is represented throughout the SDEIS and in continual media coverage. From the SDEIS, we are not able to determine whether mining this mineral deposit in accordance with environmental standards will be profitable enough to provide adequate environmental protections and financial assurance.	characterized as a low- to medium-grade mineral resource. These two characterizations are not in conflict as the commenter seems to suggest. One is a regional characterization while the other applies to the NorthMet Deposit proposed by PolyMet to be mined. See the response to theme ALT 01 for more details on the Underground Mining Alternative. FEIS Section 3.2.3.4.1 states that tonnage/volume and grade of rock would not generate enough revenue to pay for costs associated with underground mining. The FEIS Executive Summary and FEIS Section 3.2.2.1.2 states that the NorthMet Deposit is a low- to medium-grade deposit, matching the language in Appendix B. FEIS Section 3.2.2.4 includes available details regarding financial assurance. Additional details on the cost estimates and calculations that would be required for the project would be addressed during permitting. Specific infrastructure timelines and life expectancies of equipment would be accounted for during permitting as well. FEIS Table 3.2-15 provides financial assurance cost estimates for various years of closure, as well as for monitoring and mitigation costs. FEIS Section 3.2.2.4.1 discusses the activities that would be considered in cost estimates, and states that cost estimates would be updated annually under the Permit to Mine. *Minnesota Rules* 6132.1200, Subpart 3 states that cost estimates shall be annually adjusted, using current dollar value at the time of the estimate.	
2799	while the co-lead agencies stipulate in the SDEIS that PolyMet will bear liability through financial assurance[legacy contamination at LTV], it is troubling to see that apparently, they will not be required to complete remedial activities until closure, many decades from now	FEIS Section 4.2.1.4.2 discusses Legacy Contamination, and states that PolyMet would address AOCs "on a schedule to be approved by the MPCA", some of which would likely occur prior to closure. In addition, FEIS Section 4.2.1.4.2 states that, "all historic and any potentially operational AOCs not already addressed by the start of mine closure would be investigated and remediated as necessary."	LU 02
2845	The mass balance does not take into account seepage from the saturated overburden at the OSLA, or the load of mercury from Colby Lake stream augmentation. Given the known concentrations of mercury in Colby Lake, which consistently exceed the GLI standard, this mitigation measure is clearly not permittable as a discharge that would contribute to an existing water quality exceedance.	Any mercury released from the peat decomposition process is thought to occur relatively rapidly. The mercury released from organic matter decomposition and in solution would have the potential to move with precipitation that falls on the Overburden Storage and Laydown Area. The Overburden Storage and Laydown Area would be unlined; therefore, there would be some potential for seepage to enter the groundwater system from peat that has decomposed and releases as a pulse of mercury. Water contacting the Overburden Storage and Laydown Area is considered to be process water and would be routed to Pond PW-OSLA. In years 1 to 11, the water from Pond PW-OSLA would be routed to the Tailings Basin,	MERC 20

Comment ID	Comment	Response	Theme(s)
		and any mercury in the routed water would have the chance to be sequestered in the tailings. In years 12 to 20, some of the water from Pond PW-OSLA would be used to backfill the East Pit. Any mercury in the water routed to the East Pit would mix with waste rock and become sequestered at depth in the East Pit. In addition, any contributions of water in years 21 to 65 from the East Pit to the West Pit would reflect water from the East Pit and its associated watershed runoff, and would not reflect process water from Pond PW-OSLA. Because peat removal from the areas to be mined would be completed between years 5 and 11, any potential release of mercury from stored peat materials would have occurred, or be ending, by the time water is routed from Pond PW-OSLA to the East Pit beginning in year 12. All water that is discharged would meet the GLI mercury standard of 1.3 ng/L. Colby Lake water would not be directly discharged to tributaries north or south of the Tailings Basin under the NorthMet Project Proposed Action, as described in the FEIS. The NorthMet Project Proposed Action would include treatment of all water discharged at the Plant Site, including water used for flow augmentation. Additional information has been included in FEIS Section 5.2.2. The FEIS recommends that tributaries that extend from the Tailings Basin be monitored. In the event that the monitoring identifies the potential for any water quality standard exceedances, the Proposer would be obligated to take action to ensure compliance. Potential mitigation measures are included in FEIS Section 5.2.2.3.5.	
2856	Hunting pressure has been ruled out as a major contributing factor to population-level declines, but the appearance of holding a hunt does not sit well with the public, so the DNR, 1854 Treaty Authority and Fond du Lac all closed the 2013 moose season.	FEIS Sections 4.2.5, 4.3.5, 5.2.5, and 5.3.5 (Wildlife) have been updated to include the new state endangered, threatened, and special concern (ETSC) status listings from August 19, 2013, as well as new federal status listing changes. The FEIS includes a more robust analysis on effects to moose, including habitat and displacement.	WI 01
2860	The Band's consistently expressed concerns for potential air quality impacts from the Proposed Project (a new source of mercury, visibility in a Class 1 airshed, fugitive dust impacts to terrestrial and aquatic resources, asbestos-like mineral fibers) from the Proposed Project remain largely unaddressed in the SDEIS.	Air quality impacts from the NorthMet Project are addressed in FEIS Section 5.2.7.	AIR 08
2878	The Plant Site multi-pathway cancer risk for a	The calculations for cancer risk are based on an increased risk of	HU 02

Comment ID	Comment	Response	Theme(s)
	farmer was found to be equal to the MDH additional lifetime cancer risk guidance level of 1E-05. Although this level is considered "guidance" and not a regulatory action level, the Band believes this value clearly indicates the potential for adverse health effects. The same result was found for the off-site worker inhalation additional lifetime cancer risk. The major drivers for these endpoints were cobalt, nickel, and dioxins (farmers only). Exposure to nickel has been linked with increased risk of lung cancer, cardiovascular disease, neurological and developmental deficits, and high blood pressure.	contracting cancer using very conservative assumptions. The increased risk of contracting cancer due to the Project's emissions is extremely small. The AERA contains toxicological information for arsenic, diesel, nickel, manganese, mercury, and methylmercury (plus additional chemicals), as well as an analysis of the potential health effects of those chemicals. The toxicological information was included in the AERA summary in FEIS Section 7.3.4.. Section 5.2.7.5 also includes a discussion of health risks from airborne fibers, as well as dust suppression measures that would be used to minimize fiber generation.	HU 05 HU 07
2879	As shown in SDEIS Table 6.2-22, cumulative inhalation risks for non-cancer chronic and non-cancer acute effects from both the facility and existing sources are equal to the incremental acute risk guideline value of 1. This shows that the predicted impacts of NorthMet, when added to the toxic releases already prevalent in the area, have reached the level where health authorities begin to be concerned about cancer risks.	The cumulative inhalation risk estimate is a combination of modeled facility air emissions and background air concentrations measured at locations reflective of the proposed facility surroundings. These two pieces of information are based on several tiers of health protective (conservative) assumptions. Since there are no state or federal cumulative risk guidelines, the cumulative inhalation risk results are compared to facility risk guidelines for context and information. The cumulative respiratory acute non-cancer and chronic non-cancer risks were equal to facility risk guidelines. The cumulative inhalation cancer risk estimate is above facility risk guidelines (1 additional case of cancer in a population of 100,000 people), but lies within EPA's excess cancer risk goal range of 0.1 in 100,000 and 10 in 100,000. This excess cancer risk range is generally considered to be acceptable by EPA according to the 1999 Residual Risk Report to Congress (http://www.epa.gov/ttn/oarpg/t3/reports/risk_rep.pdf). For further discussions, see FEIS Sections 6.2.3.8.11, and the responses to themes HU02, HU06.	HU 05
2897	Cumulative effects result in a relentless, unmitigated diminishment of treaty resources and access to those resources. Yet across virtually all resource categories, the SDEIS predicts that there	The Co-lead Agencies considered the information included in the Tribal Cooperating Agencies' cumulative effects assessment and found no compelling information or analysis to change the original approach or conclusions.	CU 11 CU 12

Comment ID	Comment	Response	Theme(s)
	will be no adverse impacts….; this conclusion then enables the co-leads to determine 'no cumulative effects' from the project and the land exchange. ….over the course of the DEIS and SDEIS processes that support our misgivings for this circular logic. We presented a substantial alternative analysis of cumulative effects from the NorthMet Project Proposed Action as part of our commenting during the preliminary SDEIS review.		
2905	The Band's comments on the 2009 DEIS related to impacts to the 1854 Ceded Territory stand.	The Cultural Resources sections of FEIS Chapters 4 and 5 address the federal Co-lead Agencies' federal tribal trust responsibilities under the 1854 Treaty. These sections, along with other relevant natural resources sections of FEIS Chapters 4, 5, and 6 also address effects on, and any proposed mitigation for effects on cultural resources and culturally significant natural resources. Mitigation/compensation for effects on cultural resources and culturally significant natural resources is considered to the extent possible within the parameters of the statutes and regulations providing the federal authorities for the review of the NorthMet Project Proposed Action.	NEPA 12
2906	The Band's comments on the 2009 DEIS related to environmental justice impacts still stand.	FEIS Sections 5.2.10.2.7 and 5.3.10.2.1 discuss Environmental Justice effects. See also the response to theme NEPA 12.	SO 09 NEPA 12
2907	The Band's comments on the 2009 DEIS related to climate change impacts still stand.	Comments provided on the DEIS were considered for the SDEIS and therefore, in turn, the FEIS. Climate change is addressed in accordance with the requirements of NEPA and MEPA. Please refer to SDEIS comment themes AIR 01, AQ 16, COE 03, PD 22, VEG 03, WET 07, WET 13, WI 02, WI 03, WI 08, and WR 180, and DEIS comment themes AQ 03, and WR2B.	NEPA 12
2909	The Band also shares concerns communicated by the Bois Forte Tribal Historic Preservation Officer: Mesabe Widjiu is correctly identified as a sacred landform, but needs to be considered in its entirety (see attached map as an example). The segment encountered within the project area is small, but integral to the property. Adverse affects to any portion impact the entire feature.	The federal Co-lead Agencies have determined the Partridge River section of the Mesabe Widjiu to be eligible for inclusion in the NRHP under Criterion A for its association with important Ojibwe spiritual and cultural practices. Although the federal Co-lead Agencies are assessing the effects of the NorthMet Project Proposed Action on only the portion of the Mesabe Widjiu within the APE, it is recognized that the property and its significance extends beyond the APE. The federal Co-lead Agencies have updated the FEIS to include a graphic of the entire Mesabe Widjiu, as provided by the consulting Bands.	CR 02 CR 05

Comment ID	Comment	Response	Theme(s)
3102	Multiple mine plan alternatives exist that could provide mitigation for or prevent long-term environmental damage... • paste or dry tailings disposal to reduce the project footprint and use less water (decrease risk of surface and groundwater pollution); • perpetual pumping of the west pit to prevent a pit lake from forming (protect surface and groundwater); • back-filling all waste rock into the east, central and west mine pits (reduce the mine foot print at closure, reduce contaminant runoff to surface and groundwater, reduce volume of water requiring perpetual treatment, restore mine site wetlands); • provide reverse osmosis treatment at the mine site immediately rather than waiting until year 40 (augment water loss in adjacent high quality wetlands in the Partridge River watershed), and; • underground mining (multiple environmental benefits).	The Underground Mine alternative was first considered but eliminated during the Final Scoping Decision Document (FSDD) process. The FEIS Section 3.2.3.4.1 describes how it was re-considered during the DEIS process as alternative E7 in response to Cooperating Agency and stakeholder comments, but eliminated from further consideration. The economic feasibility of the Underground Mine alternative was re-considered during development of the SDEIS. In response to a request from the Co-lead Agencies, PolyMet's consultants prepared an updated economic assessment of underground mining, which the Co-lead Agencies independently evaluated (see FEIS Appendix B). The Co-lead Agencies concluded that an underground mine would not be economically feasible, regardless of the tonnage extracted. In addition, the lower rate of ore production would not meet the Purpose and Need of the project. Although the Underground Mine alternative would offer environmental benefits over the NorthMet Project Proposed Action, it would result in reduced socioeconomic benefits. A position paper (FEIS Appendix B) was prepared to document the Co-lead Agencies' rationale for eliminating the Underground Mine alternative from further consideration. The West Pit Backfill alternative (E20) was considered but eliminated during the development of the DEIS. It was eliminated from further consideration because it was determined that it would not offer significant environmental or socioeconomic benefits compared to the NorthMet Project Proposed Action and because backfilling the West Pit would prevent recovery of additional mineral resources. These factors are sufficient to qualify the West Pit Backfill alternative as unreasonable under NEPA, and justify its exclusion under *Minnesota Rules* 4410.2300, Subpart G. It was re-considered in the SDEIS in response to DEIS comments from the Cooperating Agencies. A Co-lead Agencies memorandum (MDNR et al. 2013b) was prepared to summarize the decision-making process, which is referenced in FEIS Section 3.2.3.4.2. The Co-lead Agencies screened the alternative against criteria used for other alternatives, including Purpose and Need, Technical and Economic Feasibility, Availability, and Environmental or Socioeconomic Benefit. The opportunity to reclaim wetlands and vegetation at the Category 1 Waste Rock Stockpile footprint area would be a measurable environmental benefit offered by backfilling the Category 1 Stockpile into the West Pit. However, some degree of these vegetation and wetland impacts would occur and would require mitigation regardless of future backfilling or not because of the need to "temporarily" store these materials until mining operations cease.	ALT 01 ALT 03 ALT 04 ALT 06

Comment ID	Comment	Response	Theme(s)
		An interagency memorandum was prepared regarding the West Pit Water Elevation Alternative (MDNR et al. 2014, as cited in the FEIS). This alternative includes both the option to maintain a dry West Pit through perpetual pumping and maintaining pit water levels below the elevation of the Partridge River. The alternative was screened against criteria used for other alternatives, including Purpose and Need, Technical and Economic Feasibility, Availability, and Environmental or Socioeconomic Benefit. The screening level assessment concluded that the alternative would meet all criteria except for the environmental or socioeconomic benefit criterion. Continuous dewatering of the West Pit would keep the pit walls exposed instead of covered by a pit lake as in the NorthMet Project Proposed Action. This exposure would potentially result in increased solute loading to a smaller pit lake volume, and thus higher concentrations of pollutants than under the NorthMet Project Proposed Action. Consequently, treatment would be required for a longer period of time. The Co-lead Agencies recommend that the Alternative be considered as an adaptive mitigation measure in the event that monitoring during operations and reclamation indicate that implementing this action is better able to meet future environmental objectives compared to the NorthMet Project Proposed Action.	
3105	The Fond du Lac Band of Lake Superior Chippewa conducted meetings in February 2011 to discuss past and current traditional uses by the Band of the area in the NorthMet project. It was expected from the beginning that the distance between the NorthMet area and the Fond du Lac Reservation would reduce the chances of documenting specific use of the area by Fond du Lac Band members.	The federal Co-lead Agencies have made a reasonable and good-faith effort to identify cultural resources potentially affected by the NorthMet Project Proposed Action, and to determine which resources qualify for inclusion in the NRHP as historic properties. Impacts to historic properties have been appropriately assessed, and the federal Co-lead Agencies are actively consulting with the federally recognized Bands, the Minnesota SHPO, and other consulting parties to develop appropriate mitigation measures. Effects on resources significant to the Bands that do not qualify as historic properties, as well as general effects on natural resources, are considered within the parameters of the statutes that shape this review. Effects on cultural resources and culturally significant natural resources are addressed in the Cultural Resources sections in FEIS Chapters 4, 5, and 6.	CR 01 CR 05 CR 06
19571	The NEPA "hard look" requires agencies to "exercise a degree of skepticism in dealing with self-serving statements from the prime beneficiary of a project" when analyzing alternatives. Contrary to the explicit requirements of the Council on Environmental Quality (CEQ) rules, the SDEIS	The original NorthMet Project proposal and alternatives were developed during project scoping in 2005. The NorthMet Project Proposed Action was refined at various points in response to public and agency input. As a result, the NorthMet Project Proposed Action studied in the SDEIS is not identical to the proposed action in the 2009 DEIS. Because some of the alternatives to the proposed action were eliminated during the scoping and DEIS phases	ALT 14 ALT 21

Comment ID	Comment	Response	Theme(s)
	does not evaluate or examine in any substantive way potentially viable Project alternatives. Even the no action alternative is lacking in detail and analysis. Tribal cooperating agencies identified this deficiency in the DEIS, consistently brought it forward for discussions throughout the SDEIS process, and US EPA cited the lack of alternatives as a factor when issuing an EU-3 rating for the DEIS.	of the project, they were not re-evaluated in the SDEIS. Alternatives were eliminated from detailed evaluation if they did not offer substantial environmental or socioeconomic benefits, were not reasonable (technically or economically feasible), were not available, or would not meet the Purpose and Need. This review—beginning during the scoping process and concluding with the FEIS—is consistent with the alternatives review required by the National Environmental Policy Act (NEPA) and the Minnesota Environmental Policy Act (MEPA), and with the Council on Environmental Quality (CEQ) rules for analyzing alternatives. FEIS Section 3.2.3.2 discusses how the Consent Decree under the NorthMet Project No Action Alternative would require Cliffs Erie to complete closure and reclamation activities at the Plant Site. This would include completing activities for the localized affected areas under the Minnesota Voluntary Investigation and Cleanup (VIC) Program, removal of the former Plant Site building, and management of seepage at the Tailings Basin embankment. The FEIS mentions in Table 3.2-1 that under the NorthMet Project no Action Alternative, there would be no mining activities, and that existing management and land use of the federal lands would continue. The NorthMet Project No Action Alternative is also analyzed under each resource area in FEIS Chapter 5, and summarized in FEIS Table 7.2-1. Several other alternatives for both the NorthMet Mining Project and Land Exchange were screened before the FEIS (see FEIS Section 3.2.3.3). These alternatives were eliminated as they did not offer a substantial environmental or socioeconomic benefit, were not reasonable (economically or technically feasible in accordance with CEQ guidelines), or would not meet the Purpose and Need.	
19573	Although the SDEIS was revised to reflect the Project proponent's preferred action, the only alternative analyzed in any detail concerns simply the acreage of the proposed land exchange. This is not consistent with the CEQ regulations that require federal agencies to identify an agency-preferred alternative in a draft EIS. Yet the SDEIS states "At this time, the Co-lead Agencies have not identified a preferred alternative, and for the USACE, Appendix B of 33 CFR Part 325 supersedes the CEQ requirement to identify an agency-preferred alternative."	Neither Minnesota Rules nor CEQ regulations required the Co-lead Agencies to identify a preferred alternative in the SDEIS (40 CFR 1502.14(e)). The FEIS includes available details regarding the identification of an Agency Preferred Alternative. Additional Land Exchange alternatives were identified, screened, and eliminated during scoping leading up to the SDEIS (see FEIS Sections 3.3.3 and 7.2). FEIS Section 7.4 includes additional information about the Agency Preferred Alternative. The United States Forest Service (USFS) must identify a preferred alternative for the Land Exchange in the FEIS. The Minnesota Department of Natural Resources (MDNR) is not required to identify a preferred alternative under MEPA. FEIS Sections 3.2 and 3.3 further detail this process.	ALT 21 ALT 23

Comment ID	Comment	Response	Theme(s)
19575	There is no evaluation or identification in the SDEIS of the 'least environmentally damaging practicable alternative' ("LEDPA") as required before approving a CWA §404 wetlands permit.	The LEDPA process is described in FEIS Section 7.5. The ROD for the USACE would include the Section 404(b)(1) analysis and the public interest review, and would determine the LEDPA. Furthermore, the ROD for the USACE cannot be finalized until 30 days after release of an FEIS. Any comments received during the 30 day period may be considered in the ROD for the USACE. The ROD for the USACE would recommend issuance, issuance with conditions, or denial of the Project.	COE 04
19577	A fundamental operational component of the Proponent's preferred alternative analysis described in the SDEIS is to deposit their reactive slurry tailings on top of existing taconite tailings in an unlined basin that is currently required, under a Consent Decree, to remediate seepage that has already polluted the nearby ground and surface waters. The SDEIS analysis is assumes a tailings basin seepage capture rate of 95% – a performance efficiency that has not been demonstrated anywhere in the US, nor is it feasible since the tailings basin was constructed (per standard Minnesota ferrous mining practices) without a liner. There is an existing seepage capture system installed at SD026 as a requirement of the Consent Decree, yet it has proven to be so ineffective that Cliffs Erie LLC (the responsible party) has proposed building an additional dam and capture system further downstream.	The Co-lead Agencies acknowledge that there are existing water containment systems at other mine sites that do not operate with a high degree of capture, but these are different designs and cannot be compared to the system proposed for the NorthMet Project Proposed Action. The proposed containment system uses pumping on the tailings side and discharge on the opposite side to reverse hydraulic gradients across the slurry wall and in underlying bedrock. Relatively few containment systems have been built with this degree of pumping and discharge to ensure effective containment. The conceptual hydraulics of this type of system provides evidence that it would achieve complete or nearly complete capture. The FEIS describes a 2014 field program that investigated bedrock along the alignment of the proposed containment system on the northern, northwestern, and western sides of the Tailings Basin in Section 4.2.2.3.1. This investigation provided field data on bedrock hydraulic conductivity, Rock Quality Designation, and depth to top of bedrock. This information was used to develop revised MODFLOW cross-section models to evaluate containment system efficiencies on the northern, northwestern, and western sides of the Tailings Basin, which are documented in the Plant Site Water Management Plan (PolyMet 2015i, as cited in the FEIS). These new models considered the presence of an upper more-permeable bedrock zone directly below the slurry wall, with hydraulic properties based on 2014 packer tests conducted in five boreholes along the proposed containment system alignment. Sensitivity analyses included variable bedrock hydraulic conductivity and different upper bedrock zone thicknesses up to 100 feet. The model results predict that the overall capture efficiencies of the proposed Tailings Basin containment systems would be substantially greater than 90%. The assumption in the Plant Site GoldSim model of 90% or greater capture efficiency is justified by the analyses performed.	GT 02 PD 12 WR 020 WR 117

Comment ID	Comment	Response	Theme(s)
19578	Dewatered or paste tailings placed on a liner and covered could substantially minimize the mass and concentration of pollutants reaching the Embarrass River watershed wetlands and the Embarrass River. This is a modern mine waste management technique used by many mines in the US and around the world, yet it has never been evaluated as an alternative for this project. "Converting to paste tailings technology from conventional slurry tailings at most mines makes sense, both environmentally and economically. Paste tailings use less water, require less land, do not require engineered containment dams, generate less acid and contaminants, reduce long-term costs and allow for early reclamation. Slurry tailings use and discharge large volumes of water, require dust control measures, require large land areas and containment dams for disposal, and create contaminated water that must be captured and treated."	A thickened tailings (paste tailings) alternative (A1) was considered but eliminated in the DEIS and post-DEIS as it was determined not to offer significant environmental benefits over the NorthMet Project Proposed Action. A co-disposal of waste rock and tailings on a lined tailings basin alternative (E14) was considered but eliminated in the DEIS because the technical feasibility and cost of doing so were uncertain. Several different tailings basin alternatives (TB2-TB6) were re-considered but eliminated since the DEIS. These Tailings Basin alternatives did not afford meaningful environmental benefits compared to the enhanced engineering controls (seepage collection and reverse osmosis [RO] mechanical water treatment) built into the NorthMet Project Proposed Action. Dry cap seepage was predicted to result in substantially higher concentrations, under the current modeling approach, which would make the future transition from mechanical to non-mechanical water treatment more difficult during post-closure.	ALT 10 ALT 16
19580	The State of New Mexico, Office of Natural Resource Trustee, requires perpetual pumping of the mine pits to prevent formation of a pit lake at the Chino and Tyrone copper mines, specifically for the protection of groundwater. The experience of numerous western mines discharging plumes of polluted water into the bedrock aquifer from leaking mine pits, tailings basins and waste rock piles, highlights a predictable problem that is not only difficult but expensive to fix. By requiring perpetual pumping [alternative not considered in the SDEIS] of the mine pit, the regulatory agencies would minimize leakage of contaminated water into the surrounding bedrock aquifer, and thereby protect groundwater that the State of Minnesota is required to protect as source of drinking water.	An interagency memorandum was prepared regarding the West Pit Water Elevation Alternative (MDNR et al. 2014). This alternative includes both the option to maintain a dry West Pit through perpetual pumping and maintaining pit water levels below the elevation of the Partridge River. The alternative was screened against criteria used for other alternatives, including Purpose and Need, Technical and Economic Feasibility, Availability, and Environmental or Socioeconomic Benefit. The screening level assessment concluded that the alternative would meet all criteria except for the environmental or socioeconomic benefit criterion. Continuous dewatering of the West Pit would keep the pit walls exposed instead of covered by a pit lake as in the NorthMet Project Proposed Action. This exposure would potentially result in increased solute loading to a smaller pit lake volume, and thus higher concentrations of pollutants than under the NorthMet Project Proposed Action. Consequently, treatment would be required for a longer period of time. The Co-lead Agencies recommend that the Alternative be considered as an adaptive mitigation measure in the event that monitoring during operations and reclamation indicate that implementing this action is better able to meet future environmental objectives compared to the NorthMet Project Proposed	ALT 04

Comment ID	Comment	Response	Theme(s)
		Action.	
19581	In the 2009 DEIS, the co-lead agencies maintained that all waste rock should be considered reactive. SDEIS Table 3.2-8, Waste Rock Characterization Properties , acknowledges that the Category 1 waste rock (rock that is <0.12% sulfur), which constitutes 70% of the volume of waste rock, has a "low potential to generate acid, but may leach metals." Back-filling all of the mine pits with all of the waste rock would reduce the final surface footprint of the mine at closure, and make possible 526 acres of wetland restoration where the Category 1 stockpile is now proposed to be stored in perpetuity. This alternative would prevent the need for a permanent separate seepage capture system around an unlined waste rock pile, as proposed in the preferred alternative, which would have to perform at an above-optimum capture rate in perpetuity to comply with Minnesota Water Quality Standards ("MN WQS"). Capping and re-vegetating the mine pits after backfilling with waste rock would prevent deep infiltration of precipitation and reduce mobilization of toxic metals.	FEIS Section 3.2.2.1.10 states that waste rock would be backfilled into the East Pit starting at year 11 and in the combined East Central Pit starting in year 16. After backfilling is complete, a wetland would be constructed over the combined East Central Pit. The West Pit Backfill alternative (E20) was considered but eliminated during the development of the DEIS. It was eliminated from further consideration because it was determined that it would not offer significant environmental or socioeconomic benefits compared to the NorthMet Project Proposed Action and because backfilling the West Pit would prevent recovery of additional mineral resources. These factors are sufficient to qualify the West Pit Backfill alternative as unreasonable under NEPA and justify its exclusion under *Minnesota Rules* 4410.2300, Subpart G. It was reconsidered in the SDEIS in response to comments from the Cooperating Agencies. A Co-lead Agency memorandum (MDNR et al. 2013b, as cited in the FEIS) was prepared to summarize the decision-making process, which is referenced in FEIS Section 3.2.3.4.2. The Co-lead Agencies screened the alternative against criteria used for other alternatives, including Purpose and Need, Technical and Economic Feasibility, Availability, and Environmental or Socioeconomic Benefit. The opportunity to reclaim wetlands and vegetation at the Category 1 Waste Rock Stockpile footprint area would be the only measurable environmental benefit offered by backfilling the Category 1 Stockpile into the West Pit. However, because of the temporal impact that the stockpile would have, these impacts would be required to be mitigated regardless of future backfilling or not.	ALT 06
19582	The SDEIS inexplicably removes the stockpile liner described in the 2009 DEIS for Category 1/2 waste rock in the current project proposed action. From Table 3.2-16 Comparison of DEIS and SDEIS NorthMet Project Proposed Action: DEIS: Category 1 and 2 waste rock would be stored in a permanent lined/covered stockpile (Category 1/2 Stockpile) north of the west pit (years 1-11) SDEIS: Category 1 waste rock mined from years 1-13 would be stored in an unlined, permanent stockpile north of the West Pit. The stockpile	The Final Scoping Decision Document (FSDD) examined several modified design alternatives, as well as multiple mitigation and monitoring measures. The 2009 DEIS also discussed a liner system as part of its consideration of a modified design or layout at the Mine Site. Key aspects of this alternative from the 2009 DEIS were incorporated into the NorthMet Project Proposed Action and studied in the SDEIS. As proposed in the FEIS, liners would be installed for stockpiles or areas where there is a potential to generate acid and metal leachate from potentially reactive waste. Temporary stockpiles (Category 2/3 and Category 4) and the Ore Surge Pile would contain a liner. The Category 1 Stockpile would have a containment system to collect seepage, which would be pumped to the Waste Water Treatment Facility (WWTF). The Overburden Storage and Laydown Area would hold peat soils and	ALT 07 ALT 13

Comment ID	Comment	Response	Theme(s)
	would have a geomembrane cover system at completion and surface water and groundwater collection system would encompass the entire stockpile and direct water to the Mine Site WWTF. If not backfilled, the Category 1 waste rock stockpile must be lined.	unsaturated overburden, which are not considered to be reactive.	
19583	However, combining the two alternatives of perpetual pumping and backfilling the Category 1 waste rock pile would substantially reduce the risk of polluting groundwater and wetlands in the Partridge River watershed.	The two alternatives are contradictory together, as backfilling of the Category 1 waste rock into the West Pit would eliminate the opportunity to perpetually pump the West Pit lake. The West Pit Backfill alternative (E20) was considered but eliminated during the development of the DEIS. It was eliminated from further consideration because it was determined that it would not offer significant environmental or socioeconomic benefits compared to the NorthMet Project Proposed Action and because backfilling the West Pit would prevent recovery of additional mineral resources. These factors are sufficient to qualify the West Pit Backfill alternative as unreasonable under NEPA and justify its exclusion under *Minnesota Rules* 4410.2300, Subpart G. It was reconsidered in the SDEIS in response to comments from the Cooperating Agencies. A Co-lead Agency memorandum (MDNR et al. 2013b, as cited in the FEIS) was prepared to summarize the decision-making process, which is referenced in the FEIS Section 3.2.3.4.2. The Co-lead Agencies screened the alternative against criteria used for other alternatives, including Purpose and Need, Technical and Economic Feasibility, Availability, and Environmental or Socioeconomic Benefit. The opportunity to reclaim wetlands and vegetation at the Category 1 Waste Rock Stockpile footprint area would be the only measurable environmental benefit offered by backfilling the Category 1 Stockpile into the West Pit. However, because of the temporal impact that the stockpile would have, these impacts would be required to be mitigated regardless of future backfilling or not. An interagency memorandum was prepared regarding the West Pit Water Elevation Alternative (MDNR et al. 2014, as cited in the FEIS). This alternative includes both the option to maintain a dry West Pit through perpetual pumping and maintaining pit water levels below the elevation of the Partridge River. The alternative was screened against criteria used for other alternatives, including Purpose and Need, Technical and Economic	ALT 04 ALT 06

Comment ID	Comment	Response	Theme(s)
		Feasibility, Availability, and Environmental or Socioeconomic Benefit. The screening level assessment concluded that the alternative would meet all criteria except for the environmental or socioeconomic benefit criterion. Continuous dewatering of the West Pit would keep the pit walls exposed instead of covered by a pit lake as in the NorthMet Project Proposed Action. This exposure would potentially result in increased solute loading to a smaller pit lake volume, and thus higher concentrations of pollutants than under the NorthMet Project Proposed Action. Consequently, treatment would be required for a longer period of time. The Co-lead Agencies recommend that the Alternative be considered as an adaptive mitigation measure in the event that monitoring during operations and reclamation indicate that implementing this action is better able to meet future environmental objectives compared to the NorthMet Project Proposed Action.	
19584	The Minnesota Department of Natural Resources (DNR) and US Army Corps of Engineers (USACE) superficially evaluated and subsequently dismissed underground mining as an alternative to the proposed open pit Project for the 2009 DEIS. The co-lead agencies eliminated this alternative from further evaluation because it would have had "a significantly reduced rate of operation that would not be considered economically feasible, and, therefore, would not meet the Purpose and Need of the Project." Tribal cooperating agencies urged the co-lead agencies, now including the US Forest Service (USFS), to do a more robust analysis of the underground mining alternative for the SDEIS, but the co-lead agencies did not "exercise a degree of skepticism in dealing with self-serving statements from the prime beneficiary of a project" when analyzing this alternative. This alternative was eliminated by the Project proponent based purely on an economic decision that underground mining would not be as profitable as open pit mining. The co-lead agencies claim that "it was not possible to undertake a quantitative, side-by-side	The Underground Mine alternative was first considered but eliminated during the Final Scoping Decision Document (FSDD) process. The FEIS Section 3.2.3.4.1 describes how it was re-considered during the DEIS process as alternative E7 in response to Cooperating Agency and stakeholder comments, but eliminated from further consideration. The economic feasibility of the Underground Mine alternative was reconsidered during development of the SDEIS. In response to a request from the Co-lead Agencies, PolyMet's consultants prepared an updated economic assessment of underground mining, which the Co-lead Agencies independently evaluated (see FEIS Appendix B). The Co-lead Agencies concluded that an underground mine would not be profitable, regardless of the tonnage extracted. The lower rate of ore production would not meet the Purpose and Need of the project. Though it would offer environmental benefits over the NorthMet Project Proposed Action, it would result in reduced socioeconomic benefits. They accordingly concluded that the Underground Mine alternative was not economically feasible, and would not meet the NorthMet Project's Purpose and Need. A position paper (FEIS Appendix B) was prepared to document the Co-lead Agencies' rationale for eliminating the Underground Mine alternative from further consideration. FEIS Section 5.2.10.1.4 states, "Neither NEPA nor CEQ requires the cost and benefits of a proposed action to be quantified in dollars or any other common metric; however, this EIS acknowledges that economic costs and loss of non-market value may results from environmental and social effects. Also acknowledged is that the agreement on the value (i.e., the "cost") of environmental effects is often difficult to achieve. Therefore, the approach	ALT 01

Comment ID	Comment	Response	Theme(s)
	assessment of the underground mining alternative." An underground mine would have a reduced mining rate and life of mine, employed fewer workers for a shorter period of time, and reduced state and local tax revenues. Although the underground mining alternative would offer substantial environmental benefits (significantly less wetland destruction, less mine-generated waste, less groundwater and surface water pollution generated and requiring treatment and control, less reclamation and closure activities, less nuisance and reactive dust to be controlled, less noise and vibration impacts, less visual impacts), the economic and intrinsic value of those benefits are not even estimated. In addition, an underground mine project would not require a federal land exchange, resulting in lower start-up costs and avoiding the permanent loss of high quality resources (as discussed in later comments on Land Exchange impacts). Based upon an incomplete analysis of the benefits of an underground mine, the co-lead agencies determined that this alternative would result in reduced socioeconomic benefits, and; "PolyMet would not move forward with an unprofitable project, thus any potential environmental or socioeconomic benefits associated with this alternative are moot."	of this EIS is to evaluate environmental and social impacts directly, in the appropriate resource-specific section." CEQ regulations for implementing NEPA (40 CFR 1502.23) state that, "for purposes of complying with the Act, the weighing of the merits and drawbacks of the various alternatives need not be displayed in a monetary cost-benefit analysis and should not be when there are important qualitative considerations."	
19585	The co-lead agencies determined that underground mining was considered technically feasible, but concluded that "PolyMet is a private sector and for-profit company, the value of the saleable material would need to provide sufficient income to cover operating cost (which includes, but is not limited to, the cost of mining, processing, transportation, and waste management), capital cost (to build and sustain facilities), an adequate return to investors, reclamation, and closure costs and taxes. An underground mining project would	The Underground Mine alternative was first considered but eliminated during the Final Scoping Decision Document (FSDD) process. The FEIS Section 3.2.3.4.1 describes how it was re-considered during the DEIS process as alternative E7 in response to Cooperating Agency and stakeholder comments, but eliminated from further consideration. The economic feasibility of the Underground Mine alternative was re-considered during development of the SDEIS. In response to a request from the Co-lead agencies, PolyMet's consultants prepared an updated economic assessment of underground mining, which the Co-lead agencies independently evaluated (see FEIS Appendix B). The Co-lead agencies concluded that an underground mine would not be profitable, regardless of	ALT 01

Comment ID	Comment	Response	Theme(s)
	leave most of the NorthMet Deposit unmined because of its low metal value relative to the cost of mining and mineral processing. Other material would have to be left in place for safety reasons, to prevent collapse." Therefore, "the Co-lead Agencies found that while underground mining is technically feasible, available, and would offer significant environmental benefits over the proposed NorthMet Project, it would not be economically feasible and would not meet the Purpose and Need. Since the underground mining alternative would not meet all of the screening criteria, it is not considered to be a reasonable alternative. Therefore, the underground mining alternative was eliminated from further evaluation in the SDEIS." The SDEIS does not contain the appropriate level of detail required to eliminate this alternative. The conclusion that underground mining is neither viable nor preferable remains substantially unjustified, despite repeated requests by the tribal cooperating agencies for further analysis.	the tonnage extracted. The lower rate of ore production would not meet the purpose and need of the project. Though it would offer environmental benefits over the NorthMet Project Proposed Action, it would result in reduced socioeconomic benefits. They accordingly concluded that the Underground Mine alternative was not economically feasible, and would not meet the NorthMet Project's Purpose and Need. A position paper (FEIS Appendix B) was prepared to document the Co-lead Agencies' rationale for eliminating the Underground Mine alternative from further consideration.	
19587	The Project Proponent, without considering the economics of perpetual treatment, the purchase of thousands of acres of land for the federal land exchange, direct and indirect wetland mitigation costs, etc., concludes in their economic analysis that underground mining is "[n]ot economically viable" while simultaneously claiming that backfilling the west pit would create encumbrances not allowed in their mineral lease due to mineral resources located below the west pit that could only be accessed through underground mining. This is not the appropriate rigor in a cost-benefit analysis for thoroughly evaluating an EIS alternative. The CEQ regulations require that, where a cost-benefit analysis is "relevant to the choice among environmentally different	The Underground Mine alternative was first considered but eliminated during the FSDD process. FEIS Section 3.2.3.4.1 describes how it was reconsidered during the DEIS process as alternative E7 in response to Cooperating Agency and stakeholder comments, but eliminated from further consideration. The economic feasibility of the Underground Mine alternative was reconsidered during development of the SDEIS. In response to a request from the Co-lead Agencies, PolyMet's consultants prepared an updated economic assessment of underground mining, which the Co-lead Agencies independently evaluated (see FEIS Appendix B). The Co-lead Agencies concluded that an underground mine would not be profitable, regardless of the tonnage extracted. The lower rate of ore production would not meet the Purpose and Need of the project. Though it would offer environmental benefits over the NorthMet Project Proposed Action, it would result in reduced socioeconomic benefits. They accordingly concluded that the Underground Mine alternative was not economically feasible, and would not meet the NorthMet Project's Purpose and Need. A	ALT 01 ALT 03

Comment ID	Comment	Response	Theme(s)
	alternatives," there are a variety of additional requirements, including "analysis of un-quantified environmental impacts, values, and amenities," in addition to other CEQ alternatives rules.	position paper (FEIS Appendix B) was prepared to document the Co-lead Agencies' rationale for eliminating the Underground Mine alternative from further consideration. The FEIS Section 5.2.10.1.4 states, "Neither NEPA nor CEQ requires the cost and benefits of a proposed action to be quantified in dollars or any other common metric; however, this EIS acknowledges that economic costs and loss of non-market value may results from environmental and social effects. Also acknowledged is that the agreement on the value (i.e., the "cost") of environmental effects is often difficult to achieve. Therefore, the approach of this EIS is to evaluate environmental and social impacts directly, in the appropriate resource-specific section." CEQ regulations for implementing NEPA (40 CFR 1502.23) state that, "for purposes of complying with the Act, the weighing of the merits and drawbacks of the various alternatives need not be displayed in a monetary cost-benefit analysis and should not be when there are important qualitative considerations."	
19588	As already argued in the Tribal Position, significant additional study of the underground mining alternative is mandated, and the SDEIS offers no new discussion of the reasons for rejecting the alternative. The economic viability of an underground mine depends on a variety of factors including ore grade, market prices, cost of tailings management, and waste rock disposal. A study of this particular deposit was performed by the prior owner of the site, US Steel, which actually recommended underground mining. PolyMet is well aware of this study, given that the company included it in a filing with the Securities and Exchange Commission in 2003. In fact, by examining geologic cross-sections showing the distribution of ore by depth, it appears that there are substantial ore reserves at depths that likely could not be accessed by the proposed open-pit mine.	The Underground Mine alternative was first considered but eliminated during the FSDD process. The FEIS Section 3.2.3.4.1 describes how it was reconsidered during the DEIS process as alternative E7 in response to Cooperating Agency and stakeholder comments, but eliminated from further consideration. The economic feasibility of the Underground Mine alternative was reconsidered during development of the SDEIS. In response to a request from the Co-lead Agencies, PolyMet's consultants prepared an updated economic assessment of underground mining, which the Co-lead Agencies independently evaluated (see FEIS Appendix B). The Co-lead Agencies concluded that an underground mine would not be profitable, regardless of the tonnage extracted. The lower rate of ore production would not meet the Purpose and Need of the project. Though it would offer environmental benefits over the NorthMet Project Proposed Action, it would result in reduced socioeconomic benefits. They accordingly concluded that the Underground Mine alternative was not economically feasible, and would not meet the NorthMet Project's Purpose and Need. A position paper (FEIS Appendix B) was prepared to document the Co-lead Agencies' rationale for eliminating the Underground Mine alternative from further consideration. The FEIS Section 5.2.10.1.4 states, "Neither NEPA nor CEQ requires the cost and benefits of a proposed action to be quantified in dollars or any other common metric; however, this EIS acknowledges that economic costs	ALT 01

Comment ID	Comment	Response	Theme(s)
		and loss of non-market value may results from environmental and social effects. Also acknowledged is that the agreement on the value (i.e., the "cost") of environmental effects is often difficult to achieve. Therefore, the approach of this EIS is to evaluate environmental and social impacts directly, in the appropriate resource-specific section." CEQ regulations for implementing NEPA (40 CFR 1502.23) state that, "for purposes of complying with the Act, the weighing of the merits and drawbacks of the various alternatives need not be displayed in a monetary cost-benefit analysis and should not be when there are important qualitative considerations."	
19589	The environmental costs of open-pit mining and the requisite wetland mitigation and above-ground disposal of tailings and waste rock are immense. These environmental costs, combined with the most current understanding of deposit ore grades, reasonably potential metals prices, and the costs associated with perpetual treatment must all be evaluated to determine the feasibility of this [underground mining] alternative.	The Underground Mine alternative was first considered but eliminated during the Final Scoping Decision Document (FSDD) process. FEIS Section 3.2.3.4.1 describes how it was re-considered during the DEIS process as alternative E7 in response to Cooperating Agency and stakeholder comments, but eliminated from further consideration. The economic feasibility of the Underground Mine alternative was re-considered during development of the SDEIS. In response to a request from the Co-lead Agencies, PolyMet's consultants prepared an updated economic assessment of underground mining, which the Co-lead Agencies independently evaluated (see FEIS Appendix B). The Co-lead Agencies concluded that an underground mine would not be economically feasible, regardless of the tonnage extracted. In addition, the lower rate of ore production would not meet the Purpose and Need of the project. Although the Underground Mine alternative would offer environmental benefits over the NorthMet Project Proposed Action, it would result in reduced socioeconomic benefits. A position paper (FEIS Appendix B) was prepared to document the Co-lead Agencies' rationale for eliminating the Underground Mine alternative from further consideration. FEIS Section 5.2.10.1.4 states, "neither NEPA nor CEQ requires the cost and benefits of a proposed action to be quantified in dollars or any other common metric. However, this EIS acknowledges that economic costs and loss of non-market value may result from environmental and social effects. Also acknowledged is that the agreement on the value (i.e., the "cost") of environmental effects is often difficult to achieve. Therefore, the approach of this EIS is to evaluate environmental and social impacts directly, in the appropriate resource-specific section." The Council on Environmental Quality (CEQ) regulations for implementing the National Environmental Policy Act (NEPA) (40 CFR 1502.23) state that, "for purposes of	ALT 01

Comment ID	Comment	Response	Theme(s)
		complying with the Act, the weighing of the merits and drawbacks of the various alternatives need not be displayed in a monetary cost-benefit analysis and should not be when there are important qualitative considerations.”	
19594	Even the No Action Alternative analysis is deficient: Under the NorthMet Project No Action Alternative, the NorthMet Project Proposed Action would not occur. The consideration of a No Action Alternative is required to be evaluated in the SDEIS in accordance with NEPA and MEPA. If the NorthMet Project Proposed Action is not approved, the Mine Site would be returned to pre-exploration conditions under the requirements of exploration approvals to reclaim surface disturbance associated with exploratory and development drilling activities. Other existing surface uses would be allowed to continue consistent with the Forest Plan. No further upgrades or new segments would be constructed along the existing power transmission line, railroad, or Dunka Road, which would continue to be used by their private owners. At the brownfield Plant Site, Cliffs Erie would continue to complete closure and reclamation activities as specified under state permits and plans and the Cliffs Erie Consent Decree. This would include completing activities for the localized affected areas under the Minnesota Voluntary Investigation and Cleanup (VIC) Program, removal of the former Plant Site building, and management of seepage at the Tailings Basin embankment. This evaluation must also acknowledge that there would be no direct disturbance of over 900 acres	The FEIS discusses in Section 3.2.3.2 how the Consent Decree under the NorthMet Project No Action Alternative would require Cliffs Erie to complete closure and reclamation activities at the Plant Site. This would include completing activities for the localized affected areas under the Minnesota Voluntary Investigation and Cleanup (VIC) Program, removal of the former Plant Site building, and management of seepage at the Tailings Basin embankment. The FEIS identifies in Table 3.2-1 that under the NorthMet Project No Action Alternative, there would be no mining activities, and that existing management and land use of the federal lands would continue. The NorthMet Project No Action Alternative is also analyzed under each resource area in the FEIS Chapter 5, and summarized in the FEIS Table 7.2-1. FEIS Section 5.2.3.4 identifies that under the NorthMet Project No Action Alternative there would be no direct or indirect effects on wetlands.	ALT 14 WR 108

Comment ID	Comment	Response	Theme(s)
	of high quality wetlands, thousands more wetland acres that would not be indirectly affected, no loss of high quality forested uplands, no further diminishment of wildlife habitat, no permanent loss of treaty resources under the land exchange, no cumulative effects to resources and environmental quality. In fact, water quality should improve substantially under the No Action Alternative, as the Cliffs Erie Consent Decree requires that the closed tailings basin ultimately achieves compliance with MN WQS.		
19595	The SDEIS is approach to considering less environmentally degrading alternatives is fundamentally inadequate. CEQ rules require that the EIS "present the environmental impacts of the proposal and the alternatives in comparative form, thus sharply defining the issues and providing a clear basis for choice among options by the decision maker and the public." The SDEIS must be revised to fully evaluate reasonable alternatives in the SDEIS, including identifying the federal agency preferred alternative and the LEDPA.	The original project proposal and alternatives were developed during project scoping in 2005. The NorthMet Project Proposed Action was refined at various points in response to public and agency input. As a result, the NorthMet Project Proposed Action studied in the SDEIS is not identical to the proposed action in the 2009 DEIS. Because some of the alternatives to the proposed action were eliminated during the scoping and DEIS phases of the project, they were not re-evaluated in the SDEIS. Alternatives were eliminated from detailed evaluation if they did not offer substantial environmental or socioeconomic benefits, were not reasonable (technically or economically feasible), were not available, or would not meet the Purpose and Need. This review—beginning during the scoping process and concluding with the FEIS—is consistent with the alternatives review required by NEPA and MEPA, and with the CEQ rules for analyzing alternatives. The FEIS explains in Section 3.2.3 how alternatives were eliminated or incorporated. Minnesota Rules and CEQ rules (40 CFR 1502.14) require that the effects of the NorthMet Project Proposed Action and alternatives must be compared. The FEIS compares the NorthMet Project Proposed Action, NorthMet Project No Action, Land Exchange Proposed Action, Land Exchange Alternative B, and Land Exchange No Action Alternative separately.	ALT 20
19597	The land Exchange Proposed Action, as described in the SDEIS, serves to confirm our concerns for permanent, unmitigated impacts to treaty resources in the 1854 Ceded Territory.	As described in the FEIS, there would not be a net loss to the 1854 Ceded Territory. All of the non-federal lands proposed for exchange are located within the 1854 Ceded Territory. Land exchanges do not include mitigation; instead, the resource values and public objectives of the non-federal lands must equal or exceed the resource values and public objectives of the federal lands. See Section 1.4.3 of the FEIS. Mitigation	LAN 05

Comment ID	Comment	Response	Theme(s)
		for cultural resources as a result of the NorthMet Project Proposed Action is discussed in Section 5.2.9 of the FEIS. The NorthMet Project Proposed Action mining activities would result in a loss of bogs; however, as part of the NorthMet Proposed Action, the Applicant is required to provide compensatory mitigation for wetland impacts in accordance with state and federal permits. One of the proposed mitigation sites (Zim Site) for wetland impacts is proposing to compensate for the loss of bogs and would be located within the 1854 Ceded Territory. The Lake County lands were tax forfeit lands that were offered for sale by the County through a public auction. The Lake County lands would still be accessible to the Bands for their use if the exchange took place because the lands would become part of the SNF managed lands. No heritage surveys were conducted on the non-federal lands. If any cultural resources are located on the non-federal lands, those cultural resources would be transferred to federal ownership. Such transfer would not adversely affect the heritage resource, but would provide greater preservation protection under federal law. The non-federal lands that contain wild rice beds would not be impacted as a result of the Land Exchange Proposed Action as no activities are proposed on these lands and the proposed mining activities would not affect these lands. As noted in the FEIS, the Land Exchange Proposed Action would result in additional wild rice beds to the federal estate. The FEIS, Section 5.3.2, clarifies that the Land Exchange Proposed Action would not result in a loss of wild rice beds, nor would the use of the wild rice beds change for the Bands. Please refer to theme LAN 01 for more information on the public interest determination as part of the USFS process.	
19599	The land Exchange Proposed Action does not meet the need of the Bands in the 1854 Ceded Territory. It results in a permanent loss of 382 acres, does not protect fish and wildlife habitat within the Mine Site, does not protect important cultural resources such as wild rice beds, historic trails, and a substantial portion of the Mesabi Widjiu, does not protect the Embarrass, Partridge or St. Louis River watersheds, does not consolidate mineral interests in the private parcels that would be conveyed to the federal estate, does not promote multiple-use	The Agency's obligation is to ensure that Band members have ample opportunity to exercise their treaty-reserved usufructuary rights; that federal lands are managed to maintain both the diversity and abundance of natural resources; and to ensure that the Bands' usufructuary rights to treaty resources are not impaired. The Land Exchange Proposed Action was analyzed to understand the potential effects on usufructuary rights. The Co-lead Agencies have consulted, and continue to consult with the Bois Forte Band of Chippewa, the Grand Portage Band of Lake Superior Chippewa, and the Fond du Lac Band of Lake Superior Chippewa, the three principle Bands that retain usufructuary rights in the proposed project area. In addition, the Co-lead Agencies have consulted with the Great Lakes Indian	LAN 05

Comment ID	Comment	Response	Theme(s)
	values, or fulfill public needs.	Fish and Wildlife Commission and the 1854 Treaty Authority, the principal natural resource agencies representing the aforementioned Bands. Through consultation, the Co-lead Agencies understand that the Bands' principle interest with regards to the Land Exchange Proposed Action are the following: to retain or increase the amount of public land within the 1854 Treaty Ceded Territory, shoreline wetlands, culturally important natural resources used in exercising treaty rights of hunting, fishing, and gathering, cultural or religious properties, and access to culturally important natural resources and cultural or religious properties. The Co-lead Agencies have a fiduciary obligation to understand and consider the effects that the Land Exchange Proposed Action would have on Band members exercising their Treaty rights in the 1854 ceded territory. While the Land Exchange Proposed Action would remove certain lands from federal ownership, this loss is potentially offset by incoming private lands that would become part of the federal estate within the 1854 Ceded Territory. Outside of the Land Exchange Proposed Action, the Co-lead Agencies have also analyzed the potential effects posed by the Proposed Connected Actions. The potential affects posed to natural resources and cultural resources of importance to the Bands have been disclosed and would be considered during the Co-lead Agency decision process. Land exchanges do not include mitigation; instead, the resource values and public objectives of the non-federal lands must equal or exceed the resource values and public objectives of the federal lands. See FEIS Section 1.4.3. Mitigation for cultural resources as a result of the NorthMet Project Proposed Action is discussed in Section 5.2.9 of the FEIS. The NorthMet Project Proposed Action mining activities would result in a loss of bogs; however, as part of the NorthMet Proposed Action, the Applicant is required to provide compensatory mitigation for wetland impacts in accordance with state and federal permits. One of the proposed mitigation sites for wetland impacts (Zim Site) would be a compensation site for the loss of bogs, and would be located within the 1854 Ceded Territory. The Lake County lands were tax forfeit lands that were offered for sale by the County through a public auction. The Lake County lands would still be accessible to the Bands for their use if the exchange took place, because the lands would become part of the SNF managed lands. No heritage surveys were conducted on the non-federal lands. If any cultural resources are located on the non-federal lands, those cultural resources would be transferred to federal ownership. Such transfer would	

Comment ID	Comment	Response	Theme(s)
		not adversely affect the heritage resource, but would provide greater preservation protection under federal law. The non-federal lands that contain wild rice beds would not be affected as a result of the Land Exchange Proposed Action or Land Exchange Alternative B, because no activities are proposed on these lands and the proposed mining activities would not affect these lands. As noted in the FEIS, the Land Exchange Proposed Action and Land Exchange Alternative B would increase wild rice stands within the federal estate. FEIS Sections 5.3.2 and 5.3.4 clarify that, although the Land Exchange would result in an increase in wild rice stands within the federal estate boundaries, there would be no change to the existing public access to Tract 1 wild rice stands via the Pike River. Consequently, there would be no increase in wild rice harvest opportunities for the public. No wild rice stands are known to occur on the federal lands, and suitable habitat is limited. Please refer to the response to theme LAN 01 for more information on the public interest determination.	
19600	maintaining public land ownership is critical for the exercise of treaty rights. There are 382 acres of Lake County land proposed for the land exchange (Tract 2). This means a net loss, through the exchange, of publicly accessible land for band members exercising their treaty rights.	The Agency's obligation is to ensure that Band members have ample opportunity to exercise their treaty-reserved usufructuary rights; that federal lands are managed to maintain both the diversity and abundance of natural resources; and to ensure that the Bands' usufructuary rights to treaty resources are not impaired. The Land Exchange Proposed Action was analyzed to understand the potential effects on usufructuary rights. The Co-lead Agencies have consulted, and continue to consult with the Bois Forte Band of Chippewa, the Grand Portage Band of Lake Superior Chippewa, and the Fond du Lac Band of Lake Superior Chippewa, the three principle Bands that retain usufructuary rights in the proposed project area. In addition, the Co-lead Agencies have consulted with the Great Lakes Indian Fish and Wildlife Commission and the 1854 Treaty Authority, the principal natural resource agencies representing the aforementioned Bands. Through consultation, the Co-lead Agencies understand that the Bands' principle interest with regards to the Land Exchange Proposed Action are the following: to retain or increase the amount of public land within the 1854 Treaty Ceded Territory, shoreline wetlands, culturally important natural resources used in exercising treaty rights of hunting, fishing, and gathering, cultural or religious properties, and access to culturally important natural resources and cultural or religious properties. The Co-lead Agencies have a fiduciary obligation to understand and consider the effects that the Land Exchange Proposed Action would have on Band members exercising	LAN 05

Comment ID	Comment	Response	Theme(s)
		their Treaty rights in the 1854 ceded territory. While the Land Exchange Proposed Action would remove certain lands from federal ownership, this loss is potentially offset by incoming private lands that would become part of the federal estate within the 1854 Ceded Territory. Outside of the Land Exchange Proposed Action, the Co-lead Agencies have also analyzed the potential effects posed by the Proposed Connected Actions. The potential affects posed to natural resources and cultural resources of importance to the Bands have been disclosed and would be considered during the Co-lead Agency decision process. Land exchanges do not include mitigation; instead, the resource values and public objectives of the non-federal lands must equal or exceed the resource values and public objectives of the federal lands. See FEIS Section 1.4.3. Mitigation for cultural resources as a result of the NorthMet Project Proposed Action is discussed in Section 5.2.9 of the FEIS. The NorthMet Project Proposed Action mining activities would result in a loss of bogs; however, as part of the NorthMet Proposed Action, the Applicant is required to provide compensatory mitigation for wetland impacts in accordance with state and federal permits. One of the proposed mitigation sites for wetland impacts (Zim Site) would be a compensation site for the loss of bogs, and would be located within the 1854 Ceded Territory. The Lake County lands were tax forfeit lands that were offered for sale by the County through a public auction. The Lake County lands would still be accessible to the Bands for their use if the exchange took place, because the lands would become part of the SNF managed lands. No heritage surveys were conducted on the non-federal lands. If any cultural resources are located on the non-federal lands, those cultural resources would be transferred to federal ownership. Such transfer would not adversely affect the heritage resource, but would provide greater preservation protection under federal law. The non-federal lands that contain wild rice beds would not be affected as a result of the Land Exchange Proposed Action or Land Exchange Alternative B, because no activities are proposed on these lands and the proposed mining activities would not affect these lands. As noted in the FEIS, the Land Exchange Proposed Action and Land Exchange Alternative B would increase wild rice stands within the federal estate. FEIS Sections 5.3.2 and 5.3.4 clarify that, although the Land Exchange would result in an increase in wild rice stands within the federal estate boundaries, there would be no change to the existing public access to Tract 1 wild rice stands	

Comment ID	Comment	Response	Theme(s)
		via the Pike River. Consequently, there would be no increase in wild rice harvest opportunities for the public. No wild rice stands are known to occur on the federal lands, and suitable habitat is limited. Please refer to the response to theme LAN 01 for more information on the public interest determination.	
19601	The Forest Service should consider exchange for private lands only in order to maintain - or better yet, increase - the total public land acreage within the 1854 Ceded Territory.	The Agency's obligation is to ensure that Band members have ample opportunity to exercise their treaty-reserved usufructuary rights; that federal lands are managed to maintain both the diversity and abundance of natural resources; and to ensure that the Bands' usufructuary rights to treaty resources are not impaired. The Land Exchange Proposed Action was analyzed to understand the potential effects on usufructuary rights. The Co-lead Agencies have consulted, and continue to consult with the Bois Forte Band of Chippewa, the Grand Portage Band of Lake Superior Chippewa, and the Fond du Lac Band of Lake Superior Chippewa, the three principle Bands that retain usufructuary rights in the proposed project area. In addition, the Co-lead Agencies have consulted with the Great Lakes Indian Fish and Wildlife Commission and the 1854 Treaty Authority, the principal natural resource agencies representing the aforementioned Bands. Through consultation, the Co-lead Agencies understand that the Bands' principle interest with regards to the Land Exchange Proposed Action are the following: to retain or increase the amount of public land within the 1854 Treaty Ceded Territory, shoreline wetlands, culturally important natural resources used in exercising treaty rights of hunting, fishing, and gathering, cultural or religious properties, and access to culturally important natural resources and cultural or religious properties. The Co-lead Agencies have a fiduciary obligation to understand and consider the effects that the Land Exchange Proposed Action would have on Band members exercising their Treaty rights in the 1854 ceded territory. While the Land Exchange Proposed Action would remove certain lands from federal ownership, this loss is potentially offset by incoming private lands that would become part of the federal estate within the 1854 Ceded Territory. Outside of the Land Exchange Proposed Action, the Co-lead Agencies have also analyzed the potential effects posed by the Proposed Connected Actions. The potential affects posed to natural resources and cultural resources of importance to the Bands have been disclosed and would be considered during the Co-lead Agency decision process. Land exchanges do not include mitigation; instead, the resource values and public objectives of the non-federal lands must equal or exceed the resource	LAN 05

Comment ID	Comment	Response	Theme(s)
		values and public objectives of the federal lands. See FEIS Section 1.4.3. Mitigation for cultural resources as a result of the NorthMet Project Proposed Action is discussed in Section 5.2.9 of the FEIS. The NorthMet Project Proposed Action mining activities would result in a loss of bogs; however, as part of the NorthMet Proposed Action, the Applicant is required to provide compensatory mitigation for wetland impacts in accordance with state and federal permits. One of the proposed mitigation sites for wetland impacts (Zim Site) would be a compensation site for the loss of bogs, and would be located within the 1854 Ceded Territory. The Lake County lands were tax forfeit lands that were offered for sale by the County through a public auction. The Lake County lands would still be accessible to the Bands for their use if the exchange took place, because the lands would become part of the SNF managed lands. No heritage surveys were conducted on the non-federal lands. If any cultural resources are located on the non-federal lands, those cultural resources would be transferred to federal ownership. Such transfer would not adversely affect the heritage resource, but would provide greater preservation protection under federal law. The non-federal lands that contain wild rice beds would not be affected as a result of the Land Exchange Proposed Action or Land Exchange Alternative B, because no activities are proposed on these lands and the proposed mining activities would not affect these lands. As noted in the FEIS, the Land Exchange Proposed Action and Land Exchange Alternative B would increase wild rice stands within the federal estate. FEIS Sections 5.3.2 and 5.3.4 clarify that, although the Land Exchange would result in an increase in wild rice stands within the federal estate boundaries, there would be no change to the existing public access to Tract 1 wild rice stands via the Pike River. Consequently, there would be no increase in wild rice harvest opportunities for the public. No wild rice stands are known to occur on the federal lands, and suitable habitat is limited. Please refer to the response to theme LAN 01 for more information on the public interest determination.	
19603	This language and description [SDEIS 3.1.2, Land Exchange Overview] is misleading; it downplays the largely undisturbed nature and ecological and biodiversity significance of most of the contiguous lands (i.e., the Hundred Mile Swamp, St. Louis	The FEIS includes information about the baseline conditions of the federal lands and MBS sites such as the One Hundred Mile Swamp Site in Sections 4.2.4.2.1 (Mine Site) and 4.3.4.1.1 (Federal Lands). The FEIS Sections 4.2.4 and 4.3.4 provide maps of the MBS Sites (Figures 4.2.4-1, 4.2.4-2, 4.2.4-5, 4.3.4-1, and 4.3.4-2) to provide further clarity on locations and	LAN 06 VEG 02

Comment ID	Comment	Response	Theme(s)
	River Headwaters Site).	extent.	
19611	Of the approximately 6,025 acres of MBS Sites of High Biodiversity Significance under the Land Exchange Proposed Action, nearly 2,000 acres of coniferous bog wetlands will be lost to the federal estate and therefore effectively to the Bands, if the Land Exchange Proposed Action is implemented. This is significant because many tribally harvested resources are only available in coniferous bogs (e.g. cranberries, soft-leaved blueberries, sweet flag), and mitigation for coniferous bogs is simply not feasible.	The FEIS includes discussion about NorthMet Project impacts to habitat types, MBS sites, and native plant communities. The vegetation analysis cross-references the FEIS cultural resources section (Section 5.2.9) to ensure consistency and to discuss potential impacts on tribally harvested resources. FEIS Section 5.2.3 discusses restoration of coniferous bogs in mitigation wetlands. The WCA rules (including those parts applicable to mining projects under *Minnesota Rules* 8420.0930) include a special consideration for wetlands that are rare natural communities (*Minnesota Rules* 8420.0515, Subpart 3). *Minnesota Rules* 6132.2700 require that a project site be reclaimed once mining has ceased. The goals of such reclamation are to “control erosion, to screen mining areas from non-compatible uses, and to provide for subsequent land uses such as wildlife habitat or timber production.” The rules also include requirements about the characteristics and planting schedule for vegetation used in reclamation. The Permit to Mine would address special consideration of wetlands that include rare natural communities. Additional information on rare natural communities would be included in the wetland permit application as part of the Permit to Mine process for further refinement of site-specific conditions. The Agency’s obligation is to ensure that Band members have ample opportunity to exercise their treaty-reserved usufructuary rights; that federal lands are managed to maintain both the diversity and abundance of natural resources; and that the Bands’ usufructuary rights to resources are not impaired. The Land Exchange Proposed Action was analyzed to understand the potential effect posed to usufructuary rights. The Co-lead Agencies have consulted, and continue to consult with the Bois Forte Band of Chippewa, the Grand Portage Band of Lake Superior Chippewa, and the Fond du Lac Band of Lake Superior Chippewa, the three principle Bands that retain usufructuary rights in the proposed project area. In addition, the Co-lead Agencies have consulted with the Great Lakes Indian Fish and Wildlife Commission and the 1854 Treaty Authority, the principal natural resource agencies representing the aforementioned Bands Through consultation, the Co-lead Agencies understand that the Bands’ principle interest with regards to the Land Exchange Proposed Action are the following: to retain or increase the amount of public land within the 1854 Treaty Ceded Territory, shoreline wetlands, culturally important natural resources used in exercising treaty rights of hunting, fishing and gathering,	CR 01 WET 05 VEG 02

Comment ID	Comment	Response	Theme(s)
		cultural or religious resources, and access to culturally important natural resources and cultural or religious properties. The Co-lead Agencies have a fiduciary obligation to understand and consider the effects that the Land Exchange Proposed Action would have on Band members exercising their Treaty rights in the 1854 ceded territory. While the Land Exchange Proposed Action would remove certain lands from federal ownership, this loss is potentially offset by incoming private lands that would become part of the federal estate within the 1854 ceded territory. Outside of the Land Exchange Proposed Action, the Co-lead Agencies have also analyzed the potential effects posed by the Proposed Connected Actions. The potential affects posed to natural resources and cultural resources of importance to the Bands have been disclosed and would be considered during the Co-lead Agency decision process.	
19612	The exchange of thousands of acres of high quality wetlands and forests containing some of the few remaining wildlife corridors in northeastern Minnesota available to the Bands to exercise reserved 1854 Treaty rights, for lands that have moderate diversity is inconsistent with fiduciary responsibilities that are shared by all federal agencies.	The Agency's obligation is to ensure that Band members have ample opportunity to exercise their treaty-reserved usufructuary rights; that federal lands are managed to maintain both the diversity and abundance of natural resources; and to ensure that the Bands' usufructuary rights to treaty resources are not impaired. The Land Exchange Proposed Action was analyzed to understand the potential effects on usufructuary rights. The Co-lead Agencies have consulted, and continue to consult with the Bois Forte Band of Chippewa, the Grand Portage Band of Lake Superior Chippewa, and the Fond du Lac Band of Lake Superior Chippewa, the three principle Bands that retain usufructuary rights in the proposed project area. In addition, the Co-lead Agencies have consulted with the Great Lakes Indian Fish and Wildlife Commission and the 1854 Treaty Authority, the principal natural resource agencies representing the aforementioned Bands. Through consultation, the Co-lead Agencies understand that the Bands' principle interest with regards to the Land Exchange Proposed Action are the following: to retain or increase the amount of public land within the 1854 Treaty Ceded Territory, shoreline wetlands, culturally important natural resources used in exercising treaty rights of hunting, fishing, and gathering, cultural or religious properties, and access to culturally important natural resources and cultural or religious properties. The Co-lead Agencies have a fiduciary obligation to understand and consider the effects that the Land Exchange Proposed Action would have on Band members exercising their Treaty rights in the 1854 ceded territory. While the Land Exchange Proposed Action would remove certain lands from federal ownership, this loss is potentially offset by incoming private lands that would become part of the federal estate within the 1854 Ceded Territory. Outside of the Land	CR 01 LAN 05

Comment ID	Comment	Response	Theme(s)
		Exchange Proposed Action, the Co-lead Agencies have also analyzed the potential effects posed by the Proposed Connected Actions. The potential affects posed to natural resources and cultural resources of importance to the Bands have been disclosed and would be considered during the Co-lead Agency decision process. Land exchanges do not include mitigation; instead, the resource values and public objectives of the non-federal lands must equal or exceed the resource values and public objectives of the federal lands. See FEIS Section 1.4.3. Mitigation for cultural resources as a result of the NorthMet Project Proposed Action is discussed in Section 5.2.9 of the FEIS. The NorthMet Project Proposed Action mining activities would result in a loss of bogs; however, as part of the NorthMet Proposed Action, the Applicant is required to provide compensatory mitigation for wetland impacts in accordance with state and federal permits. One of the proposed mitigation sites for wetland impacts (Zim Site) would be a compensation site for the loss of bogs, and would be located within the 1854 Ceded Territory. The Lake County lands were tax forfeit lands that were offered for sale by the County through a public auction. The Lake County lands would still be accessible to the Bands for their use if the exchange took place, because the lands would become part of the SNF managed lands. No heritage surveys were conducted on the non-federal lands. If any cultural resources are located on the non-federal lands, those cultural resources would be transferred to federal ownership. Such transfer would not adversely affect the heritage resource, but would provide greater preservation protection under federal law. The non-federal lands that contain wild rice beds would not be affected as a result of the Land Exchange Proposed Action or Land Exchange Alternative B, because no activities are proposed on these lands and the proposed mining activities would not affect these lands. As noted in the FEIS, the Land Exchange Proposed Action and Land Exchange Alternative B would increase wild rice stands within the federal estate. FEIS Sections 5.3.2 and 5.3.4 clarify that, although the Land Exchange would result in an increase in wild rice stands within the federal estate boundaries, there would be no change to the existing public access to Tract 1 wild rice stands via the Pike River. Consequently, there would be no increase in wild rice harvest opportunities for the public. No wild rice stands are known to occur on the federal lands, and suitable habitat is limited. Please refer to the response to theme LAN 01 for more information on the	

Comment ID	Comment	Response	Theme(s)
		public interest determination.	
19613	The SDEIS attempts to diminish the significance of the loss of these high quality lands by stating "Given the existing lack of overland public access and actual use of the federal lands, as well as historic use of this area for mineral exploration (see Section 4.2.9), the Land Exchange Proposed Action represents little to no change in the actual level of recent or current use of the federal lands." In fact, historic trails connect what is now Beaver Bay with Lake Vermillion. These trails "are associated with the lives of persons significant in our past" including John Beargrease, Peter Gagnon, and Alec Posey. In more recent history, Bois Forte Band members used a sugarbush near the plant site and harvested wild rice in the Embarrass River near the LTVSMC tailings basin.	As discussed in FEIS Section 5.3.1.2.1, the only public access to the federal lands is via the Partridge and Embarrass rivers. The remainder of the federal lands are surrounded by private lands (or by other public lands that are themselves surrounded by private lands) (see Figure 4.3.1-1). While members of the public may obtain permission to cross these private lands and access the federal lands, there is no designated land-based access for the federal lands.	CR 04
19614	The SDEIS does not provide adequate discussion of the adverse effects of the proposed land exchange on wetlands and headwater streams within the St. Louis River watershed/Lake Superior Basin, where the loss of first-order headwaters streams, second-order streams and wetlands have the potential to significantly adversely impact downstream water quality, fisheries, and wildlife that are important to the Bands. The Land Exchange Proposed Action would relinquish water resources within the Lake Superior basin for wetlands and surface water resources outside the Lake Superior basin and the St. Louis River watershed, although still within the 1854 Ceded Territory. Federal lands include 4,164 acres of wetlands within the Lake Superior basin; non-federal lands contain 4,669 acres of wetlands, of which only 373 acres are within the Lake Superior Basin, demonstrating there would be a permanent loss of 3,791 acres of federally managed wetlands within the Lake Superior Basin.	The SDEIS and FEIS acknowledge a possibility that habitat could be affected from water chemistry changes resulting from the Land Exchange Proposed Action. Habitat loss from flow changes or riparian activities is not expected as a result of the NorthMet Project Proposed Action. It is noted that under the Land Exchange Proposed Action, , the net reduction to the Superior National Forest of 0.3 miles of first order streams may result in slightly less habitat available for headwater stream dependent species. The FEIS Section 5.3.3 included a discussion of wetland resources to be gained or lost as part of the Land Exchange Proposed Action. The Land Exchange Proposed Action represents a transfer of surface rights of 6,495.4 acres from the Superior National Forest to PolyMet to eliminate the conflict between federal surface and private mineral estate. This action, if approved, would remove those acres from Superior National Forest management and public use and transfer them to private ownership. Effects to wetland resources as a result of the mining activities are discussed in FEIS Section 5.2.3. The FEIS Section 5.3.6 included a discussion of headwater streams to be gained or lost from the proposed land exchange. The proposed land exchange non-federal lands are not mitigation sites and are not required to be exchanged within the same watershed. The non-federal lands being considered are all lands that are located within the proclamation boundary of the Superior National Forest and would consolidate land ownership	AQ 29 CR 01 WET 14 WR 114 WI 02

Comment ID	Comment	Response	Theme(s)
	It is well known that wetlands play an important role in protecting the quality and condition of downstream waters by retaining floodwaters, sediment, nutrients, and other pollutants. wetlands also function as thermal refuge for moose when summertime temperatures exceed 14oC, the point at which moose become thermally stressed, and wetlands provide an important forage resource for moose during the open water season.	management.	
19615	the SDEIS concedes that the land exchange will cause irretrievable losses of resources for the Bands	The Cultural Resources sections of FEIS Chapters 4 and 5 address the federal Co-lead Agencies' federal tribal trust responsibilities under the 1854 Treaty. These sections, along with other relevant natural resources sections of FEIS Chapters 4, 5, and 6 also address effects on, and any proposed mitigation for effects on cultural resources and culturally significant natural resources. Mitigation/compensation for effects on cultural resources and culturally significant natural resources is considered to the extent possible within the parameters of the statutes and regulations providing the federal authorities for the review of the NorthMet Project Proposed Action.	CR 01
19616	The SDEIS states, "The Land Exchange Proposed Action would result in additional wild rice beds by the acquisition of Tract 1. Tract 1 contains Little Rice Lake, which supports a continuous population of wild rice. Wild rice also grows along the Pike River south of Little Rice Lake and in isolated populations on Hay Lake." However, the wild rice waters in Tract 1 are already accessible to the Bands via the Pike River; adding Tract 1 to the federal estate does not provide additional wild rice harvesting opportunities to Band members in the 1854 Ceded Territories even though it would add an additional 126 acres of wild rice beds to the federal estate.	The non-federal lands that contain wild rice beds would not be affected as a result of the Land Exchange Proposed Action or Land Exchange Alternative B as no activities are proposed on these lands and the proposed mining activities would not affect these lands. As noted in the FEIS, the Land Exchange Proposed Action and Land Exchange Alternative B would result in additional wild rice beds to the federal estate. The FEIS, Sections 5.3.2 and 5.3.4 , clarifies that though the Land Exchange Proposed Action would result in an increase in wild rice beds within the federal estate boundaries there would be no change to the existing public access to Tract 1 wild rice beds via the Pike River. Consequently, there would be no increase in wild rice harvest opportunities for the public. No wild rice beds are known to occur on the federal lands, and suitable habitat is limited.	LAN 05 WR 155
19617	This is the essential argument against Alternative B, from the Bands' perspective. The additional lands would essentially be permanently removed from tribal access, habitat and resources would be degraded, and there would be no compensation via	The Agency's obligation is to ensure that Band members have ample opportunity to exercise their treaty-reserved usufructuary rights; that federal lands are managed to maintain both the diversity and abundance of natural resources; and to ensure that the Bands' usufructuary rights to treaty resources are not impaired. The Land Exchange Proposed Action was	LAN 05

Comment ID	Comment	Response	Theme(s)
	conveyance of lands to the federal estate.	analyzed to understand the potential effects on usufructuary rights. The Co-lead Agencies have consulted, and continue to consult with the Bois Forte Band of Chippewa, the Grand Portage Band of Lake Superior Chippewa, and the Fond du Lac Band of Lake Superior Chippewa, the three principle Bands that retain usufructuary rights in the proposed project area. In addition, the Co-lead Agencies have consulted with the Great Lakes Indian Fish and Wildlife Commission and the 1854 Treaty Authority, the principal natural resource agencies representing the aforementioned Bands. Through consultation, the Co-lead Agencies understand that the Bands' principle interest with regards to the Land Exchange Proposed Action are the following: to retain or increase the amount of public land within the 1854 Treaty Ceded Territory, shoreline wetlands, culturally important natural resources used in exercising treaty rights of hunting, fishing, and gathering, cultural or religious properties, and access to culturally important natural resources and cultural or religious properties. The Co-lead Agencies have a fiduciary obligation to understand and consider the effects that the Land Exchange Proposed Action would have on Band members exercising their Treaty rights in the 1854 ceded territory. While the Land Exchange Proposed Action would remove certain lands from federal ownership, this loss is potentially offset by incoming private lands that would become part of the federal estate within the 1854 Ceded Territory. Outside of the Land Exchange Proposed Action, the Co-lead Agencies have also analyzed the potential effects posed by the Proposed Connected Actions. The potential affects posed to natural resources and cultural resources of importance to the Bands have been disclosed and would be considered during the Co-lead Agency decision process. Land exchanges do not include mitigation; instead, the resource values and public objectives of the non-federal lands must equal or exceed the resource values and public objectives of the federal lands. See FEIS Section 1.4.3. Mitigation for cultural resources as a result of the NorthMet Project Proposed Action is discussed in Section 5.2.9 of the FEIS. The NorthMet Project Proposed Action mining activities would result in a loss of bogs; however, as part of the NorthMet Proposed Action, the Applicant is required to provide compensatory mitigation for wetland impacts in accordance with state and federal permits. One of the proposed mitigation sites for wetland impacts (Zim Site) would be a compensation site for the loss of bogs, and would be located within the 1854 Ceded Territory. The Lake County lands were tax forfeit lands that were offered for sale by	

Comment ID	Comment	Response	Theme(s)
		the County through a public auction. The Lake County lands would still be accessible to the Bands for their use if the exchange took place, because the lands would become part of the SNF managed lands. No heritage surveys were conducted on the non-federal lands. If any cultural resources are located on the non-federal lands, those cultural resources would be transferred to federal ownership. Such transfer would not adversely affect the heritage resource, but would provide greater preservation protection under federal law. The non-federal lands that contain wild rice beds would not be affected as a result of the Land Exchange Proposed Action or Land Exchange Alternative B, because no activities are proposed on these lands and the proposed mining activities would not affect these lands. As noted in the FEIS, the Land Exchange Proposed Action and Land Exchange Alternative B would increase wild rice stands within the federal estate. FEIS Sections 5.3.2 and 5.3.4 clarify that, although the Land Exchange would result in an increase in wild rice stands within the federal estate boundaries, there would be no change to the existing public access to Tract 1 wild rice stands via the Pike River. Consequently, there would be no increase in wild rice harvest opportunities for the public. No wild rice stands are known to occur on the federal lands, and suitable habitat is limited. Please refer to the response to theme LAN 01 for more information on the public interest determination.	
19618	The desire to resolve "conflict" between the USFS and the Project proponent, whose goal to develop an open pit mine is barred due to deed restrictions on the federal estate, should not prevail over the federal fiduciary responsibility to the Bands. The potential for more roads and hiking trails may provide more access to the public, but does nothing to promote habitat diversity and long-term ecosystem sustainability that are requirements for the preservation of tribal usufructuary rights. Although the Land Exchange Proposed Action may increase acreage in the federal estate, the countervailing permanent loss of Critical Wildlife corridors, high quality and diverse land and water resources that would result is simply not in the	The Agency's obligation is to ensure that Band members have ample opportunity to exercise their treaty-reserved usufructuary rights; that federal lands are managed to maintain both the diversity and abundance of natural resources; and to ensure that the Bands' usufructuary rights to treaty resources are not impaired. The Land Exchange Proposed Action was analyzed to understand the potential effects on usufructuary rights. The Co-lead Agencies have consulted, and continue to consult with the Bois Forte Band of Chippewa, the Grand Portage Band of Lake Superior Chippewa, and the Fond du Lac Band of Lake Superior Chippewa, the three principle Bands that retain usufructuary rights in the proposed project area. In addition, the Co-lead Agencies have consulted with the Great Lakes Indian Fish and Wildlife Commission and the 1854 Treaty Authority, the principal natural resource agencies representing the aforementioned Bands. Through consultation, the Co-lead Agencies understand that the Bands' principle interest with regards to the Land Exchange Proposed Action are the following: to retain or increase the amount of public land within the	LAN 05

Comment ID	Comment	Response	Theme(s)
	public interest.	1854 Treaty Ceded Territory, shoreline wetlands, culturally important natural resources used in exercising treaty rights of hunting, fishing, and gathering, cultural or religious properties, and access to culturally important natural resources and cultural or religious properties. The Co-lead Agencies have a fiduciary obligation to understand and consider the effects that the Land Exchange Proposed Action would have on Band members exercising their Treaty rights in the 1854 ceded territory. While the Land Exchange Proposed Action would remove certain lands from federal ownership, this loss is potentially offset by incoming private lands that would become part of the federal estate within the 1854 Ceded Territory. Outside of the Land Exchange Proposed Action, the Co-lead Agencies have also analyzed the potential effects posed by the Proposed Connected Actions. The potential affects posed to natural resources and cultural resources of importance to the Bands have been disclosed and would be considered during the Co-lead Agency decision process. Land exchanges do not include mitigation; instead, the resource values and public objectives of the non-federal lands must equal or exceed the resource values and public objectives of the federal lands. See FEIS Section 1.4.3. Mitigation for cultural resources as a result of the NorthMet Project Proposed Action is discussed in Section 5.2.9 of the FEIS. The NorthMet Project Proposed Action mining activities would result in a loss of bogs; however, as part of the NorthMet Proposed Action, the Applicant is required to provide compensatory mitigation for wetland impacts in accordance with state and federal permits. One of the proposed mitigation sites for wetland impacts (Zim Site) would be a compensation site for the loss of bogs, and would be located within the 1854 Ceded Territory. The Lake County lands were tax forfeit lands that were offered for sale by the County through a public auction. The Lake County lands would still be accessible to the Bands for their use if the exchange took place, because the lands would become part of the SNF managed lands. No heritage surveys were conducted on the non-federal lands. If any cultural resources are located on the non-federal lands, those cultural resources would be transferred to federal ownership. Such transfer would not adversely affect the heritage resource, but would provide greater preservation protection under federal law. The non-federal lands that contain wild rice beds would not be affected as a result of the Land Exchange Proposed Action or Land Exchange Alternative B, because no activities are proposed on these lands and the	

Comment ID	Comment	Response	Theme(s)
		proposed mining activities would not affect these lands. As noted in the FEIS, the Land Exchange Proposed Action and Land Exchange Alternative B would increase wild rice stands within the federal estate. FEIS Sections 5.3.2 and 5.3.4 clarify that, although the Land Exchange would result in an increase in wild rice stands within the federal estate boundaries, there would be no change to the existing public access to Tract 1 wild rice stands via the Pike River. Consequently, there would be no increase in wild rice harvest opportunities for the public. No wild rice stands are known to occur on the federal lands, and suitable habitat is limited. Please refer to the response to theme LAN 01 for more information on the public interest determination.	
19619	Federal land exchanges are discretionary, and federal agencies cannot approve permits that will have impacts to treaty resources without additional evaluation and mitigation. No mitigation has been identified in the SDEIS for this permanent loss of lands and resources (natural and cultural) to the 1854 Ceded Territory. The public interest determination must include a specific finding that "The intended use of the conveyed Federal land will not substantially conflict with established management objectives on adjacent Federal lands, including Indian Trust lands" (36 CFR. 254.3(b)(2)(ii)). This threshold has not been met, and the Fond du Lac Band objects to the implementation of the Land Exchange Proposed Action.	The Agency's obligation is to ensure that Band members have ample opportunity to exercise their treaty-reserved usufructuary rights; that federal lands are managed to maintain both the diversity and abundance of natural resources; and to ensure that the Bands' usufructuary rights to treaty resources are not impaired. The Land Exchange Proposed Action was analyzed to understand the potential effects on usufructuary rights. The Co-lead Agencies have consulted, and continue to consult with the Bois Forte Band of Chippewa, the Grand Portage Band of Lake Superior Chippewa, and the Fond du Lac Band of Lake Superior Chippewa, the three principle Bands that retain usufructuary rights in the proposed project area. In addition, the Co-lead Agencies have consulted with the Great Lakes Indian Fish and Wildlife Commission and the 1854 Treaty Authority, the principal natural resource agencies representing the aforementioned Bands. Through consultation, the Co-lead Agencies understand that the Bands' principle interest with regards to the Land Exchange Proposed Action are the following: to retain or increase the amount of public land within the 1854 Treaty Ceded Territory, shoreline wetlands, culturally important natural resources used in exercising treaty rights of hunting, fishing, and gathering, cultural or religious properties, and access to culturally important natural resources and cultural or religious properties. The Co-lead Agencies have a fiduciary obligation to understand and consider the effects that the Land Exchange Proposed Action would have on Band members exercising their Treaty rights in the 1854 ceded territory. While the Land Exchange Proposed Action would remove certain lands from federal ownership, this loss is potentially offset by incoming private lands that would become part of the federal estate within the 1854 Ceded Territory. Outside of the Land Exchange Proposed Action, the Co-lead Agencies have also analyzed the	CR 01 LAN 05

Comment ID	Comment	Response	Theme(s)
		potential effects posed by the Proposed Connected Actions. The potential affects posed to natural resources and cultural resources of importance to the Bands have been disclosed and would be considered during the Co-lead Agency decision process. Land exchanges do not include mitigation; instead, the resource values and public objectives of the non-federal lands must equal or exceed the resource values and public objectives of the federal lands. See FEIS Section 1.4.3. Mitigation for cultural resources as a result of the NorthMet Project Proposed Action is discussed in Section 5.2.9 of the FEIS. The NorthMet Project Proposed Action mining activities would result in a loss of bogs; however, as part of the NorthMet Proposed Action, the Applicant is required to provide compensatory mitigation for wetland impacts in accordance with state and federal permits. One of the proposed mitigation sites for wetland impacts (Zim Site) would be a compensation site for the loss of bogs, and would be located within the 1854 Ceded Territory. The Lake County lands were tax forfeit lands that were offered for sale by the County through a public auction. The Lake County lands would still be accessible to the Bands for their use if the exchange took place, because the lands would become part of the SNF managed lands. No heritage surveys were conducted on the non-federal lands. If any cultural resources are located on the non-federal lands, those cultural resources would be transferred to federal ownership. Such transfer would not adversely affect the heritage resource, but would provide greater preservation protection under federal law. The non-federal lands that contain wild rice beds would not be affected as a result of the Land Exchange Proposed Action or Land Exchange Alternative B, because no activities are proposed on these lands and the proposed mining activities would not affect these lands. As noted in the FEIS, the Land Exchange Proposed Action and Land Exchange Alternative B would increase wild rice stands within the federal estate. FEIS Sections 5.3.2 and 5.3.4 clarify that, although the Land Exchange would result in an increase in wild rice stands within the federal estate boundaries, there would be no change to the existing public access to Tract 1 wild rice stands via the Pike River. Consequently, there would be no increase in wild rice harvest opportunities for the public. No wild rice stands are known to occur on the federal lands, and suitable habitat is limited. The Cultural Resources sections of FEIS Chapters 4 and 5 address the federal Co-lead Agencies' federal tribal trust responsibilities under the	

Comment ID	Comment	Response	Theme(s)
		1854 Treaty. These sections, along with other relevant natural resources sections of FEIS Chapters 4, 5, and 6 also address effects on, and any proposed mitigation for effects on cultural resources and culturally significant natural resources. Mitigation/compensation for effects on cultural resources and culturally significant natural resources is considered to the extent possible within the parameters of the statutes and regulations providing the federal authorities for the review of the NorthMet Project Proposed Action. Please refer to the response to theme LAN 01 for more information on the public interest determination.	
19620	In the SDEIS, no detail is provided regarding the estimated amount of financial assurance that would be sufficient for reclamation, closure, mitigation, and remediation of adverse effects from the Project..., the SDEIS provides neither a timeline nor a discussion regarding financial assurance for the existing contamination associated with previous mining activities at the site.	FEIS Section 3.2.2.4 provides available details regarding financial assurance. Additional details on the cost estimates, time frames, and calculations that would be required for the project would be addressed during permitting. Specific infrastructure timelines and life expectancies of equipment would be accounted for during permitting as well. Table 3.2-15 provides financial assurance cost estimates for various years of closure, as well as monitoring and mitigation costs. Section 3.2.2.4.1 discusses what activities would be considered in cost estimates, and that cost estimates would be updated annually under the Permit to Mine. *Minnesota Rules* 6132.1200, Subpart 3, states that cost estimates shall be annually adjusted using current dollar value at the time of the estimate. To the extent the reclamation plan includes maintenance, mitigation, and cleanup of legacy contamination, those items would be covered by financial assurance.	FIN 05
19621	The financial assurance costs for long-term treatment identified in the SDEIS range from $3.5 to $6 million, but appears to be an estimate for monitoring activities only without any long-term wastewater treatment costs.	FEIS Section 3.2.2.4 provides available details regarding financial assurance, including for reclamation of all disturbed areas and ongoing long-term monitoring and maintenance. Additional details on the cost estimates, time frames, and calculations that would be required for the project would be addressed during permitting. Table 3.2-15 provides financial assurance cost estimates for various years of closure, as well as monitoring and mitigation costs. Section 3.2.2.4.1 discusses what activities would be considered in cost estimates, and that cost estimates would be updated annually under the Permit to Mine. *Minnesota Rules* 6132.1200, Subpart 3, states that cost estimates shall be annually adjusted using current dollar value at the time of the estimate.	FIN 05
19622	The cursory estimate of financial assurance provides little detail about how the cost estimates were derived. Instead, specific discussions about	FEIS Section 3.2.2.4 provides available details regarding financial assurance, including for reclamation of all disturbed areas and ongoing long-term monitoring and maintenance, as required under NEPA/MEPA.	FIN 13

Comment ID	Comment	Response	Theme(s)
	the scale and appropriate instruments for financial assurance have been postponed until the permitting phase of this Project. This approach fundamentally contradicts federal and state environmental policy and the SDEIS must be revised, with significant additional study, to appropriately evaluate closure, mitigation, reclamation, and perpetual treatment cost estimates.	Additional details on the cost estimates, time frames, and calculations that would be required for the project would be addressed during permitting. Table 3.2-15 provides financial assurance cost estimates for various years of closure, as well as monitoring and mitigation costs. Section 3.2.2.4.1 discusses what activities would be considered in cost estimates, and that cost estimates would be updated annually under the Permit to Mine. *Minnesota Rules* 6132.1200, Subpart 3, states that cost estimates shall be annually adjusted, using current dollar value at the time of the estimate. *Minnesota Rules* 6132.1200 Subpart 4 state that the Commissioner shall evaluate all financial assurance cost estimates and adjustments to cost estimates using individuals with documented experience in material handling and construction and mining costs. Neither NEPA nor MEPA rules require that all financial assurance mechanisms be in place before the EIS is finalized.	
19623	Long-term treatment of contaminated water; consistency with maintenance-free closure goals: The SDEIS lists the sulfur concentrations of Project waste rock ranging between 0.01 - 5.0% with an average mass-weighted concentration of 0.15%. The Virginia Formation has the highest concentrations of sulfur at 0.4 - 5.0%, and the Duluth Complex 0.13 – 0.6% sulfur. These concentrations are at least equal to, or in some instances significantly higher than the Zortman-landusky mine waste rock (0.2% sulfur) that requires perpetual wastewater treatment. Just as Zortman-landusky predicted for their mine project, PolyMet has suggested that "most (70%) of the NorthMet waste rock would be the low-sulfur, non-acid-generating" and will never cause acid mine drainage. Yet the SDEIS speaks to the need for at least centuries of wastewater treatment at both the Mine Site and Plant Site: "Once the West Pit is full (approximately year 40), discharge of treated water from the WWTF to the West Pit would be terminated. The WWTF would be upgraded to RO and include evaporator/crystalizers to convert the RO reject concentrate to residual solids, which would be	The GoldSim model used probabilistic modeling to avoid improbable predictions that can occur when a deterministic simulation is done with a suite of "worst case" inputs. The probabilistic modeling approach used in GoldSim provides cumulative probability distributions for predicted concentrations that are far more useful for impacts assessment and project evaluation. Computing a "highest predicted concentration" is not useful if the probability of its occurrence is exceedingly small. Concentration caps are established at the highest expected concentrations of solutes in the various types of mine waste. Concentration caps incorporated into the GoldSim model are based upon the widely observed finding that the concentration of many solutes released by oxidation of sulfide metals in mine wastes can be limited by the precipitation of secondary minerals or adsorption to mineral surfaces. Because concentration caps vary with aqueous chemical conditions (i.e., most metals in mine waste pore waters have higher concentration caps in acidic conditions than neutral conditions), the GoldSim model applied different caps to water from acid-generating waste and non-acid generating waste. The selection of specific values for concentration caps was considered by the Co-lead Agencies (see Table 1 of MDNR, et. al. 2011, as cited in the FEIS); the specific ranges for concentration caps were estimated from mineral solubilities (for those solutes commonly found as secondary minerals in mine wastes) or observed in effluent from field-scale mine wastes (see Tables 1-15 and 1-30 through 1-33 in Barr 2012d, as cited in the FEIS). Concentration caps were based on field studies rather than laboratory studies so that the rock to	PD 03 WR 056

Comment ID	Comment	Response	Theme(s)
	disposed of at appropriate off-site facilities."…Based on current GoldSim P90 model predictions, treatment activities could be required for a minimum of 200 years at the Mine Site"...Mechanical water treatment is part of the modeled NorthMet Project Proposed Action for the duration of the simulations (200 years at the Mine Site, and 500 years at the Plant Site). The duration of the simulations was determined based on capturing the highest predicted concentrations of the modeled NorthMet Project Proposed Action. It is uncertain how long the NorthMet Project Proposed Action would require water treatment, but it is expected to be long term; actual treatment requirements would be based on measured, rather than modeled, NorthMet Project water quality performance, as determined through monitoring requirements." The tribal cooperating agencies have provided substantial evidence that the modeling for the NorthMet Project Proposed Action potentially underestimates those "highest predicted concentrations." This will affect both volumes of water requiring treatment and duration of the need for mechanical treatment.	water ratios would be similar to conditions expected at the NorthMet Project Site, and thus would avoid the higher water to rock ratios in humidity cell tests that could under-estimate caps. The use of concentration caps is described in FEIS Section 5.2.2.2.3.	
19624	After refill, the West Pit water level would be controlled by pumping to the WWTF to prevent surface water overflow from the pit lake. However, release of pit lake water to the West Pit Surficial Flowpath would continue. The WWTF would also receive low flow rates from the Category 1 Stockpile groundwater containment system. The WWTF effluent would be discharged into a tributary channel that flows into the Partridge River at the location shown on Figure 5.2.2-15. Mine site: The WWTF would continue to operate during long-term closure, treating excess water from the West Pit and discharging the effluent to	Section 5.2.2 of the FEIS says water quality modeling performed in support of the FEIS indicates that water treatment systems would be needed indefinitely at the Mine Site and Plant Site.	WR 035 WR 036

Comment ID	Comment	Response	Theme(s)
	the small Partridge River tributary. The typical discharge rate from the WWTF is predicted to be 285 gpm. The water balance model predicts periodic temporary higher treatment/discharge rates to account for conditions when the freeboard in the pit becomes too small. By pumping pit lake water to the WWTF, the pit water level would be managed to always provide sufficient freeboard to absorb extreme precipitation events without overflowing. The estimated discharge for this condition is 570 gpm. In the water balance model, the occasional switch to the "high" treatment flow pushes the long-term average discharge rate to 290 gpm. Plant Site: During long-term closure, the WWTP would continue to treat water collected by the Tailings Basin containment systems. Some of the treated effluent would be used for flow augmentation to Unnamed Creek, Mud Lake Creek, Trimble Creek, and Second Creek. It is predicted that Colby Lake water would no longer be needed for augmentation (Barr 2013a). Tailings seepage bypassing the containment system (approximately 19.4 gpm) would continue to enter the North, Northwest, and West Surficial flowpaths, and migrate slowly toward the Embarrass River. By year 200 in closure, which reflects when effects would have peaked and would be decreasing, the WWTF would be discharging and all groundwater contaminant loads would have reached the Partridge River (except negligible contributions from the bedrock flowpaths). Whatever the long-term goals to transition to non-mechanical treatment, this acknowledges a minimum of 200 years of operation of the WWTF. It is clear that the NorthMet Project Proposed Action would require long term treatment of water at both the Plant and Mine Sites. The minimum duration of this treatment is on the order of centuries, but the		

Comment ID	Comment	Response	Theme(s)
	SDEIS does not provide an estimate of when mechanical treatment would no longer be needed to meet MN WQS. Therefore, as provided in multiple comments on the preliminary SDEIS, Fond du Lac conservatively assumes that water treatment for the proposed PolyMet mine is perpetual and the SDEIS should be clear on this issue.		
19625	However, instead of clarifying this factor, it appears that the co-lead agencies are attempting to minimize the significance of the necessity for long term/perpetual treatment by using vague and confusing language in the SDEIS. The specific language describing long term water treatment has changed during the development of the document, even though the model results have not. The co-lead agencies use creative wording to obscure the results of the modeling; this is misdirection at best and highly inappropriate for the co-lead agencies to present to the public.	Water quality modeling performed in support of the FEIS indicates that water treatment systems in some form and at some scale would be needed at the Mine Site and Plant Site indefinitely. The water models constructed to assess the potential effects from the NorthMet Project Proposed Action were not designed to predict the duration of treatment nor do they capture all the factors that influence the duration of treatment, for example potential future regulatory and technological changes. Therefore, the models cannot be used to predict a year treatment would end. Actual treatment requirements would be assessed on a reoccurring basis throughout operations and closure based on results of ongoing discharges, performance and water resource monitoring ensuring continuous protection of ground and surface water quality and compliance with applicable water quality standards. This reassessment process would rely on measured monitoring results (evaluated through modeling) rather than the results of the predictive modeling included in the FEIS. Regardless of the precise duration of effects or water treatment at either the Mine Site or Plant Site, there are measures available to address impacts to natural resources.	NEPA 09 WR 035
19626	In addition to water treatment, there will also need to be a substantial investment in long-term or perpetual operation, maintenance and replacement of other environmental controls for the Project, including seepage capture and pumping at multiple locations at both the mine site and plant site, repair and replacement of liners, managing appropriate stream augmentation and Tailings Basin pond elevation, and pumping, treating, and disposal of seepage from the HRF: The Tailings Basin pond would primarily receive solute loadings from the tailings, treated Mine Site process water (primarily during years 1 to 11, and possibly through year 20,	It is acknowledged that operation, maintenance and periodic replacement of environmental controls would be required during closure. Financial Assurance would be required under the State's Permit to Mine to perform these activities on a continuous and/or periodic basis for as long as these activities are needed. The FEIS Project description indicates that no Colby Lake water would be used for direct surface water augmentation. All water used for stream augmentation would be treated prior to being added to hydrologically affected waters. See the response to theme WR 035.	PER 03 WR 035 WR 037

Comment ID	Comment	Response	Theme(s)
	depending on the NorthMet Project Proposed Action water budget), and captured seepage from the groundwater containment system. The Tailings Basin pond, in turn, would become a primary source of contaminants as its water seeps into the tailings. Therefore, the composition of the Tailings Basin pond, which would be a permanent feature of the Tailings Basin, would be an important component in the quality of water that would be discharged from the Tailings Basin. Thus, PolyMet proposes to use the WWTP to treat the pond water during reclamation, and as necessary during closure, to maintain the design water level and prevent overflow. The presence of the pond in closure would provide benefits as it would create a saturated layer that would permanently reduce the oxygen flux and associated solute release in the underlying tailings. The groundwater containment system would continue to operate during reclamation and closure, although in those phases, the seepage could not be reused as process water, but would be treated at the WWTP and used to accelerate filling of the West Pit (during reclamation) and for streamflow augmentation (during closure). Although it is designed to capture all of the Tailings Basin seepage, the groundwater containment system is assumed to capture 90 percent of the groundwater flow that approaches the system (PolyMet 2013g). During reclamation, all WWTP effluent would be used to help flood the West Pit; therefore, during this phase, all augmentation water would come from Colby Lake (approximately 1,600 gpm). In closure, it is expected that effluent from the WWTP alone (estimated at approximately 2,000 gpm) would be sufficient to meet the minimum flow augmentation requirements of the tributaries without requiring additional water from Colby Lake.		

Comment ID	Comment	Response	Theme(s)
19627	The Tailings Basin pond would primarily receive solute loadings from the tailings, treated Mine Site process water (primarily during years 1 to 11, and possibly through year 20, depending on the NorthMet Project Proposed Action water budget), and captured seepage from the groundwater containment system. The Tailings Basin pond, in turn, would become a primary source of contaminants as its water seeps into the tailings. Therefore, the composition of the Tailings Basin pond, which would be a permanent feature of the Tailings Basin, would be an important component in the quality of water that would be discharged from the Tailings Basin. Thus, PolyMet proposes to use the WWTP to treat the pond water during reclamation, and as necessary during closure, to maintain the design water level and prevent overflow. The presence of the pond in closure would provide benefits as it would create a saturated layer that would permanently reduce the oxygen flux and associated solute release in the underlying tailings. The groundwater containment system would continue to operate during reclamation and closure, although in those phases, the seepage could not be reused as process water, but would be treated at the WWTP and used to accelerate filling of the West Pit (during reclamation) and for streamflow augmentation (during closure). Although it is designed to capture all of the Tailings Basin seepage, the groundwater containment system is assumed to capture 90 percent of the groundwater flow that approaches the system (PolyMet 2013g). During reclamation, all WWTP effluent would be used to help flood the West Pit; therefore, during this phase, all augmentation water would come from Colby Lake (approximately 1,600 gpm). In closure, it is expected that effluent from the WWTP alone (estimated at approximately 2,000 gpm) would be	It is acknowledged that operation, maintenance and periodic replacement of environmental controls would be required during closure. Financial Assurance would be required under the State's Permit to Mine to perform these activities on a continuous and/or periodic basis for as long as these activities are needed. The NorthMet Project Proposed Action has been modified since the SDEIS to address the issue of using Colby Lake water for augmentation. The FEIS Project description indicates that no Colby Lake water would be used for direct surface water augmentation. All water used for stream augmentation would be treated prior to being added to hydrologically affected waters. See the response to theme WR 035. Section 5.2.2 of the FEIS says water quality modeling performed in support of the FEIS indicates that water treatment systems would be needed indefinitely at the Mine Site and Plant Site.	WR 035 WR 037 WR 124

Comment ID	Comment	Response	Theme(s)
	sufficient to meet the minimum flow augmentation requirements of the tributaries without requiring additional water from Colby Lake. These statements indicate the need for perpetual WWTP operation, if for no other reason than needing clean water for stream augmentation, which will be required in perpetuity to compensate for the hydrologic impacts of the Tailings Basin.		
19628	The rate of drainage would decrease over time as the pore water within the hydrometallurgical residue is collected and removed. Once the entire facility is closed, the volume of water from the drainage collection systems would decline. In the long term, the volume of water requiring treatment would decline to the point that the remaining reclamation activity may consist of periodic pumping of remaining drainage into tank trucks for transportation, treatment, and disposal, as appropriate, and of inspection of the closed cells to verify integrity of the reclamation systems...The water quality of both mine pits, however, is predicted to improve over time as the pits become flooded, thereby effectively eliminating oxidation of the pit walls, the primary source of solutes, except for the upper few feet where water levels may fluctuate. Figures 5.2.2-37, 5.2.2-38, and 5.2.2-39 show how the water quality in the West Pit is predicted to improve over time for three representative solutes: cobalt, nickel, and sulfate. It is expected that eventually the solute concentrations in the pits would stabilize to more or less steady-state values, although the timeframe for this would likely be greater than 200 years as indicated by Figures 5.2.2-37 to 5.2.2-39, which show solute concentrations continuing to decrease at year 200, although still above water quality standards. These predicted improvements in water quality suggest that the WWTF may not need to operate permanently, but that at some point, non-	The NorthMet Project Proposed Action relies on mechanical treatment for as long as necessary. FEIS Chapter 3 states that PolyMet has committed to conducting pilot and other feasibility studies on the use of non-mechanical treatment as an adaptive management measure if proven effective and cost efficient. The possible future use of non-mechanical treatment is stated as a long-term goal, but the details of how such systems would operate would be determined once operations begin and site specific data could be used for pilot/feasibility studies, and if eventually proposed would be addressed in future permitting.	PD 06 WR 137

Comment ID	Comment	Response	Theme(s)
	mechanical treatment systems may be sufficient to meet water quality standards. The SDEIS frequently states the long-term goal is to transition to non-mechanical treatment, but there is little evidence to suggest that current treatment technologies can consistently treat large volumes of water to meet WQS.		
19629	Furthermore, constructed wetlands would require substantial acreage to handle the volume of wastewater that will perpetually be collected, and do not function well in our cold climate for at least half of the year (when vegetation is not actively growing). They are not likely to be able to treat wastewater sufficiently to consistently meet water quality standards, including the wild rice sulfate criterion. But perhaps most the most significant factor to consider for the likelihood of successfully transitioning is that non-mechanical treatment, at least at the Mine Site, necessitates the seasonal application of the wild rice sulfate criterion: "…However, the non-mechanical system will be designed to discharge only during a portion of the year, to comply with the seasonal discharge criterion for wild rice downstream of the Mine Site. The design of the West Pit Overflow Non-Mechanical Treatment System is based on a discharge period of two months, September and October."	The NorthMet Project Proposed Action relies on mechanical treatment for as long as necessary. FEIS Chapter 3 states that PolyMet has committed to conducting pilot and other feasibility studies on the use of non-mechanical treatment as an adaptive management measure if proven effective and cost efficient. The possible future use of non-mechanical treatment is stated as a long-term goal, but the details of how such systems would operate would be determined once operations begin and site specific data could be used for pilot/feasibility studies, and if eventually proposed would be addresses in future permitting. Reference to a seasonal application of the wild rice standard has been removed from the description of these potential future non-mechanical treatment systems for the FEIS.	WR 137 WR 153
19630	"However, the non-mechanical system will be designed to discharge only during a portion of the year, to comply with the seasonal discharge criterion for wild rice downstream of the Mine Site. The design of the West Pit Overflow Non-Mechanical Treatment System is based on a discharge period of two months, September and October." As described in the AWMP, this type of non-mechanical treatment system cannot meet the 10mg/l sulfate criterion. At this time, the	The NorthMet Project Proposed Action relies on mechanical treatment for as long as necessary. FEIS Chapter 3 states that PolyMet has committed to conducting pilot and other feasibility studies on the use of non-mechanical treatment as an adaptive management measure if proven effective and cost efficient. The possible future use of non-mechanical treatment is stated as a long-term goal, but the details of how such systems would operate would be determined once operations begin and site specific data could be used for pilot/feasibility studies, and if eventually proposed would be addresses in future permitting. Reference to a seasonal application of the wild rice standard has been removed from the description of these potential future	WR 137 WR 153

Comment ID	Comment	Response	Theme(s)
	continued implementation of the seasonal application of that criterion is highly questionable as recent research conducted by the University of Minnesota on behalf of the MPCA indicates excess sulfate loading is detrimental to wild rice regardless of the time of year.	non-mechanical treatment systems for the FEIS.	
19631	The SDEIS requires substantially more public transparency and less equivocation on what is arguably one of the most fundamental issues at stake for this project: how long will the company be required to flawlessly operate and maintain expensive mechanical treatment to comply with MN WQS? Clearly there are other engineering controls and management actions that will absolutely have to flawlessly operate and require maintenance in perpetuity (seepage collection, liners, pumps, waste rock stockpile cover systems, waste disposal, stream augmentation, Tailings Basin pond elevation management). This singular issue has significant repercussions for the public interest determinations and the scale of required financial assurance.	Water quality modeling performed in support of the FEIS indicates that water treatment systems in some form and at some scale would be needed at the Mine Site and Plant Site indefinitely. The water models constructed to assess the potential effects from the NorthMet Project Proposed Action were not designed to predict the duration of treatment nor do they capture all the factors that influence the duration of treatment, for example potential future regulatory and technological changes. Therefore, the models cannot be used to predict a year treatment would end. Actual treatment requirements would be assessed on a reoccurring basis throughout operations and closure based on results of ongoing discharges, performance and water resource monitoring ensuring continuous protection of ground and surface water quality and compliance with applicable water quality standards. This reassessment process would rely on measured monitoring results (evaluated through modeling) rather than the results of the predictive modeling included in the FEIS. Regardless of the precise duration of effects or water treatment at either the Mine Site or Plant Site, there are measures available to address impacts to natural resources. Engineered systems can operate successfully over long periods of time if they are property monitored and maintained. The FEIS provides a comprehensive description of proposed water treatment and seep collection systems including surface water and groundwater containment and synthetic liners and covers. This includes the types of monitoring used to assess performance. Detailed designs are provided in supporting documents, which are fully referenced in the FEIS. The FEIS also discusses long-term operation, maintenance, and periodic replacement of engineered systems. It is acknowledged that certain components of the engineered systems would need to be replaced when monitoring indicates that performance is marginal and not readily compensated for by adaptive mitigation measures. The financial assurance process would fully consider long-term monitoring and periodic replacement of equipment including, but not limited to, water treatment hardware and synthetic liners and covers. The Financial	PD 03 WR 036

Comment ID	Comment	Response	Theme(s)
		Assurance package for the NorthMet Project Proposed Action would insure that future funding would be available if and when adaptive mitigation measures or component replacements are needed to achieve performance specifications. FEIS Section 3.2.2.4 includes available details regarding financial assurance. Additional details on the cost estimates and calculations that would be required for the project would be addressed during permitting. Specific infrastructure timelines and life expectancies of equipment would be accounted for during permitting as well. FEIS Table 3.2-15 provides financial assurance cost estimates for various years of closure, as well as for monitoring and mitigation costs. FEIS Section 3.2.2.4.1 discusses the activities that would be considered in cost estimates, and states that cost estimates would be updated annually under the Permit to Mine. *Minnesota Rules* 6132.1200, Subpart 3 states that cost estimates shall be annually adjusted, using current dollar value at the time of the estimate.	
19632	The SDEIS identifies 29 Areas of Concern (AOCs) that are now PolyMet's legal responsibility, but still does not provide the necessary clarity about the status of remedial investigations and/or actions necessary to clean up the contamination that occurred over decades of taconite mining and processing.	FEIS Table 4.2.1-2: NorthMet Project Proposed Action Area of Concern Summary List for Voluntary Investigation and Cleanup Program, has been updated in the FEIS to show the current status and additional information where available. Costs for assessment, investigation, and cleanup are not feasible to provide (Personal communication, Email from Jim Robin, MPCA, to ERM, October 27 & 29, 2014). The April 6, 2010, Consent Decree is a court registered agreement between Cliffs Erie LLC and the MPCA to resolve alleged violations of Cliffs Erie's NPDES/SDS permits for its Hoyt Lakes and Dunka mining area facilities (State of Minnesota v. Cliffs Erie, L.L.C. 2010, as cited in the FEIS). Of particular relevance to the NorthMet project, the Consent Decree addresses issues at the current Cliffs Erie tailings basin (including outfall SD026) and discharges from the Cliffs Erie Area 5 mining area (SD033). The Tailings Basin is part of the NorthMet Project Proposed Action, whereas Area 5 is not; however, PolyMet has entered into an agreement with Cliffs Erie where both areas would be transferred to PolyMet upon issuance of project permits. Until that time, Cliffs Erie retains responsibilities for permit-related activities at the tailings basin and Area 5. While certain Consent Decree-related activities have been in progress or have been completed for these areas since the SDEIS, there has been no change in ownership or responsible parties since that time (Personal communication, Email from Jim Robin, MPCA, to ERM, October 27 & 29, 2014).	HAZ 05

Comment ID	Comment	Response	Theme(s)
19633	The SDEIS does not provide sufficient information for the public to understand whether the NorthMet Project Proposed Action will be required to remediate these and other AOCs before commencing project operations, or be allowed to defer remediation until closure. It is not clear in the SDEIS how the Voluntary Investigation and Cleanup ("VIC") program requirements will be applied to PolyMet	FEIS Table 4.2.1-2: NorthMet Project Proposed Action Area of Concern Summary List for Voluntary Investigation and Cleanup Program, has been updated in the FEIS to show the current status and additional information where available. Costs for assessment, investigation, and cleanup are not available. The April 6, 2010, Consent Decree is a court registered agreement between Cliffs Erie LLC and the MPCA to resolve alleged violations of Cliffs Erie's NPDES/SDS permits for its Hoyt Lakes and Dunka mining area facilities. The Consent Decree addresses issues at the Tailings Basin (including outfall SD026) and discharges from the Cliffs Erie Area 5 mining area (SD033). While the latter area is not part of the NorthMet Project Proposed Action, PolyMet has entered into an agreement with Cliffs Erie, whereby it would be transferred to PolyMet upon issuance of permits for the NorthMet Project Proposed Action. Until that time, Cliffs Erie retains responsibilities for permit-related activities at both the Tailings Basin and Area 5. While certain Consent Decree-related activities have been in progress or have been completed for these areas since the SDEIS, there has been no change in ownership or responsible parties since that time.	HAZ 05
19634	Cliffs Erie (now Cliffs Natural Resources) was party to a Consent Decree and approved work plan(s) with MPCA regarding their remedial responsibilities, but there is little information in the SDEIS for the public to be assured regarding the need for PolyMet to enter into a legally binding agreement and develop approvable work plans to address their responsibilities.	The FEIS discusses in section 3.2.3.2 how the Consent Decree under the NorthMet Project No Action Alternative would require Cliffs Erie to complete closure and reclamation activities at the Plant Site. This would include completing activities for the localized affected areas under the Minnesota VIC Program, removal of the former Plant Site building, and management of seepage at the Tailings Basin embankment. The FEIS identifies in Table 3.2-1 that under the NorthMet Project No Action Alternative, there would be no mining activities, and that existing management and land use of the federal lands would continue. The NorthMet Project No Action Alternative is also analyzed under each resource area in the FEIS Chapter 5, and summarized in the FEIS Table 7.2-1. FEIS Section 5.2.3.4 identifies that under the NorthMet Project No Action Alternative there would be no direct or indirect effects on wetlands. If the project progresses through permitting, MPCA and DNR would determine the responsible parties for clean up of legacy and other project related impacts managed under permit. See also response to 19636.	ALT 14
19635	It seems reasonable to expect PolyMet to clean up all legacy contamination as quickly as possible; in fact, remedial actions should be integrated with the	These comments provide information on the legacy contamination sites at the NorthMet Mining project. No changes were made to the EIS as a result of these comments.	HAZ 05

Comment ID	Comment	Response	Theme(s)
	'refurbishing' actions they plan to do to re-tool the taconite processing facilities to accommodate their processing needs.		
19636	the public may not realize that the actual cleanup of LTV's legacy contamination may be deferred until reclamation and closure of the NorthMet Project. This timeline is not acceptable, and the SDEIS should not be vague about the pace of fulfilling remedial requirements.	FEIS Table 4.2.1-2 includes the updated NorthMet Areas of Concern (AOCs) Summary List from the MPCA Voluntary Investigation and Clean-up Program. PolyMet has entered into an agreement with Cliffs Erie where the AOCs on the Mine Site would be transferred to PolyMet upon issuance of project permits. Until that time, Cliffs Erie retains responsibilities for permit-related activities at the AOCs. While certain Consent Decree related activities have been in progress or completed for these areas since the SDEIS, there has been no change in ownership or responsible parties since that time. Costs for assessment, investigation, and cleanup, are not feasible to provide.	HAZ 05

Comment ID	Comment	Response	Theme(s)
19637	Inadequate hydrologic and geochemical characterizations using all existing data; insufficient new data to support modeling and assumptions. Many of the deficiencies in site characterization and water modeling from the 2009 DEIS persist in the 2013 SDEIS despite some new data collection (not all of which was used) and new modeling (using unrealistic or unsupported assumptions and neglecting to consider critical features). As detailed in extensive comments submitted by tribal cooperating agencies to the co-lead agencies over the past seven years, water quality analyses for the Partridge and Embarrass Rivers are inadequate. Water modeling results, whether deterministic (DEIS) or in the form of probability distributions (SDEIS) are based on flawed understanding of hydrology at both the mine site and plant site. One example of this flawed understanding is the error in baseflow calculations, which is carried forward in the MODFLOW hydrologic modeling. At the mine site, MODFLOW under-predicts the amount of water that would flow into the mine pits and thus under-predicts the amount of water treatment needed for both short and long term closure. At the plant site, the MODFLOW model is constructed in a way that is not representative of the site's physical conditions and therefore yields results that are not logical.	In the FEIS Mine Site GoldSim model, bedrock flowpaths have been reconfigured with a bulk hydraulic conductivity that is approximately one order-of-magnitude higher than what was used in the SDEIS. In addition, the flowpaths are remodeled to be 15 meters thick to account for new information indicating that upper bedrock tends to have higher hydraulic conductivity, and this zone tends to control the overall groundwater flow within the bedrock. The model does consider the Virginia Formation as a separate hydrostratigraphic unit and assigns a higher hydraulic conductivity to this unit compared to the Duluth Complex. The presence of higher hydraulic conductivity Virginia Formation explains the higher pit inflows predicted for the East Pit, which is partially excavated into this bedrock unit. Note that Virginia Formation is not relevant to bedrock flowpaths in the Mine Site GoldSim model because the flowpaths only exist in Duluth Complex rock. The FEIS Plant Site MODFLOW model was modified and recalibrated for the FEIS as follows: 1) updated areal distribution of surficial deposits and bedrock outcrops, 2) established surficial deposits below and adjacent to the East Embankment, 3) used drain or river cells along the East Embankment to allow surface seepage of tailings water, 4) incorporated the hydrologic effects of the future swale to drain surface water from the East Embankment area, 5) recalibrated model material properties and boundary conditions using all available site data through 2013 (this is mostly new hydraulic head information), and 6) expanded the use of river and drain cells to provide a more accurate representation of wetlands outside the Tailings Basin. As a result of these changes, the FEIS Plant Site MODFLOW model no longer has no-flow boundary condition at the toe of the East Embankment, and river and/or drain cells in surficial deposits are in place to allow the potential for surface seepage ("upwelling") were added. The model was calibrated to insure that hydraulic heads in the tailings and adjacent surficial deposits were not well above ground surface. In the FEIS Plant Site MODFLOW model, storage coefficients for the surficial deposits and bedrock outcrops were assigned and/or calibrated to be more in line with literature values for these types of materials.	WR 011 WR 058 WR 060 WR 071 WR 093 WR 103 WR 176 WR 179

Comment ID	Comment	Response	Theme(s)
19638	"Hard rock mining affects fresh water through heavy use of water in processing ore, and through water pollution from discharged mine effluent and seepage from tailings and waste rock impoundments." Acid mine drainage ("AMD") is one of the greatest environmental liabilities associated with mining, especially in pristine, water-rich environments like the Project mine site, that have economically and ecologically valuable natural resources. There are no hard rock surface mines that exist today that can demonstrate that AMD can be stopped once it occurs on a large scale. Inaccurate pre-mining characterization and interpretation often results in a failure to recognize or predict impacts to water quality and aquatic life. Evidence from literature and field observations suggests that permitting large scale surface mining in sulfide-hosted rock with the expectation that no degradation of surface water will result due to acid generation imparts a substantial and unquantifiable risk to water quality and fisheries. In a report comparing predicted and actual water quality at hard rock mines, two types of characterization failures were identified that led to differences between the predicted water quality in EIS documents and the actual water quality either during or after mining began. These included: (1) insufficient or inaccurate characterization of the hydrology. The authors reported primary causes of hydrologic characterization failures as overestimations of dilution, lack of hydrological characterization, overestimations of discharge volumes, and underestimations of storm size. (2) insufficient or inaccurate geochemical characterization of the proposed mine. The primary causes of geochemical characterization failures were identified as lack of adequate geochemical characterization, in terms of sample representativeness and sample adequacy. The	The Co-Lead Agencies have requested additional hydrologic and geochemical data and the incorporation of those data into EIS analyses periodically throughout the environmental review process by the Co-Lead Agencies. The criteria the Co-Leads used to determine what data is included in the FEIS are as follows. Is the updated data: • Significantly different than the data already used in the model? • An integral component of a calibrated variable? • Linked to other data such that updating one necessitates updating the other? • Considered background information important to assessing the project's impacts? • Part of a greater dataset such that updating all of the dataset is necessary for consistency? • A type of input variable where GoldSim is sensitive? • Necessary for permitting-level analyses? Data collection and use in the FEIS are summarized in various data sufficiency documents. Nevertheless, a degree uncertainty in the predictions of environmental effects remains, as it would for any study of this type. The Co-Lead Agencies have addressed this uncertainty is several ways. Water quality modeling results (concentrations) are presented in terms of a probability, which communicates the likelihood actual concentrations could be higher or lower than what was modeled. Sensitivity analyses were performed on temperature and precipitation inputs, baseflows in the Partridge River and other inputs. The FEIS identifies monitoring and reliable mitigation measures that have been incorporated in the NorthMet Project Proposed Action, possible improvements to these measures and additional mitigation that could be implemented if effects to water quality are worse than predicted. Additionally, on-going monitoring would be used in modeling to help predict any issues before they occur. A detailed financial assurance analysis would be part of the permitting phase. The financial assurance process would fully consider long-term monitoring and periodic replacement of equipment including, but not limited to, water treatment hardware and synthetic liners/covers. The Financial Assurance package for the NorthMet Project Proposed Action would insure that future funding would be available if and when adaptive	PD 01 WR 128

Comment ID	Comment	Response	Theme(s)
	primary causes of mitigation failures were that mitigation measures were not identified, were inadequate, or were not implemented; waste rock mixing and segregation was not effective; liners leaked; tailings were spilled; or embankments failed, and land application discharge was not effective. The NorthMet Project Proposed Action, as defined in the SDEIS includes all of these characterization failures.	mitigation measures or component replacements are needed to achieve performance specifications. Taking the data, modeling, proposed monitoring, mitigation, adaptive management and financial assurance together, the NorthMet EIS sufficiently discloses and accurately predicts to the degree possible potential effects to water quality.	
19639	The Project overestimates dilution of polluted water by underestimating baseflow in the bedrock surficial aquifer at both the mine and plant sites.	Groundwater baseflows used in the SDEIS are best-estimate values and should be retained in the FEIS. This is because the SDEIS groundwater baseflow values were based on 1) winter 1986-87 and winter 1987-88 stream gaging in the Partridge River at SW006 that occurred when there were no discharges from Northshore and 2) 1942 to 1963 gaging data in the Embarrass River, which includes years prior to the LTV tailings basin startup (1957). When expressed as a groundwater baseflow yield per unit area, the similar results for both watersheds (approximately 0.05 cfs per square mile) supports the approach used. The yield per unit area is similar to other watersheds in Northern Minnesota. Studies have shown that streamflow characteristics in this part of Minnesota have not changed systematically over the last 50 years. The water quality predictions generated by the Mine and Plant Site GoldSim models reasonably consider the groundwater baseflow contributions in projecting potential contaminant levels within the Partridge River and Embarrass River during project operations, reclamation, and closure.	WR 165
19640	A fundamental lack of hydrologic characterization enables PolyMet to reach a fictitious conclusion that there will be no water pollution resulting from the Project. No bedrock monitoring wells were installed near the tailings basin. The number of groundwater samples used to model the Mine Site included three or more samples from each of 23 monitoring wells in the surficial aquifer (a 24th well was dry after the first sampling, so it only provided a single sample). Of these, 12 were new monitoring wells installed in the surficial aquifer in 2012, yet data collected from them was not used	The SDEIS was based on data generally collected through October 2012. The FEIS relied on new data collected through the end of 2013, which included 12 new monitoring wells at the Mine Site. In addition, the FEIS made use of new geotechnical data collected in 2014 along the north, northwest, and west perimeter of the Tailings Basin; included geologic logs, ten new surficial aquifer piezometers, slug tests in the piezometers, and ten bedrock packer tests performed in five boreholes advanced into upper bedrock. Hydrogeologic site characterization was sufficient for purposes of environmental review. All publically available and relevant studies were considered in developing the SDEIS and FEIS. These include technical reports prepared by the Proposer, reports from State and Federal agencies, technical papers in peer	WR 071 WR 095

Comment ID	Comment	Response	Theme(s)
	to model and predict potential impacts to water surrounding the Project. Storage coefficients used to model the entire Plant site area are not consistent with any peer reviewed scientific literature.	reviewed journals, and technical reports associated with other mine sites. The SDEIS and FEIS preparers drew on these information sources to the degree that they were reliable and relevant to the assessment of potential NorthMet Project Proposed Action impacts. The FEIS provided a description of data used to assess impacts. An explanation was provided regarding any data used and not used in finalizing the FEIS MODFLOW and GoldSim models. It is well known that unexplained sampling/laboratory issues can cause occasional chemical results to be incorrect and unusable for site characterization. This happens to some extent on all large projects where sampling is conducted at many locations and for long periods of time. When an occasional data value is clearly anomalous and does not fit in any reasonable way with the bulk of the related data, it is an acceptable practice to not use the anomalous value for characterization to develop a more accurate site characterization. During winter 2013-2014, an investigation of bedrock was conducted along the north, northwest, and west perimeter of the tailings basin. The investigation included five boreholes advanced into upper bedrock and 10 packer tests conducted in these holes. The investigation provided rock core, Rock Quality Designation data, and hydraulic conductivity of discrete intervals within the upper bedrock. The results of this investigation are reported in Barr 2014b (as cited in the FEIS) and in FEIS Section 4.2.2.3.1. It is correct there are currently no bedrock monitoring wells at the Plant Site. Installation of bedrock monitoring wells would be specified as part of the permitting process, with the results used to assess project performance on an ongoing basis. The MODFLOW and GoldSim models for the Mine and Plant Sites were modified and recalibrated using groundwater level and sampling data collected through the end of 2013. At the Mine Site, this included all 24 monitoring wells, including data from 12 newer wells that was not used in the SDEIS. Stream gaging data used in the SDEIS and FEIS is adequate to characterize groundwater baseflow, seasonal flow, and storm runoff in the Partridge and Embarrass Rivers. See the responses to themes WR 011 and WR 012 for additional discussions of fracture flow and hydrology. In the FEIS Plant Site MODFLOW model, storage coefficients for the	

Comment ID	Comment	Response	Theme(s)
		surficial deposits and bedrock outcrops were assigned and/or calibrated to be more in line with literature values for these types of materials.	
19641	The hydrology model that was applied used outdated data collected at a significant distance from the site. The Project XP-SWMM model is based on a stream gauging station for the Partridge River that is seventeen miles from the mine site and the data from that station are twenty years old; and stream gauging data for the Embarrass River that is based in data that is more than fifty years old from eleven miles downstream. Therefore, the results are highly unlikely to be representative of current conditions at the mine or plant site. This baseline hydrologic data deficiency has been carried forward from the 2009 DEIS, despite ample time and opportunity to collect sufficient new hydrologic data. The tribal cooperating agencies have long urged the co-lead agencies to require a more rigorous modeling effort before any confidence can be placed in predictions of Project impacts. From the March 2, 2012 Coleman memo to the co-lead agencies: "The calibration of the Modflow model to a Partridge River baseflow of 0.76 cfs predicted by XP-SWMM results in a model that moves very little water through the groundwater system. This can result in low predicted rates of inflow to the mine pit and slow movement of contaminants from sources (stockpiles or reflooded pits) to points of evaluation. More generally, an incorrect baseflow calibration target results in excessively low estimates of recharge and likely incorrect estimates of horizontal and vertical conductivity. These hydrologic parameters are interrelated and getting one wrong, as appears to be the case with baseflow, will almost certainly result in the other parameters being incorrectly estimated…Our long standing concern that the mine site hydrologic models incorporate incorrect assumptions about	Groundwater baseflows used in the SDEIS are best-estimate values and should be retained in the FEIS. This is because the SDEIS groundwater baseflow values were based on 1) winter 1986-87 and winter 1987-88 stream gaging in the Partridge River at SW006 that occurred when there were no discharges from Northshore and 2) 1942 to 1963 gaging data in the Embarrass River, which includes years prior to the LTVSMC tailings basin startup (1957). When expressed as a groundwater baseflow yield per unit area, the similar results for both watersheds (approximately 0.05 cfs per square mile) supports the approach used. The yield per unit area is similar to other watersheds in Northern Minnesota. Studies have shown that streamflow characteristics in this part of Minnesota have not changed systematically over the last 50 years. The only other available gaging data is from a station installed during 2011 at SW003 on the Partridge River. Interpretation of groundwater baseflow at SW-003 is not reliable for use in the GoldSim modeling of groundwater baseflow due to the complicating effects of Northshore PMP pumped discharges, seepage from the Northshore Western Pond, and complex storage/release mechanisms in the wetlands that receive these flows. More broadly, groundwater baseflow discharge varies with time and is a reflection of longer-term weather and climatic conditions. The variability of groundwater baseflow discharge is demonstrated by the examination of estimated values for several years using different methods. Evaluation of these values affirms continued reliance on the 1986-87 USGS data for the FEIS is reliable. To better understand the relationship of groundwater baseflow to the GoldSim model's water quality impact projections, a sensitivity analysis for the Mine Site was conducted to evaluate if predicted Project impacts are sensitive to groundwater baseflow values. The sensitivity analysis considered the relationship of various model inputs to groundwater baseflow including hydraulic conductivity, recharge, and surface runoff chemical concentrations. It also reflected consideration of the flow data collected at SW003 in requiring groundwater baseflows at all locations on the Partridge River be increased by a factor of 4 (e.g., 0.5 to 2.0 cfs at SW-003). The results indicate that modeled groundwater and surface water concentrations are sensitive to changes in groundwater baseflow. However, the NorthMet Project Proposed Action's ability to meet groundwater	WR 003 WR 071 WR 086 WR 091 WR 175

Comment ID	Comment	Response	Theme(s)
	recharge are supported by Fred Marinelli's comment on line 39 and elsewhere of: "Agency Responses MS and PS WP and Waste Characterization Datapackage V7 2-7-12.xls". His comment states that "A net infiltration (recharge) range of 0.3 to 1.5 in/yr represents 1.1 to 5.4 percent of mean annual precipitation (MAP). This range for local net infiltration is unrealistically low for this area of the US." These low recharge values and the low vertical K values are related to calibration of the Modflow model to low baseflow. Until Modflow, and by extension the other related models XP-SWIMM and GoldSim, are calibrated to data from the site (e.g. observed baseflow and an adequate number of observed heads) and incorporate reasonable recharge rates, the results from the models are unlikely to accurately simulate current or future conditions…The Modflow model, in particular, needs to be calibrated with targets based on observed baseflow and observed well water heads. Calibration to projections by XP-SWMM, that appear to be incorrect, means that the fundamental characterization of the site hydrology is likely to be faulty…. The focus on water quality parameters to the near exclusion of hydrologic flow parameters is reflected in the Groundwater IAP summary memo of June 2011. Groundwater flow modeling underpins contaminant transport modeling and is interrelated to surface flow models. Without adequate vetting of flow model parameters and predictions, it is impossible to have confidence in predictions of contaminant movement and water quality."	quality and surface water quality evaluation criteria is not sensitive to changes in baseflow. Evaluation criteria can be found in Section 5.2.2. The purpose of the groundwater baseflow analysis was to 1) evaluate natural characteristics of the surficial aquifer such as recharge and hydraulic conductivity and 2) estimate natural groundwater discharges into the rivers during low-flow conditions. Note that non-natural discharges into the rivers were estimated separately in the site models. Use of older data for evaluating natural hydrologic conditions was justified because it was not affected by artificial (non-natural) discharges into the stream channels by Northshore and LTVSMC operations.	
19642	Underestimation of storm size and frequency is a serious problem for capture and treatment of polluted water from the Category 1 waste rock stockpile and tailings basin, tailings basin stability, and stormwater run-off from the Overburden	Estimates of monthly and annual rainfall amounts inputted into the water models were based on best available data obtained from weather stations near the NorthMet Project Proposed Action site. Rainfall inputs were based at a minimum on the 30-year climatic normal data. In the GoldSim models, these parameters were treated as uncertain inputs and assigned probability	WR 077 WR 180

Comment ID	Comment	Response	Theme(s)
	Storage and Layout Area (OSLA). Project estimates were based on one-hundred-year storm events. Before recognition of climate change impacts, this would have been a reasonable assumption. Now, storm severity and frequency suggest that what was previously considered a one-hundred-year storm event may occur once every ten years.	distributions to capture the range of possible future conditions. While climate change may occur in the future, it cannot be stated at this time if in the long-term there would be more or less rainfall. Thus, the probabilistic approach to rainfall used in GoldSim represents a technically defensible method for dealing with this issue. Individual storm events and frequency are not incorporated into the GoldSim models.. The effects of individual storms are considered by designing facilities to handle a 100 year - 24 hour storm event based on current data. If over time, climate change causes a gradual increase in annual rainfall, the 100 year storm event would be redefined to a larger precipitation value and mine facilities would be upgraded to handle a larger storm. For the Mine Site, a GoldSim sensitivity analysis was conducted to assess the possible effects of future climate change on groundwater and surface water impacts. It was concluded that reasonably foreseeable climate change would have little effect on pit inflows, pit lake water quality, groundwater chemical concentrations, and surface water chemical concentrations. These results are reported in the Water Modeling Data Package - Mine Site (Barr; December 2014). By analogy, the Plant Site is also expected to be minimally affected by possible future climate change. See the responses to themes WR 077 and WR 180.	
19643	Many mitigation measures were not identified or evaluated using the required NEPA "hard look". Those mitigation measures that have been identified and carried forward as the Proposed Project are inadequate, especially the tailings basin seepage capture system. The tailings basin is unlined, and the seepage capture system has not been designed to collect any seepage from the east side of the tailings basin. This flow path for project pollutants to reach surface and ground water has not been addressed at all. The waste rock mixing and segregation has not been demonstrated to be effective at other similar projects. Liner leakage rates are very optimistically estimated using solid waste landfill average leakage rates (lined solid waste landfills are much smaller).	The FEIS Plant Site MODFLOW model was modified from the SDEIS to include: 1) the presence of surficial deposits below the East Embankment, 2) boundary conditions (drain and/or river cells) along the embankment toe to allow the potential for surface seepage, and 3) hydrologic inputs to account for the presence of the proposed drainage swale. Similar to other locations along the perimeter of the Tailings Basin, the project was modified to include installation of a containment system along the East Embankment where it is underlain by surficial deposits. Given the hydrogeology of the area east of the Tailings Basin and the proposed swale to be constructed there, this containment system would have higher hydraulic head on the east side compared to the west (tailings) side where a pumped trench would depress the groundwater level. This would create hydraulic gradients in the slurry wall and in shallow bedrock that would drive (low) flows from east to west across the containment system. This set of hydraulics would result in complete capture of all tailings water approaching the containment system from the Tailings Basin. Because the system would achieve complete capture of tailings water, an east side	NEPA 14 WR 054 WR 126

Comment ID	Comment	Response	Theme(s)
		chemical transport flowpath is not needed in the Plant Site GoldSim model. There is no hydrologic reason to expect that impacted water from the Tailings Basin would migrate east of the containment system. There is a long history of rock segregation on the Iron Range and regulatory agencies annually review the placement of rock. Technology like GPS has improved segregation practices. See the responses to theme WR 134 for more information on waste rock segregation. The assumed liner leakage rates are based on a combination of literature values, experience at mine sites, experience at other types of industrial facilities, manufacturer documentation, and information provided in standard engineering guidance documents (Section 5.2.2.3 in the Mine Site Water Modeling Data Package [PolyMet 2015m]). Liner leakage rates were estimated using the USEPA-approved HELP model, where simulations combined NorthMet Project Proposed Action design values for slopes and subgrade design with the published values for average liner defects per acre. See response to theme WR 126 for more information.	
19644	There are no predictions or contingency plans addressing the potential for tailings piped from the processing plant to the tailings basin could be spilled, or that tailings embankments may fail. The Hydrometallurgical Residue Facility (HRF) is proposed to be constructed in an area that is currently under water, and has a prominent historic drainage channel that has not been accounted for in project design or water modeling.	FEIS Section 5.2.14.2.2 (geotechnical stability of the Tailings Basin) and Section 3.2.2.3.5 (tailings management under the NorthMet Project Proposed Action) indicates that the Tailings Basin design would meet appropriate Factors of Safety and that Tailings Basin embankments would be monitored and inspected on a routine basis and repaired or strengthened on an as-needed basis (Geotechnical Data Package Volume 1(PolyMet 2015l as cited in the FEIS). The Hydrometallurgical Residue Facility would be constructed over the LTVSMC emergency basin. The design of the Hydrometallurgical Residue Facility acknowledges the presence of this seep by including a collection drain that would collect water from the seep below the proposed constructed embankment and liner systems to transmit the collected seep to the exterior of the facility. FEIS Section 5.2.2.3.3, and Section 5.2.14.2.3 discusses the design and construction of the Hydrometallurgical Residue Facility, and Geotechnical Data Package Volume 2 (PolyMet 2014c as cited in the FEIS) indicates the design would meet all factors of safety as required. Management of hazardous materials (including piping and other means of transport) is addressed in section 5.2.13. Monitoring would allow potential failures to be recognized and corrected if and before there would be release of impacted water to the environment..	WR 066 WR 131 WR 132 GT 01 GT 11

Comment ID	Comment	Response	Theme(s)
		Financial assurance would be adequate to: 1) monitor and inspect the engineered systems, 2) repair or replace components as necessary, and 3) apply adaptive mitigation measures that are shown to be cost-effective which would also be required under the Permit to Mine. Financial assurance is described in FEIS Section 3.2.2.4.	
19645	Project baseline data used for both the Mine Site and the Tailings Basin are still insufficient, even though this deficiency was highly criticized by many commenters on the 2009 DEIS. A comparison of hydrologic data that was collected for two other projects in the region demonstrates that the PolyMet project is data-poor in the area of basic hydrology, much less mitigation. Given the availability of the many existing studies of area hydrology, it is mystifying that the SDEIS preparers have continually neglected to use them, even as tribal cooperating agencies have repeatedly requested and recommended that they be used. A few examples of publicly available studies include: the Minnamax Project; the LTVSMC Dunka Pit, historic DNR fisheries documents; and data collected under the Cliffs Consent Decree.	Co-lead agencies rely upon the expertise and experience of their staff and consultants who bring to bear their knowledge of various studies and analyses performed on mine sites in Minnesota and elsewhere. This knowledge is applied in the review of documents prepared to evaluate the NorthMet Project Proposed Action potential effects. It should be noted that the NorthMet Project Proposed Action is different from other mining projects in this part of Minnesota in the following ways: different ore type, designs for groundwater containment systems, and use of long-term mechanical treatment. While experiences gained on other projects are informative, they do not necessarily apply to the NorthMet Project Proposed Action. This is particularly true for groundwater containment systems because the NorthMet Project Proposed Action uses a design that differs from those at other Iron Range mine sites. The mitigation designs of the NorthMet Project Proposed Action are unlike measures discussed in the Regional Copper-Nickel Study (MSPA 1979, as cited in the FEIS). The NorthMet Project Proposed Action measures include: long-term mechanical water treatment, uniquely designed groundwater containment systems, subaqueous disposal of reactive waste rock, and synthetic covers and under-liners used at waste rock stockpiles and treatment ponds. In addition, the level of construction QA/QC proposed at the NorthMet site would be much higher than what has historically occurred at older mine sites in the Iron Range. It is erroneous to conclude that operation and closure of the NorthMet Project Proposed Action site would necessarily entail the same types of failures that have occurred at some historical Iron Range mines. In fact, the unique designs and high-quality construction measures proposed are a response to past events. The detailed and sophisticated modeling work performed to support the FEIS exceed those conducted for some existing mines in Minnesota. The models used for the NorthMet Project Proposed Action represent years of development, with input from the Proposer, Co-lead Agencies and Cooperating Agencies. Based on comments received on the SDEIS, modifications were made to the models to improve FEIS impact	WR 023 WR 071

Comment ID	Comment	Response	Theme(s)
		evaluations. It is the Co-lead Agency position that incomplete or inaccurate predictions made in the past at historical mining operations do not provide a basis for judging the quality of modeling to be used in the NorthMet FEIS. The EIS reflects consideration of information pertaining to the Dunka Pit that was directly relevant to the NorthMet Project Proposed Action. It is noteworthy that many aspects of operations at the Dunka Pit are dissimilar to the NorthMet Project Proposed Action in terms of hydrogeology and mine design. See the response to theme WR 071.	
19646	there is no explanation for the failure to use pre-mining flow and sulfate data available through DNR fisheries reports to determine potential water quality and quantity impacts, or cumulative effects to flow and water quality in the Embarrass, Partridge, or St. Louis Rivers. In fact, decades-old flow data (1942 – 1964) was used instead of recently collected data in the Embarrass River watershed even though that historic flow data precedes any mining. Surface water and groundwater quality and quantity data collected for the Minnamax Project, LTVSMC Dunka Pit, and the VIC program were listed in SDEIS, but largely ignored in water quality and quantity predictions.	The Co-Lead Agencies have requested additional hydrologic and geochemical data and the incorporation of those data into EIS analyses periodically throughout the environmental review process by the Co-Lead Agencies. The criteria the Co-Leads used to determine what data is included in the FEIS are as follows. Is the updated data: • Significantly different than the data already used in the model? • An integral component of a calibrated variable? • Linked to other data such that updating one necessitates updating the other? • Considered background information important to assessing the project's impacts? • Part of a greater dataset such that updating all of the dataset is necessary for consistency? • A type of input variable where GoldSim is sensitive? • Necessary for permitting-level analyses? Data collection and use in the FEIS are summarized in various data sufficiency documents. To assess the incremental effects of the NorthMet Project Proposed Action on water resources in the Embarrass River and Partridge River, the best information representative of existing conditions was used as the baseline. This method allows the proper assessment of the project on the environment. The assessment of cumulative effects does not require the tracing of water quality throughout time, but the aggregation of effects considering a proposed action. Water quality models were calibrated to existing conditions in and around the Plant Site and Mine Site. This allowed for the highest degree of model accuracy.	WR 003 WR 023 WR 071 WR 175

Comment ID	Comment	Response	Theme(s)
19647	The cumulative body of data and public information regarding clear risks to area hydrology from mining at the PolyMet site cannot be ignored, with only new, favorable data be inserted into the SDEIS instead. Extensive experience from other hard rock mines and their faulty predictions of water quality impacts should compel the co-lead agencies to recognize the need for significant improvements to the modeling evaluations.	The detail and sophistication modeling work performed to support the FEIS far surpasses any analyses that have ever been performed at mines in Minnesota. The models used for the Proposed Action represent years of development, with input from the PolyMet, Co-lead Agencies and Cooperating Agencies. Based on comments received on the SDEIS, modification were made to the models to improve FEIS impact evaluations. Inaccurate predictions made in the past at historical mining operations do not provide a basis for judging the quality of modeling to be used in this FEIS. In addition, the mitigation designs of the Proposed Action differ from the many other hard rock mines. The Proposed Action measures include: long-term mechanical water treatment, uniquely designed groundwater capture systems, subaqueous disposal of reactive waste rock, and synthetic covers and under-liners used at waste rock stockpiles and treatment ponds. In addition, the level of construction QA/QC proposed at the NorthMet site would be much higher than what has historically occurred at older mine sites in the Iron Range. It is erroneous to conclude that operation and closure of the Proposed Action site would necessarily entail the same types of failures that have occurred at some historical Iron Range mines. Some of the unique designs and high-quality construction measures proposed are in response to past mine site events.. Also see the response to theme WR 071.	PD 26 WR 023 WR 071 WR 189
19648	Inadequate water quality impacts analysis. From SDEIS 5.2.2, Water Resources: with the proposed design modifications and engineering controls, the water quality model predicts that the NorthMet Project Proposed Action would not cause or increase the magnitude of an exceedance of the groundwater and surface water quality evaluation criteria at the P90 level for any of 28 solutes at 29 groundwater or surface water evaluation locations within the Partridge River and Embarrass River watersheds, with two exceptions: Aluminum...Lead…Evidently, the public is expected to uncritically accept the project proponent's assertion that a 700-ft deep open pit sulfide mine, a 526-acre permanent reactive waste	The FEIS discusses lead concentrations in the Embarrass River in Section 5.2.2.3.3, providing better discussion of results to avoid misinterpretation. According to the 2004 - 2012 surface water monitoring results, average lead concentrations on the Embarrass River do not exceed the water quality standard (3.2 ug/L) at 100 mg/L hardness. Under certain circumstances, water quality model results predict an exceedance of the lead surface water evaluation criterion in Unnamed Creek, north of the Tailings Basin. These exceedances would not be a direct effect but a side effect of the NorthMet Project Proposed Action and would be the result of the capture and removal of dissolved solids by the Plant Site WWTP and the associated decrease in the hardness-based lead evaluation criterion. The WWTP effluent would meet the water quality evaluation criteria, but exceedances could infrequently occur when non-project, noncontact surface runoff mixes with the WWTP effluent and lowers hardness more than it dilutes lead concentrations. Evaluation criteria	WR 003 WR 056 WR 071 WR 072 WR 082 WR 128 WR 129

Comment ID	Comment	Response	Theme(s)
	rock stockpile, a pit lake requiring water treatment in perpetuity, a tailings basin that has already contaminated ground and surface water that now will host reactive sulfide tailings, and a permanent hazardous waste facility constructed within a wetland, will collectively result in only two exceedances of water quality standards – and they are not even directly attributable to the Project Proposed Action! This stunning conclusion is a result of flawed modeling assumptions (baseflow, hydraulic connectivity, etc.), dubious decisions on data usage (omitting 'outliers', concentration caps, etc.), fuzzy compliance thresholds, and inordinate reliance on engineering controls that must perform flawlessly, most of them in perpetuity.	can be found in Section 5.2.2. The FEIS discusses current aluminum concentrations in the Embarrass River in Section 5.2.2.3.3, providing better discussion of results to avoid misinterpretation. According to the 2004 - 2012 historic surface water monitoring results, average aluminum concentrations on the Embarrass River do not exceed the water quality standard (125 ug/L). This is considered a NorthMet Project Proposed Action side effect. The NorthMet Project Proposed Action would not directly cause an exceedance of the groundwater and surface water quality evaluation criteria of aluminum. Additionally, the FEIS Project Description indicates that Colby Lake water, with higher aluminum concentrations, would not be used for direct surface water augmentation. However, the capture of Tailings Basin seepage with low aluminum concentrations (5 to 20 ug/L) by the groundwater containment system could result in exceedances of the aluminum evaluation criteria in tributary streams north of Tailings Basin. Capture of the seepage would result in less dilution, increasing the proportion of non-project, non-contact surface water runoff with higher natural aluminum concentrations (70 to 160 ug/L) reaching the streams. Elevated aluminum levels under the NorthMet Project Proposed Action modeling scenario are considered a side effect of the project.	
19649	The NorthMet Project Proposed Action is also not predicted to result in any significant changes to groundwater and surface water flows when compared to existing conditions. Again, a remarkable conclusion grounded in the assumption that all seepage capture systems will operate at unrealistic performance rates in perpetuity, and dismissing the significant error in the baseflow value used to model project impacts. Surface water quality remains insufficiently characterized or left uncharacterized, and the defects in analysis are profound in this area.	The FEIS relies on revised cross-section models from the SDEIS to evaluate containment systems on the northern, northwestern, and western sides of the Tailings Basin, which are documented in the revised NorthMet Project Water Management Plan - Plant (PolyMet 2015i, as cited in the FEIS). These new models consider the presence of an upper more-permeable bedrock zone directly below the slurry wall, with hydraulic properties based on 2014 packer tests conducted in five boreholes along the proposed capture system alignment. Sensitivity analyses have included variable bedrock hydraulic conductivity and different upper bedrock zone thicknesses up to 100 feet. The model results predict that the overall groundwater capture efficiencies of the proposed Tailings Basin surface and groundwater seepage containment system would be substantially greater than 90%. This analysis supports the conclusion that the assumption of 90% or greater groundwater capture efficiency is justified. Based on a MODFLOW groundwater model specifically developed to assess capture efficiency of the Category 1 system, it was concluded that the system would achieve an overall efficiency between 90% and 94% for groundwater flowing in surficial deposits and bedrock. This analysis	WR 003 WR 017 WR 018 WR 021 WR 115

Comment ID	Comment	Response	Theme(s)
		supports the conclusion that the proposed Category 1 surface and groundwater seepage containment system has a high probability of meeting its performance specifications; thus, there was no need to consider a range of capture efficiency inputs in modeling. Groundwater baseflows used in the SDEIS are best-estimate values and were retained in the FEIS. The Co-Lead Agencies have requested additional hydrologic and geochemical data and the incorporation of those data into EIS analyses periodically throughout the environmental review process by the Co-Lead Agencies. The criteria the Co-Leads used to determine what data is included in the FEIS are as follows. Is the updated data: • Significantly different than the data already used in the model? • An integral component of a calibrated variable? • Linked to other data such that updating one necessitates updating the other? • Considered background information important to assessing the project's impacts? • Part of a greater dataset such that updating all of the dataset is necessary for consistency? • A type of input variable where GoldSim is sensitive? • Necessary for permitting-level analyses? Data collection and use in the FEIS are summarized in various data sufficiency documents. .	
19650	Contaminant transport modeling suggests that the Project will cause manganese, aluminum, and sulfate to exceed Minnesota Water Quality Standards ("MN WQS"). Mercury, sulfate, and specific conductance already exceed surface water criteria in surface water samples collected near the tailings basin at nearby Area Pit 5, and mercury and aluminum exceed surface water criteria in the Partridge River downstream of Colby Lake. Aluminum, iron, manganese, and mercury all exceed MN WQS in Colby Lake. Contaminants from the Project will likely contribute additional loading to these existing exceedances of MN WQS in the Embarrass River, Colby Lake, and the	The evaluation and decision of whether or not the NorthMet Project Proposed Action may or may not discharge into surface waters where water quality standards are exceeded is a permit decision. The FEIS identifies potential impacts to water resources and measures available to anticipate and control these same impacts. Water resources are considered not to be significantly impacted if evaluation criteria are met at evaluation locations. Evaluation criteria can be found in Section 5.2.2. If water quality criteria are not met under the CEC modeling scenario, the FEIS evaluates whether the NorthMet Project Proposed Action causes or increases concentrations. Surface water quality criteria apply instream after the groundwater discharge has mixed with ambient surface water (independent of proximity to the project property boundary). Evaluation criteria are based on a	WR 064 WR 075 WR 109 WR 197

Comment ID	Comment	Response	Theme(s)
	Partridge River. There have not been any water samples collected from lakes in proximity to the tailings basin (Hiekkilla, Mud, Kaunonen, or Hay Lakes) to determine if the pollutants found in the surface and groundwater at the existing tailings basin have caused contamination of those waterbodies.	combination of health-based water quality standards for drinking water sources (such as groundwater and Colby Lake) and mercury in surface water (fish consumption) and on aquatic life-based standards for surface waters. Evaluation criteria can be found in Section 5.2.2. Groundwater evaluation criteria apply to groundwater at the project property boundary and the GoldSim models predicts that these criteria would be met. For the different flowpaths, groundwater travel times to groundwater evaluation locations and surface water discharge points are presented in the FEIS, including the times for initial change in chemical concentrations and the times to reach peak concentrations. Once chemicals are released from groundwater to surface water, it is assumed that migration is instantaneous to surface water evaluation locations. Sampling of the listed lakes would not have added substantially to the overall Plant Site characterization for the purpose of impacts assessment. It should be noted that Spring Mine Lake is located upstream of the east side of the Tailings Basin and has been sampled for water quality.	
19651	Groundwater contamination from previous mining activities persists near the LTVSMC tailings basin, more than twelve years after operations ceased. Over the decades of operations at the LTVSMC tailings basin, thousands of gallons per minute of tailings basin water were discharged through the bottom of the basin into groundwater. This plume of contaminated water has been slowly moving down gradient into surrounding wetlands and the Embarrass River. The monitoring wells that do exist near the tailings basin have concentrations of pollutants including iron, sulfate, manganese, aluminum, and fluoride that exceeded drinking water standards. But because of the limited distribution of monitoring wells, the extent of the existing contaminant plume is not known. No bedrock monitoring wells have been drilled in the vicinity of the tailings basin. However, domestic wells near the northern property line show substantial contamination of the groundwater aquifer.	Section 4.2.2.3.1 has been revised to more clearly communicate groundwater quality at the existing LTVSMC Tailings Basin. The FEIS uses information from 27 domestic wells, Northeast Minnesota Baseline study and Regional Copper Nickel Study to characterize existing surficial groundwater quality. It is acknowledged that bedrock groundwater at the Plant Site has not been sampled for the FEIS. Effects to bedrock groundwater at the Plant Site are not anticipated. The characteristic hydraulic conductivity of upper bedrock is taken to be 4 x 10-2 m/day, which is two orders-of-magnitude lower than the hydraulic conductivity used in the GoldSim model for the overlying surficial deposits. Given this difference in hydraulic conductivities, the Co-Lead Agencies conclude that the GoldSim water quality model does not need to be revised to specifically include groundwater flow and transport in bedrock. The cross-section modeling indicates that in the presence of more permeable upper bedrock, the groundwater capture systems would still achieve substantially higher capture efficiencies than what was assumed in the SDEIS GoldSim model.	HU 03 WR 008 WR 064

Comment ID	Comment	Response	Theme(s)
19652	Regardless, modeling of PolyMet contaminants at the tailings basin did not take existing pollutant concentrations into account, and pretends that existing contamination is an acceptable "baseline" from which only new contamination should be measured.	The FEIS does not consider the magnitude of change to water quality due to the NorthMet Project Proposed Action from a theoretical, "unimpacted" or "natural" background condition. Instead, the FEIS defines baseline for purposes of modeling as the CEC, be they impacted or unimpacted. The baseline water quality and predicted water quality with project are plotted against evaluation criteria for each water quality parameter so conclusions may be drawn about the baseline and project relative to the evaluation criteria and to one another. This approach was used because it discloses the actual changes expected to the environment from the Proposed Action. Evaluation criteria can be found in Section 5.2.2.	WR 082 WR 109
19653	The assumption that 93% of the seepage from the tailings basin can be captured is unrealistic. Tribes requested the co-lead agencies or their contractor to provide any references for the 90% or greater capture efficiency rate they were confident could be achieved; they were not able to provide a single example from anywhere in the world. The co-lead agencies provided a single citation from a USEPA guidance document (generally intended to inform solid waste sites) that revealed: • most barriers in the study have been in place for fewer than 10 years; therefore, long-term performance can only be extrapolated… • All sites included in the study were existing sites that had vertical barriers and, in many cases, caps. • None of the sites has an engineered bottom barrier. Therefore, the effect of leakage through aquitards was not evaluated in this study.	The Co-lead Agencies acknowledge that there are existing water containment systems at other mine sites that do not operate with a high degree of capture, but these are different designs and cannot be directly compared to the system proposed for the NorthMet Project Proposed Action. The proposed containment system uses pumping on the tailings side and reinjection on the downgradient side to reverse hydraulic gradients across the slurry wall and in underlying bedrock. Relatively few containment systems have been built with this degree of pumping and reinjection to ensure effective capture. The conceptual hydraulics of this type of system provides evidence that it would achieve complete or nearly complete capture. The FEIS describes a 2014 field program that investigated bedrock along the alignment of the proposed containment system on the northern, northwestern, and western sides of the Tailings Basin in FEIS Section 4.2.2.3.1. This investigation provided field data on bedrock hydraulic conductivity, Rock Quality Designation data, and depth to top of bedrock. This information was used to develop revised MODFLOW cross-section models to evaluate containment system efficiencies on the northern, northwestern, and western sides of the Tailings Basin, which are documented in the revised Plant Site Water Modeling Data Package (PolyMet 2015j, as cited in the FEIS). These revised cross-sections and MODFLOW models considered the presence of an upper more permeable bedrock zone directly below the slurry wall, with hydraulic properties based on 2014 packer tests conducted in five boreholes along the proposed containment system alignment. Sensitivity analyses included variable bedrock hydraulic conductivity and different upper bedrock zone thicknesses up to 100 feet. The model results predict that the overall capture efficiencies of the proposed Tailings Basin	WR 018

Comment ID	Comment	Response	Theme(s)
		containment systems would be substantially greater than 90%. It is the Co-lead Agency position that the assumption in the Plant Site GoldSim model of 90% or greater capture efficiency is justified by the analyses performed.	
19654	Regardless of this study's applicability (or lack thereof) to seepage capture systems proposed for the PolyMet project, the EPA found that • 10% of the reviewed containment systems failed to meet the desired performance objectives and required corrective action. • An additional 19% of the evaluated facilities did not have sufficient data to conclude weather the containment system was operating successfully or not. • There is no information on the effectiveness of any of these facilities at timeframes remotely comparable to what will be required for PolyMet… A search for examples similar to the Project Proposed Action identified the Zortman-Landusky mine in Montana…the Molycorp, Inc., mine site in New Mexico…Examples of similar seepage capture systems installed and operating in northeastern Minnesota are at the US Steel-MINNTAC tailings basin, and the former LTV tailings basin seep SD0026 (the same tailings basin PolyMet proposes to re-use), and demonstrate capture rates of less than 60%...The primary purpose of the seepage capture at the Proposed Project is to achieve compliance with MN WQS, but it is not likely to be successful, based upon limited but relevant regional experience.	The Co-lead Agencies acknowledge that there are existing water containment systems at other mine sites that do not operate with a high degree of capture, but these are different designs and cannot be directly compared to the system proposed for the NorthMet Project Proposed Action. The proposed containment system uses pumping on the tailings side and reinjection on the downgradient side to reverse hydraulic gradients across the slurry wall and in underlying bedrock. Relatively few containment systems have been built with this degree of pumping and reinjection to ensure effective capture. The conceptual hydraulics of this type of system provides evidence that it would achieve complete or nearly complete capture. The FEIS describes a 2014 field program that investigated bedrock along the alignment of the proposed containment system on the northern, northwestern, and western sides of the Tailings Basin in FEIS Section 4.2.2.3.1. This investigation provided field data on bedrock hydraulic conductivity, Rock Quality Designation data, and depth to top of bedrock. This information was used to develop revised MODFLOW cross-section models to evaluate containment system efficiencies on the northern, northwestern, and western sides of the Tailings Basin, which are documented in the revised Plant Site Water Modeling Data Package (PolyMet 2015j, as cited in the FEIS). These revised cross-sections and MODFLOW models considered the presence of an upper more permeable bedrock zone directly below the slurry wall, with hydraulic properties based on 2014 packer tests conducted in five boreholes along the proposed containment system alignment. Sensitivity analyses included variable bedrock hydraulic conductivity and different upper bedrock zone thicknesses up to 100 feet. The model results predict that the overall capture efficiencies of the proposed Tailings Basin containment systems would be substantially greater than 90%. It is the Co-lead Agency position that the assumption in the Plant Site GoldSim model of 90% or greater capture efficiency is justified by the analyses performed.	WR 018 WR 020
19655	The SDEIS acknowledges that seepage from the existing LTV tailings basin continues to drain south to Second Creek long after LTV operations have ceased (SDEIS p. 4-99). Because that	It is acknowledged that there is currently incomplete capture of impacted water at SD026. Text within the FEIS has been changed to recognize that fact. Cliffs Erie is currently addressing this issue by upgrading the performance of the existing capture system and, if necessary, constructing	WR 101 WR 117

Comment ID	Comment	Response	Theme(s)
	seepage will need to continue to be pumped back under the PolyMet Proposed Action, it "is not considered further in this discussion" (SDEIS p. 5-89). On pages 5-121 and 5-158, the SDEIS maintains that the seepage collection system installed at the south side of the existing tailings basin has "essentially eliminated the flow of Tailings Basin seepage into Second Creek". This statement is clearly not supported by the facts. PolyMet and the state regulatory agencies are fully aware that that this seepage pumpback system is not nearly as effective as claimed in the SDEIS. According to MPCA staff, the pumpback system has not resulted in the water quality improvements required under the Consent Decree, so there are two modifications currently proposed by Cliffs Natural Resources: 1) dewater the pond that is an additional source of water contributing to water quality concerns (pending a US EPA wetlands determination); or 2) create an additional barrier (dam) for seepage collection and pumpback between the existing dam and monitoring station SD026.	new systems to enhance capture. If 100% capture is not attained by the Cliffs Erie upgrades, the PolyMet has committed to installing additional systems in Second Creek to achieve this level of performance regardless of the types of measures required.	
19656	There is simply no evidence to support the rosy scenario that PolyMet will be able to capture 97% of the shallow seepage and 90% of the deep seepage from an unlined, purposefully 'leaky' tailings basin, despite the co-lead agencies' assurances. The SDEIS must be revised to accurately describe the ineffectiveness of the current seepage collection system, and the need for a redesigned system or additional mitigation must be clearly stated. The SDEIS must evaluate the impacts of polluted tailings basin seepage to Second Creek and the Partridge River.	The FEIS relies on revised cross-section models from the SDEIS to evaluate containment systems on the north, northwest, and west sides of the Tailings Basin, which are documented in the revised Water Management Plan - Plant Site. These new models consider the presence of an upper more permeable bedrock zone directly below the slurry wall, with hydraulic properties based on 2014 packer tests conducted in five boreholes along the proposed capture system alignment. Sensitivity analyses have included variable bedrock hydraulic conductivity and different upper bedrock zone thicknesses up to 100 feet. The model results predict that the overall capture efficiencies of the proposed Tailings Basin capture systems would be substantially greater than 90%. This analysis supports the conclusion that the assumption of 90% or greater capture efficiency is justified. The FEIS describes a 2014 field program that investigated bedrock along the alignment of the proposed capture system on the north, northwest, and west sides of the Tailings Basin in Section 4.2.2.3.1. This investigation	PD 08 WR 018 WR 117 WR 118 WR 133

Comment ID	Comment	Response	Theme(s)
		provided field data on bedrock hydraulic conductivity, rock RQD, and depth to top of bedrock. This information was used to develop MODFLOW cross-section models at three locations on the alignment to assess capture efficiency. The models included bedrock below the slurry wall. The water quality modeling has been updated for the FEIS to include the potential for water to seep from the east side of the Tailings Basin. FEIS Section 3.2.2.3.10 describes that a containment system would be constructed around a portion of the east side of the Tailings Basin for seepage collection. Key design considerations for the containment systems include but are not limited to the local geologic and hydrogeologic characteristics of the site, the depth to bedrock or other confining unit from the ground surface, the presence and prevalence of cobbles and boulders in the glacial till, the ground surface topography along and adjacent to the containment system alignment, the soil types to be encountered along the alignment, and the constituents in the groundwater to be contained. The proposed containment system technology is not new nor unique; the slurry cutoff wall and collection trench approach has been used for many decades, beginning initially as a means to facilitate construction of deep foundations in locations of shallow groundwater and difficult soil conditions, and subsequently expanding to other uses such as the containment of contaminated groundwater emanating from unlined waste disposal facilities (e.g., landfills, stockpiles, etc.). There are many papers written about the use of groundwater containment systems and a number of contractors well-experienced and proficient in containment system construction. The groundwater collection component of the system and the hydraulic barrier (cutoff wall) work in tandem to control the direction of groundwater flow and the amount of groundwater collected. Maintenance of a lower hydraulic head on the upgradient side of the cutoff wall than on the downgradient side of the cutoff effectively captures any seepage that would otherwise leave the site, while limiting the effect that the system has on groundwater conditions downgradient from (away from) the system. This barrier to flow thereby minimizes the potential for water quality effects on the downgradient side of the containment system. PolyMet has committed to collecting all of the south seepage from the Tailings Basin that makes its way to Second Creek by implementing additional improvements to the existing seepage management system if necessary. Potential measures that could bring the capture efficiency of the	

Comment ID	Comment	Response	Theme(s)
		system to 100% include improvements to the existing dam such as lining the upstream dam face with bentonite and injecting grout into the dam. If seepage is observed to bypass the existing dam, a second dam could be constructed approximately 500 feet downstream of the existing system, in an area where the Second Creek headwaters valley is more constricted and any remaining subsurface seepage will have to come to the surface. This potential second dam could be constructed as an earthen dam with a clay or concrete cutoff wall (extending to bedrock if necessary) in order to achieve 100% capture of the surface seepage. See FEIS Section 5.2.2.3.2.	
19658	The unsupported prediction of 90% or better seepage capture efficiency is unfortunately carried forward into other critical analyses. The SDEIS claims that construction of a groundwater containment system along the north, northwest and west sides of its unlined tailings basin "would capture virtually all of the Tailings Basin seepage presently flowing in those directions to restore water quality" (SDEIS p. 5-174). Without even a single bedrock monitoring well installed to confirm or deny this assumption, the SDEIS maintains that this is prediction is "conservative", because the modeling done by PolyMet assumes that bedrock hydraulic conductivity is "negligible" (SDEIS, pp. 5-68 - 5-69). Disturbingly, the tailings basin model uses storage coefficients that are not found anywhere in peer reviewed scientific literature.	It is acknowledged that the Plant Site MODFLOW model does not include bedrock below surficial deposits and thus does not consider flow towards the Embarrass River in bedrock. This is because the bulk hydraulic conductivity of upper bedrock is estimated to be about two orders-of-magnitude lower than the hydraulic conductivity of the surficial aquifer, and it is interpreted that deeper bedrock has substantially lower hydraulic conductivity. Based on these assumptions, calculations show that chemical mass migration downgradient of Tailings Basin is dominated by flow in the surficial aquifer and for this reason only surficial flowpaths were modeled in MODFLOW and GoldSim; see FEIS Section 5.2.2.2.1 for greater detail. MODFLOW cross-section models of the Tailings Basin containment systems showed that groundwater capture substantially greater than 90% was achieved in both surficial deposits and the underlying zone of more "permeable" bedrock that was assumed to be 15 m thick. So even if there was chemical migration in upper bedrock, it would be effectively captured by the Tailings Basin containment systems. Absent predicted impacts there was no need for modeling of the underlying bedrock in MODFLOW or GoldSim to support the water resources impact assessment. See WR62 for additional information. The water quality modeling has been updated for the FEIS to include the potential for water to seep from the east side of the Tailings Basin. In the FEIS Plant Site MODFLOW model, storage coefficients for the surficial deposits and bedrock outcrops were assigned and/or calibrated to be more in line with literature values for these types of materials. FEIS Section 3.2.2.3.10 states that a containment system would be constructed around a portion of the east side of the Tailings Basin for seepage collection. The proposed containment system technology is not new nor unique; the slurry cutoff wall and collection trench approach has been used for many decades, beginning initially as a means to facilitate construction of deep	PD 08 WR 008 WR 018 WR 071 WR 095 WR 099

Comment ID	Comment	Response	Theme(s)
		foundations in locations of shallow groundwater and difficult soil conditions, and subsequently expanding to other uses such as the containment of contaminated groundwater emanating from unlined waste disposal facilities (e.g., landfills, stockpiles, etc.). There are many papers written about the use of groundwater containment systems and a number of contractors well-experienced and proficient in containment system construction. Installation of paired monitoring wells on either side of the Tailings Basin containment systems would likely be identified during the permitting phase. Monitoring devices at these points would measure the head pressure differential, which would indicate the direction of groundwater flow through the containment system. The groundwater collection component of the system and the hydraulic barrier (cutoff wall) work in tandem to control the direction of groundwater flow and the amount of groundwater collected. Maintenance of a lower hydraulic head on the upgradient side of the cutoff wall than on the downgradient side of the cutoff effectively captures any seepage that would otherwise leave the site, while limiting the effect that the system has on groundwater conditions downgradient from (away from) the system. This barrier to flow thereby minimizes the potential for water quality effects on the downgradient side of the containment system.	
19659	These parameters are highly critical for establishing a reliable model, because the volume of groundwater that a geologic formation can contain (storativity or storage coefficient) and the rate of flow (hydraulic conductivity) are functions of the amount of open pore spaces or fractures/faults in rock, the quantity of water that infiltrates from the surface, and the groundwater gradient. The storage coefficient incorporated in the plant site model (including the tailings basin) for bedrock is 0.20, and for the surficial deposits 0.0002 (SDEIS p.5-41), suggesting that the bedrock contains several orders of magnitude more water than the surficial deposits.	In the FEIS Plant Site MODFLOW model, storage coefficients for the surficial deposits and bedrock outcrops were assigned and/or calibrated to be more in line with literature values for these types of materials.	WR 095
19660	When questioned about these extraordinary storage coefficients, the co-lead agencies' explanation was that the model was "calibrated to match predicted and measured groundwater	The FEIS relies on revised cross-section models to evaluate containment systems on the north, northwest, and west sides of the Tailings Basin, which are documented in the revised Water Management Plan – Plant (PolyMet 2015i, as cited in the FEIS). These new models considered the	WR 019 WR 128

Comment ID	Comment	Response	Theme(s)
	levels," Essentially, this model is simulates a bedrock 'storage tank' where large volumes of water go in but virtually nothing comes out. Since this is not conceptually accurate, the modeled hydraulic conductivity and/or modeled storage coefficients cannot be relied upon to estimate the amount of seepage that will bypass the seepage capture system, or the amount of time before seepage upwells to surface waters in adjacent wetlands and the Embarrass River, where MN WQS must be met.	presence of an upper more permeable bedrock zone directly below the slurry wall, with hydraulic properties based on 2014 packer tests conducted in five boreholes along the proposed containment system alignment. Sensitivity analyses included variable bedrock hydraulic conductivity and different upper bedrock zone thicknesses up to 100 feet. The new models explicitly consider groundwater flow in bedrock below the slurry wall and at the contact between the slurry wall and bedrock. The model results predicted that the overall capture efficiencies of the proposed Tailings Basin containment systems (with bedrock flow) would be substantially greater than 90%. FEIS Figure 3.2-28 has been revised to show that the slurry wall is keyed into bedrock. It is the Co-lead Agencies' opinion that engineered systems can operate successfully over long periods of time is they are property monitored and maintained. The FEIS provides a comprehensive description of proposed water treatment and seep collection systems including groundwater containment and synthetic liners and covers in Section 5.2.2. This includes conceptual designs and discussions of the types of monitoring used to assess performance. Detailed designs are provided in supporting documents, which are referenced in the FEIS. The FEIS also discusses long-term operation, maintenance, and periodic replacement of engineered systems. It is acknowledged that certain components of the engineered systems would need to be replaced when monitoring indicates that performance is marginal and not readily compensated for by adaptive mitigation measures. A detailed financial assurance analysis would be part of the permitting phase and is not a required component of the FEIS. The financial assurance process would fully consider long-term monitoring and periodic replacement of equipment including, but not limited to, water treatment hardware and synthetic liners/covers. The Financial Assurance package for the Project would ensure that future funding would be available if and when adaptive mitigation measures or component replacements are needed to achieve performance specifications.	
19661	Another major deficiency in the plant site model is that seepage capture at the flotation tailings basin, as modeled with MODFLOW and GoldSim, does not account for any seepage out of the east side of the basin. SDEIS Figure 3.2-27, that indicates	The FEIS Plant Site MODFLOW model was modified from the SDEIS to include: 1) the presence of surficial deposits below the East Embankment, 2) boundary conditions (drain and/or river cells) along the embankment toe to allow the potential for surface seepage, and 3) hydrologic inputs to account for the presence of the proposed drainage swale. See FEIS Section	WR 054

Comment ID	Comment	Response	Theme(s)
	continuous bedrock on the east side of the tailings basin, is incorrect and must be corrected.	5.2.2.2.1. Similar to other locations along the perimeter of the Tailings Basin, the project was modified to include installation of a containment system along the East Embankment where it is underlain by surficial deposits. Given the hydrogeology of the area east of the Tailings Basin and the proposed swale to be constructed there, this containment system would have higher hydraulic head on the east side compared to the west (tailings) side where a pumped trench would depress the groundwater level. This would create hydraulic gradients in the slurry wall and in shallow bedrock that would drive (low) flows from east to west across the containment system. This set of hydraulics would result in complete capture of all tailings water approaching the containment system from the Tailings Basin. Because the system would achieve complete capture of tailings water, an east side chemical transport flowpath is not needed in the Plant Site GoldSim model. There is no hydrologic reason to expect that impacted water from the Tailings Basin would migrate east of the containment system.	
19662	Baseline groundwater elevations, depths to bedrock, and surface water drainage locations have been used to identify four flowpaths (West, Northwest, North, and South) that represent the most direct paths between Tailings Basin facilities and evaluation locations (i.e., property boundaries and surface waters of the state) (MDNR 2011L [as cited in the submission]). The modeling approach used by PolyMet has placed an artificial and unrealistic no-flow boundary on the east side of the tailings basin, when a critical evaluation of hydraulic head clearly shows the potential for substantial groundwater movement to east. Because of this this flawed assumption, there has been no contaminant transport modeling or water quality impacts analysis for seepage leaving the east side of the tailings basin.	The Plant Site MODFLOW model was modified for the FEIS to better represent natural and Project-related conditions. These include: 1) more accurate representation of surficial deposits and bedrock outcrops around the perimeter of the Tailings Basin, 2) more extensive distribution of drain and/or river cells to provide for potential surface seepage and distribution of wetlands, 3) more appropriate storage coefficients, and 4) steady-state and transient calibrations using new data extending through the end of 2013. Many of the improvements pertained to the East Embankment area of the Tailings Basin, where it is acknowledged that tailings water seepage would be likely to occur and model changes were made to simulate this seepage more accurately. These changes in response to the Theme improve the SDEIS MODFLOW model that limited tailings seepage on the east side of the Tailings Basin.	WR 054 WR 102
19663	Also, according to the plant site surficial geology and depth to bedrock figures, the thickest layer of glacial till for the entire Proposed Project occurs around the tailings basin, representing, essentially, the biggest "pipe" for conducting contaminated	The Plant Site MODFLOW model was modified for the FEIS to better represent natural and project-related conditions. These include: 1) more accurate representation of surficial deposits and bedrock outcrops around the perimeter of the Tailings Basin, 2) more extensive distribution of drain and/or river cells to provide for potential surface seepage and distribution	WR 093

Comment ID	Comment	Response	Theme(s)
	tailings basin seepage to downgradient wetlands and eventually the Embarrass River. Tribal agency re-analysis is using MODFLOW for the east side of the tailings basin reveals that this is likely the most significant discharge area for the entire tailings basin.	of wetlands, 3) more appropriate storage coefficients, and 4) steady-state and transient calibrations using new data extending through the end of 2013. Many of the improvements pertained to the East Embankment area of the Tailings Basin, where it is acknowledged that tailings water seepage would be likely to occur and model changes were made to simulate this seepage more accurately. These changes correct deficiencies in the SDEIS MODFLOW model that limited tailings seepage on the east side of the Tailings Basin. With the modifications described above, the FEIS Plant Site MODFLOW model has provided reliable flow directions in this area.	
19664	The SDEIS maintains that mine pit dewatering impacts will be very limited or non-existent based on an assumption carried forward from the DEIS that there is little or no connection between the bedrock and surficial aquifers. This assumption is based solely on an unsupported "professional opinion," when in fact there is ample evidence that there may be substantial connection between the bedrock and surficial aquifers. Such a connection indicates that dewatering the mine pits could cause significant drawdown of the water table in the surficial aquifer, potentially dewatering wetlands and ephemeral streams.	Impact assessment modeling relies on site characterization data that indicate the bulk hydraulic conductivity of upper bedrock is two to three orders-of-magnitude lower than the hydraulic conductivity of the surficial aquifer. Thus, groundwater flow and transport at both the Mine Site and Plant Site are dominated by the hydraulics of the surficial aquifer. Bedrock plays a negligible role in transporting water. However, it is acknowledge that there could be some negligible hydraulic connections between bedrock and the surficial aquifer. Therefore, the approach in the FEIS was to not consider this possible connection in the NorthMet Project Proposed Action water quality models, but to recommend extensive monitoring during operations and closure to assess if interactions occur and if they would raise concerns for permitting agencies. If monitoring data indicate trends toward permit non-compliance, adaptive mitigation measures would be implemented to prevent or eliminate what is expected to be a small transport-related bedrock impact relative to surficial flows. See FEIS Section 5.2.2.3.5 for information on adaptive mitigation measures and Section 5.2.2.3.6 for information on monitoring. The FEIS further evaluated the possibility of fractures and faults at the Mine Site and Plant Site to determine what (if any) changes need to be made to model assumptions to accurately predict potential environmental effects for purposes of environmental review. Although no change was made to the Plant Site GoldSim model, the FEIS Mine Site GoldSim model was modified to include a flow/transport zone 15 meters thick from that present in the SDEIS. The results of the analysis are included in FEIS Section 5.2.2.3.2. The response to theme WR169 also contains additional information.	WR 010 WR 012 WR 013
19665	Tritium and unionized ammonia nitrogen were found in water samples collected from two deep boreholes in the area where the Project mine pits	Tritium and non-ionized ammonia can be indicators of relatively young water. However, when these constituents are identified in water extracted from a borehole, the overriding question is whether or not foreign (young)	NEPA 09 WR 010

Comment ID	Comment	Response	Theme(s)
	will be located. Both tritium and unionized ammonia are classic indicators for a strong connection with surface water. Tritium indicates water found in the deep boreholes was surface water that originated post-1952, during or after nuclear testing. The boreholes are approximately one mile southwest of the Peter Mitchell Pit, which is the closest and most likely source of this pollution. Production at the Northshore mine started in 1955. Review of the Peter Mitchell Pit discharge monitoring data for SD001 from 2006 and 2008 shows the average concentration of unionized ammonia exceeded their 0.04 mg/l NPDES permit limit. Unionized ammonia and tritium in the deep boreholes suggest that travel time of contaminants through bedrock fractures will be on the order of decades, not the hundreds or thousands of years that are assumed in the SDEIS. Impacts to surface waters, groundwater, and wetlands for a project of this size and complexity demand a scientific, data-driven approach rather than one based on opinion and scant, selectively used data.	water was introduced during the drilling process. There are many documented cases where tritium in borehole water could be traced to makeup water introduced during the drilling process to help maintain circulation. Experience indicates that conclusions about the age of groundwater based on tritium and non-ionized ammonia are unreliable unless it can be absolutely verified that no foreign (makeup) water was introduced during the drilling process. Given the isolated occurrences additional verification is not warranted for the EIS. It is acknowledged that there could be some hydraulic connections between bedrock and the surficial aquifer where transport is expected to be negligible. Given these factors, the approach was to not consider this possible connection in the NorthMet Project Proposed Action water quality models, but to recommend extensive monitoring during operations and closure to assess if interactions occur and if they would raise concerns for permitting agencies. If monitoring data indicate trends toward permit non-compliance, adaptive mitigation measures would be implemented to prevent or eliminate what is expected to be a small transport-related bedrock impact relative to surficial flows. See FEIS Section 5.2.2.3.5 for information on adaptive mitigation measures and Section 5.2.2.3.6 for information on monitoring. The Co-lead Agencies believe that the EIS contains adequate information and analyses consistent with the NEPA and MEPA guidance and best practices. Also refer to the response to theme NEPA 09 for more detail.	WR 013
19667	The lack of fracture and fault analysis is a major deficiency of this SDEIS. The map provided by GLIFWC in their SDEIS comments, Geologic Faults at the PolyMet Mine and Plant Site, indicates: 1. There are several faults extending from Northshore pits to the PolyMet mine site. This may explain why there is ammonia and tritium in the deep borehole samples. 2. There is an inferred fault running right through the area of the Hydrometallurgic Residue Facility. (Not only is the HRF proposed to be constructed within wetland, with a buried stream and springs, but it will also be receiving seepage from the tailings basin and it could be geologically predisposed to facilitate groundwater movement. 3. There is a	Regarding tritium and non-ionized ammonia, these can be indicators of relatively young water. However, when these constituents are identified in water extracted from a borehole, the overriding question is whether or not foreign (young) water was introduced during the drilling process. There are many documented cases where tritium in borehole water could be traced to makeup water introduced during the drilling process to help maintain circulation. Experience indicates that conclusions about the age of groundwater based on tritium and non-ionized ammonia are unreliable unless it can be absolutely verified that no foreign (makeup) water was introduced during the drilling process. Given the isolated occurrences additional verification is not warranted for the EIS. Geologic mapping suggests bedrock faults could exist in areas at the Hydrometallurgical Residue Facility and Tailings Basin. However, on published geologic maps, the faults in these areas are dashed and identified as conjectural with inferred (not exact) locations. Regional geologic maps	WR 007 WR 008 WR 012 WR 013

Comment ID	Comment	Response	Theme(s)
	fault system right where water would exit the tailings basin on the east side. Notice that the inferred fault may connect to other fault systems running east-west to the south of the facility.	of the Iron Range do show the existence of fault lines, but hydrogeologic studies have not provided evidence that any faults that may be present behave as conduits for groundwater flow. In addition, case histories at similar Iron Range mine sites indicate that groundwater movement is dominated by flow in surficial materials (where present) and not bedrock, regardless of the presence of fractures and faults. At the Plant Site, there is no field evidence to suggest that bedrock faults or fracture zones provide enhanced groundwater flow to the Partridge and Embarrass Rivers. It is possible that structural features with enhanced groundwater flow exist, but the Co-lead Agencies believe they are improbable given the body of evidence for the Project Site and other mines sites in the Iron Range with similar geology. Further, if such features do exist, it is highly unlikely that they could be intercepted and characterized by any reasonable field program of exploratory boreholes. The management approach is to require robust groundwater monitoring during operations and closure to identify if structurally controlled groundwater flow actually occurs at the site, and if this proves to be the case, require the implementation of adaptive management measures. Monitoring would include observations from paired piezometers to be installed on opposite sides of the containment systems to verify reversal of hydraulic gradients and thus, essentially complete capture of affected groundwater. If reversed gradients are not indicated, adaptive mitigation measures would be implemented to modify the groundwater hydraulics so that essentially complete capture is established.	
19668	The potential for water quality impacts from prospecting and mining operations that have contacted the Duluth Complex have long been known to the MNDNR and MPCA. The State of Minnesota spent $4.3 million over three years in the late 1970s to produce the Regional Copper-Nickel Study, a 5-volume compilation of technical information regarding the potential impacts of copper-nickel mining in the Duluth Complex. Nevertheless, predicted water quality impacts and ineffective mitigation methods referenced in the Study were ignored when the technical documents and SDEIS were drafted for PolyMet.	The Co-lead Agencies rely upon the expertise and experience of their staff and consultants who bring to bear their knowledge of various studies and analyses performed on mine sites in Minnesota and elsewhere. This knowledge is applied in the review of documents prepared to evaluate the NorthMet Project Proposed Action potential effects. It should be noted that the NorthMet Project Proposed Action is different from other mining projects in this part of Minnesota in the following ways: different ore type, designs for groundwater containment systems, and use of long-term mechanical treatment. While experiences gained on other projects are informative, they do not necessarily apply to the NorthMet Project Proposed Action. This is particularly true for groundwater containment systems because the NorthMet Project Proposed Action uses a design that differs from those at other Iron Range mine sites. The mitigation designs of the NorthMet Project Proposed Action are unlike	WR 023 WR 203

Comment ID	Comment	Response	Theme(s)
		measures discussed in the Regional Copper-Nickel Study. The NorthMet Project Proposed Action measures include: long-term mechanical water treatment, uniquely designed groundwater containment systems, subaqueous disposal of reactive waste rock, and synthetic covers and under-liners used at waste rock stockpiles and treatment ponds. In addition, the level of construction QA/QC proposed at the NorthMet site would be much higher than what has historically occurred at older mine sites in the Iron Range. It is erroneous to conclude that operation and closure of the NorthMet Project Proposed Action site would necessarily entail the same types of failures that have occurred at some historical Iron Range mines. In fact, the unique designs and high-quality construction measures proposed are a response to past events. The detailed and sophisticated modeling work performed to support the FEIS exceed those conducted for some existing mines in Minnesota. The models used for the NorthMet Project Proposed Action represent years of development, with input from the Proposer, Co-lead Agencies and Cooperating Agencies. Based on comments received on the SDEIS, modifications were made to the models to improve FEIS impact evaluations. It is the Co-lead Agency position that incomplete or inaccurate predictions made in the past at historical mining operations do not provide a basis for judging the quality of modeling to be used in the NorthMet FEIS. The EIS reflects consideration of information pertaining to the Dunka Pit that was directly relevant to the NorthMet Project Proposed Action. It is noteworthy that many aspects of operations at the Dunka Pit are dissimilar to the NorthMet Project Proposed Action in terms of hydrogeology and mine design.	
19669	The SDEIS also diminishes the lessons learned from the Dunka Pit, located on the former LTVSMC site approximately five miles north and east of the PolyMet Project mine site. Within the Dunka Pit, LTVSMC contacted the Duluth Complex and the Virginia Formation while mining for taconite in the Biwabik Iron Formation. By 1991, LTVSMC had removed about 50 million tons of Duluth Complex material from the Dunka pit and placed it in “gabbro” stockpiles. Monitoring of the drainage from these stockpiles	The Co-lead Agencies rely upon the expertise and experience of their staff and consultants who bring to bear their knowledge of various studies and analyses performed on mine sites in Minnesota and elsewhere. This knowledge is applied in the review of documents prepared to evaluate the NorthMet Project Proposed Action potential effects. It should be noted that the NorthMet Project Proposed Action is different from other mining projects in this part of Minnesota in the following ways: different ore type, designs for groundwater containment systems, and use of long-term mechanical treatment. While experiences gained on other projects are informative, they do not necessarily apply to the Proposed Action. This is particularly true for groundwater containment systems because the	WR 023

Comment ID	Comment	Response	Theme(s)
	beginning in 1976 revealed a decrease in pH and an increase in trace metals. Copper and nickel concentrations as high as 1.7 and 40 mg/l respectively were observed in seepage/run-off from the Duluth Complex waste rock stockpiles and pH was observed as low as 5.0 at seep 1 between 1976 and 1980. Most of the seepage from waste rock piles at the Dunka site was discharged to Bob's Bay in Birch Lake via Unnamed Creek. A 1976-1977 study of trace metals in Bob's Bay found that concentrations of copper, nickel, cobalt, and zinc in the water of the Bay were higher than regional average concentrations and decreased with distance from the mouth of Unnamed Creek. Additionally, it was determined that Unnamed Creek contributed more than 90% of the trace metals load to Bob's Bay. The NPDES permit for this discharge expired in 2005 and another variance request is expected. A WWTF located at the site has been inactive because Cliffs Erie, LLC, the owner who acquired the property from LTVSMC, declared bankruptcy and claims it is simply too expensive to continue running. Unfortunately, the passive wetland treatment system did not function well enough to remove nickel and copper in waters still discharging from the mine pit and stockpiles to a concentration that complies with MN WQS.	NorthMet Project Proposed Action uses a design that differs from those at other Iron Range mine sites. The mitigation designs of the Proposed Action are unlike measures discussed in the Regional Copper-Nickel Study (MSPA 1979). The Proposed Action measures include: long-term mechanical water treatment, uniquely designed groundwater containment systems, subaqueous disposal of reactive waste rock, and synthetic covers and under-liners used at waste rock stockpiles and treatment ponds. In addition, the level of construction QA/QC proposed at the NorthMet site would be much higher than what has historically occurred at older mine sites in the Iron Range. It is erroneous to conclude that operation and closure of the NorthMet Project Proposed Action Site would necessarily entail the same types of failures that have occurred at some historical Iron Range mines. In fact, the unique designs and high-quality construction measures proposed are a response to past events. The detailed and sophisticated modeling work performed to support the FEIS exceed those conducted for some existing mines in Minnesota. The models used for the NorthMet Project Proposed Action represent years of development, with input from PolyMet, Co-lead Agencies and Cooperating Agencies. Based on comments received on the SDEIS, modifications were made to the models to improve FEIS impact evaluations. It is the Co-lead Agencies 'position that incomplete or inaccurate predictions made in the past at historical mining operations do not provide a basis for judging the quality of modeling to be used in the NorthMet FEIS. The FEIS reflects consideration of information pertaining to the Dunka Pit that was directly relevant to the NorthMet Project Proposed Action. It is noteworthy that many aspects of operations at the Dunka Pit are dissimilar to the NorthMet Project Proposed Action in terms of hydrogeology and mine design.	
19670	The Mining Simulation Project (funded in part by a Minnesota Legislative appropriation of $185,000 to the MNDNR and MPCA) was a cooperative study to identify and resolve environmental issues associated with non-ferrous mining and to anticipate industry and government data needs to address those issues before commercial development occurred in Minnesota. The study clearly identified those state ground and surface	Evaluation criteria are based on applicable water quality standards. Where a water body is classified as Domestic Consumption (1B) or for groundwater, USEPA primary drinking water standards apply. The USEPA primary drinking water standards set mandatory maximum contaminant levels for drinking water to protect the public from consuming water that presents a risk to human health. Evaluation criteria can be found in Section 5.2.2. For purposes of the FEIS, the MPCA has provided guidance as to what waters in the Embarrass and Partridge rivers are waters used for production of wild rice to which the current 10 mg/L wild rice sulfate standard applies.	WR 041 WR 042 WR 110 WR 154

Comment ID	Comment	Response	Theme(s)
	water quality regulations that would apply to copper-nickel mining operations in Minnesota, including applying the 10 mg/l sulfate criterion to effluent discharges where wild rice is present; it prioritized nondegradation of both surface and groundwater and protection of groundwater as a drinking water source; and it rejected using natural wetlands for mine effluent treatment ("as a toxic metals dumping ground"). The tribal cooperating agencies have also consistently elevated our concerns for the Proposed Project's potential to adversely impact groundwater quality and quantity. "Groundwater maintains stream flows and wetlands during dry periods, supporting significant ecosystem functions. Groundwater is an important source of drinking water in the Great Lakes Basin, where 8.2 million people, or 82% of the rural population, rely on groundwater for their drinking water." In Minnesota, all groundwater is protected for drinking water supplies, "constituting the highest priority use, and as such, to provide maximum protection to all underground waters." When considering water allocations, drinking water is supposed to be considered the highest priority by the MN DNR. According to MPCA's groundwater profile for Northeastern MN including the Project area: "Glacial aquifers are commonly thin and limited in their extent and yield. Bedrock aquifers have limited yield, generally from fractures; groundwater movement is difficult to define. There are no large-scale regional aquifers. The Biwabik Iron Formation is the only source of groundwater for many Iron Range cities." The SDEIS has not adequately evaluated the potential for impacting drinking water sources, and it is clear from the state regulatory agencies' uncertainties about the frequency, volume, and water quality of other mine discharges (i.e., the Peter Mitchell Pit) even	The MPCA reviewed all available relevant information in making their recommendation; however, that recommendation in itself is a policy decision of the MPCA that is not part of the EIS process. Water treatment using natural wetlands is not included in the Project Description. The NorthMet Project Proposed Action would rely upon mechanical treatment for as long as necessary. During operations and closure, the use wetland treatment may be considered as an adaptive management measure if pilot and other studies indicate that this method has potential utility and is cost-effective. Groundwater and surface water flow model predict that the NorthMet Project Proposed Action would have a minimal effect on drinking water standard-based evaluation criteria in the groundwater at the project boundaries or in Colby Lake (the locations at which drinking water standards apply. Based on this, It is therefore expected that the NorthMet Project Proposed Action would not have any significant impacts on water quality downstream of the Project area or significantly contribute to any cumulative effects on drinking water resources.	

Comment ID	Comment	Response	Theme(s)
	while regulated under permits, that this issue remains a significant deficiency in the SDEIS analysis.		
19671	The tribal cooperating agencies have consistently raised concerns about reactive dust and ore fines along the Transportation and Utility Corridor, and potential for water quality impacts to the three streams and wetlands that are crossed within the corridor. Yet these concerns have been repeatedly kicked back and forth between the Air IAP and Water Quality IAP work groups, with neither group ultimately resolving the information and risk analysis gap. The end result of this 'oversight' in the SDEIS is that no consideration, discussion, or proposed management of this potential water and wetland quality impact is provided for the public to review.	The Project Description in the FEIS includes routine inspections of the Transportation and Utility Corridor to identify accumulations of dust or ore spillage. Regarding dust, given the majority of the dust that could leave the NorthMet Project area could be characterized as low sulfide/low metal, potential impacts would be controlled by: 1) the commitment to treat all runoff from disturbed areas as process wastewater, and 2) the facilities would be subject to an air quality Fugitive Emissions Plan. Significant impact on water resources or historic properties is not expected. All active areas at the Mine Site and Plant Site would be subject to a Fugitive Dust Control Plan approved by the MPCA, which describes management of fugitive dust generated from unpaved roads across the NorthMet Project area, rock dumping and loading locations on the Mine Site, and areas potentially subject to wind erosion on the Plant Site (see Sections 4.1.6, and 4.3.9, in PolyMet 2015a, as cited in the FEIS). Regarding potential spillage, any significant accumulations would be removed by a combination of machines and hand work. Ore transport would be by special railcars that minimize dust and spillage, where, since the SDEIS, the Proposer has committed to retrofit the railcars to better control spillage and develop an ore management/transport plan for monitoring site conditions. It is unlikely that there would be sufficient spillage to affect the quality of surface water or groundwater. See FEIS Section 5.2.2.3.2. See FEIS Section 3.2.2.4 for more information on the railcars, and Sections 5.2.3 and 5.2.7 for impacts of railcar spillage and dust on wetlands and air quality, respectively. The effect of dust falling on the disturbed portions of the Mine Site would be controlled by the perimeter dike and ditch system, which would route runoff to the WWTF (Section 4.1.5.3 and Large Figures 19 through 21 of PolyMet 2015a, as cited in the FEIS). Please refer to the responses to themes WET 11 and WR 151.	WET 11 WR 151
19672	The only potential solute sources along the Transportation and Utility Corridor or at the processing plant (both within the Partridge River Watershed) would be from spills, as there would	The FEIS Project Description includes routine inspections of the Transportation and Utility Corridor to identify accumulations of dust or ore spillage. Regarding dust, given the majority of the dust that could leave the	WET 11 WR 023 WR 151

Comment ID	Comment	Response	Theme(s)
	be no surface stockpiles of waste rock, ore, or other potential solute sources in these areas. There is the potential, however, for ore spillage from rail cars in transport from the Mine Site to the processing plant during operations. Based on observations at other mining operations using similar side-dump rail cars, it is assumed that spillage could occur along the first 1,000 meters of rail from the Rail Transfer Hopper (PolyMet 2013l). It is estimated that 55.7 kg ore per m2 track could spill from rail cars within the first 1,000 meters of the Transportation and Utility Corridor over the 20-year life of the NorthMet Project Proposed Action. This is equivalent to 1.25 inches of spilled material over a 2,000-m2 area. Rainfall contacting the spilled ore material has the potential to release solutes, but with the small volume of ore and dilution from other sources, water quality is expected to meet the evaluation criteria (PolyMet 2013l). This is not a trifling mass of ore, nor is it an insignificant quantity of reactive dust and fines, deposited directly into the watershed. It is unacceptable to dismiss the likely water quality impacts of twenty years of ore spillage and dust/fine deposition with a casual statement and zero analysis. It is especially disheartening to the tribal cooperating agencies that have attempted to elevate this issue for so many years, that the co-leads have been completely unwilling to consider giving it the analysis it requires, or to even provide examples from other sulfide mines where this has not proven to be a concern.	NorthMet Project area could be characterized as low sulfide/low metal, potential impacts would be controlled by: 1) the commitment to treat all runoff from disturbed areas as process wastewater, and 2) the facilities would be subject to an air quality Fugitive Emissions Plan. Significant impact on water resources or historic properties is not expected. All active areas at the Mine Site and Plant Site would be subject to a Fugitive Dust Control Plan approved by the MPCA, which describes management of fugitive dust generated from unpaved roads across the NorthMet Project area, rock dumping and loading locations on the Mine Site, and areas potentially subject to wind erosion on the Plant Site (see Sections 4.1.6, and 4.3.9, in PolyMet 2015a, as cited in the FEIS). Regarding potential spillage, any significant accumulations would be removed by a combination of machines and hand work. Ore transport would be by special railcars that minimize dust and spillage, where, since the SDEIS, the Proposer has committed to retrofit the railcars to better control spillage and develop an ore management/transport plan for monitoring site conditions. It is unlikely that there would be sufficient spillage to affect the quality of surface water or groundwater. See FEIS Section 5.2.2.3.2. See FEIS Section 3.2.2.4 for more information on the railcars, and Sections 5.2.3 and 5.2.7 for impacts of railcar spillage and dust on wetlands and air quality, respectively. The effect of dust falling on the disturbed portions of the Mine Site would be controlled by the perimeter dike and ditch system, which would route runoff to the WWTF (Section 4.1.5.3 and Large Figures 19 through 21 of PolyMet 2015a, as cited in the FEIS).	
19673	Regardless of the 'footprint' of the equalization basins, the liner leakage estimate of 5 gallons per acre per day (gpad) is not consistent with what we have found in the literature for the maximum allowable, or "Action Leak Rate", above which a	The assumed liner leakage rates are based on a combination of literature values, experience at mine sites, experience at other types of industrial facilities, manufacturer documentation, and information provided in standard engineering guidance documents (Section 5.2.2.3 in PolyMet 2015m, as cited in the FEIS). Liner leakage rates were estimated using the USEPA-approved HELP model, where simulations combined NorthMet	WR 126

Comment ID	Comment	Response	Theme(s)
	leak must be found and repaired.	Project design values for slopes and subgrade design with the published values for average liner defects per acre. It is acknowledged that there have been historical instances where poor-quality liner installations have failed or leaked at relatively high rates. However, for the high-quality liner installations to be used for the NorthMet Project Proposed Action, the assumed liner leakage rates are reasonable and consistent with industry standards. While solid waste landfills may typically be smaller than the NorthMet facilities, the liner leakage rates are expressed on a unit area basis, so the results can be scaled to larger facilities. Further, the waste rock stockpiles where liners would be used are only temporary and monitoring would give early warning if they are not functioning properly.	
19674	The Band has consistently raised concerns for the NorthMet Project potential to increase mercury concentrations in fish within the St. Louis River watershed, where we exercise water quality jurisdiction, and within the 1854 Ceded Territory where Band members can exercise treaty fishing rights.	The change in mercury concentration in fish is thought to be ultimately proportional to the percent increase in mercury load (MPCA 2006a, as cited in the FEIS). The current MPCA-estimated mercury deposition rate is 12.5 µg/m2/yr for northeast Minnesota (MPCA 2007, as cited in the FEIS), which translates into about 250 pounds per year of mercury currently being deposited onto the St. Louis River Watershed (3,600 square miles) due to background deposition. The potential total annual deposition in the watershed from the NorthMet Project Proposed Action is estimated to be about 0.17 pounds per year (Barr 2012b), which is less than 0.1% of the background deposition levels described above. Discharges from the WWTF and WWTP are expected to meet the 1.3 ng/L standard for mercury, and overall the NorthMet Project Proposed Action is predicted to result in a net decrease in mercury loading. Therefore, mercury concentrations are not likely to result in an appreciable change in the mercury concentration in fish in waterbodies of the St. Louis River watershed or in the St. Louis River itself (Barr 2015f, as cited in the FEIS). Per FEIS Section 6.2.6, the NorthMet Project Proposed Action would not have any direct effects on aquatic habitat in the St. Louis River, and would not have any appreciable indirect effects on fish or aquatic invertebrates as a result in changes in flow or water quality.	AQ 05
19675	There has not been significant "ground-truthing" of mercury deposition rates that were used in the modeling assessment. Tribal cooperating agencies note that no studies have been conducted within this region of active mining to determine why fish tissue mercury concentrations are so high if the	The assessment of potential local mercury deposition and resulting changes in fish mercury conducted for the NorthMet Project Proposed Action are consistent with the assessments conducted for other recent mining projects requiring environmental review. Such information in reference to mercury deposition has been summarized in Barr 2006g (as cited in the FEIS).	AQ 28

Comment ID	Comment	Response	Theme(s)
	local sources mainly emit 'non-locally polluting' forms of mercury.		
19676	The Band concurs with the letter recently signed by 19 Duluth health care professionals expressing concerns that the SDEIS fails to define the human health effects of increased mercury emissions, exposure to asbestos-like mineral fibers, and arsenic.	The AERA contains toxicological information for various emissions, including mercury and airborne fibers, as well as an analysis of the potential health effects of those chemicals. The toxicological information was included in the AERA summary in FEIS Section 7.3.4. The AERA includes an evaluation of the most sensitive health endpoint for each chemical (e.g., neurological morbidity from manganese, reproductive toxicity of methyl mercury, and the carcinogenic potential of diesel, nickel, and arsenic). Arsenic releases to groundwater and surface water were evaluated in FEIS Section 5.2.2.3.2, and modelled concentrations were compared to drinking water standards. Drinking water standards would not be exceeded for arsenic. FEIS Section 5.2.7.5 contains a discussion of various types of fibers, as well as the health effects found in the scientific literature, including a summary of toxicity information from a scientific literature review conducted in 2009. FEIS Section 5.2.7.5 concludes with a finding of "an uncertain level of potential public health risk" being present due to airborne fibers in the area, and provides a summary of the dust suppression practices that would be used to minimize fiber generation. This information is referenced in the human health section of Chapter 7 (FEIS Section 7.3.4).	HU 01 HU 02 HU 07
19677	The SDEIS states that the current fish tissue concentrations in the five local lakes that were studied result in Hazard Quotients (HQs) that exceed 1 (page 6-63), but gives no further information. The Cumulative Impacts Analysis, Local Mercury Deposition and Bioaccumulation in Fish (July 2012) (Barr report) showed modeled contributions from both the Mesabi Nugget LDSP and PolyMet; this information should be included in the SDEIS for public review. The Barr report provides the actual HQs, rather than just saying "they exceed 1". The SDEIS should state clearly that in one case, the existing HQ equals 46.2, which is 46 times as high as the number where action is recommended. This is an unacceptable situation.	'Information pertaining to the specific Hazard Quotients summarized in Barr 2012b (as cited in the FEIS) have been included in FEIS Section 6.2.6, summarizing the cumulative effects assessment for mercury deposition.	AQ 03

Comment ID	Comment	Response	Theme(s)
19678	The SDEIS does not provide any rationale for more mercury to be added to a system that is already so high in mercury, but rather only suggests that the TMDL should take care of this.	This comment was originally presented as part of the Tribal Position Summary included in MDO #2, which was previously addressed in SDEIS Table 8-1. Further explanation is provided below. MPCA's goal is to protect high-quality waters and improve the quality of impaired waters, so water quality standards are met and beneficial uses are maintained and restored, where these uses are attainable. As summarized in FEIS Section 5.2.7.2.5, widespread contamination of fish from atmospheric pollution is why Minnesota established a statewide mercury TMDL. The TMDL seeks to reduce atmospheric deposition everywhere in the state, in order to make the state's lakes and streams fishable, as required by federal regulations, and is intended to provide the long-term framework to reduce mercury in fish. The MPCA published Guidelines for New and Modified Mercury Air Emission Sources, and revised those guidelines in 2012 (MPCA 2012h, as cited in the FEIS). The guidelines were developed to limit the mercury emissions from new and expanding sources in order to meet the TMDL goal of total statewide mercury emissions of 789 lbs/year by 2025. The MPCA has conducted a review of the NorthMet Project Proposed Action mercury emissions, and has determined that it would not impede the reduction goals (MPCA 2013b, as cited in the FEIS). The MPCA has provided guidance to the Co-lead Agencies that a discharge to a water body impaired for fish tissue mercury is not prohibited, provided that the discharge can meet the applicable water quality standard without benefit of mixing or dilution (i.e., does not cause or contribute to the impairment). The FEIS has evaluated mercury concentrations from the Plant Site WWTP and Mine Site WWTF, and has concluded that effluent from both facilities can meet the applicable mercury water quality standard of 1.3 ng/L. Overall the NorthMet Project Proposed Action is predicted to result in a net decrease of mercury-loading.	MERC 22
19679	The background site-specific analyses and data presented in the SDEIS for total mercury and methylmercury in surface and groundwater is not sufficient to adequately describe existing conditions or evaluate the potential for impact due to changes in hydrology and water quality as a result of the NorthMet Proposed Project.	The comments in this theme correctly recognize that impact assessment requires collection of background information to establish baseline conditions. For assessing mercury impacts, the SDEIS relied on monitoring data for total mercury and methylmercury collected through August 2012 at both the Mine Site and Plant Site. Because collection of baseline data is ongoing, data used for the impact assessment was expanded for the FEIS by using data collected through December 2013. Selected surface waters where water quality samples have been taken include, but are not limited to, the LTVSMC Tailings Basin, Unnamed Creek, Trimble Creek, Spring Mine Creek, Second Creek, Embarrass	MERC 02

Comment ID	Comment	Response	Theme(s)
		River, Sabin Lake, Wynne Lake, Esquagama Lake, Embarrass Lake, Heikkila Lake, Partridge River, Colby Lake, and the St. Louis River. FEIS Table 4.2.2-4 summarizes total mercury concentrations in the Partridge River and Embarrass River watersheds in the NorthMet Project area. Groundwater monitoring has also been conducted at the Mine Site and Plant Site. For surficial groundwater resources, 24 wells collected data at the Mine Site, while 8 wells were used at the Plant Site. Bedrock monitoring for the Mine Site includes 4 deep monitoring wells and 5 shallower bedrock wells. FEIS Table 4.2.2-6 summarizes total mercury concentrations sampled from these wells at the Mine Site. No bedrock water quality sampling has been required at the Plant Site. All of these data were subject to statistical analysis to estimate baseline mercury concentrations for surface water and groundwater resources at the Mine Site and Plant Site. This baseline estimate was subsequently used as input into the respective GoldSim water quality models, with the results reported in the FEIS. See FEIS Section 4.2.2. This data collection and subsequent analyses are documented in (all as cited in the FEIS): PolyMet 2015j, PolyMet 2015m, PolyMet 2015q, and Barr 2015f. Additional relevant documentation includes (all as cited in the FEIS): Barr 2010c, Barr 2012b, and Barr 2015g, as well as PolyMet 2011 (not cited in the FEIS). These analyses are considered adequate for FEIS impact evaluations.	
19680	There is very little methylmercury data included in the analysis for any waterbodies, and there is no sediment mercury or methylmercury data used to evaluate and understanding existing conditions. For the data that is presented, there are numerous inconsistencies in reporting limits and method detection limits, casting doubt on data quality and its utility for critical analysis is of project impacts.	Additional baseline monitoring was performed in 2009 and additional data was included in the SDEIS to evaluate the Embarrass River and tributary streams and assess relationships between sulfate and methylmercury. This data are summarized in FEIS Section 4.2.2.3.1 and 4.2.2.3.2. Data presented in the FEIS were gathered from various sources thereby leading to inconsistencies in the way the results are reported. The data presented in tables in the FEIS have been reviewed for consistency and updated as necessary. The quality assurance process is documented in the FEIS.	MERC 04
19681	The SDEIS also fails to evaluate other scientifically documented factors that affect mercury methylation and bioaccumulation. The SDEIS approach to evaluating mercury impacts of the Proposed Project avoids addressing complex but well-studied environmental processes by	The FEIS assesses NorthMet Project Proposed Action-related mercury contributions using a mass-balance methodology. This approach was identified as the appropriate analytic tool for predicting mercury concentrations during scoping of this EIS, and is a common and reliable analytical tool used by agencies to assess mercury impacts in impact assessments. This estimation method is preferred over a detailed	MERC 13

Comment ID	Comment	Response	Theme(s)
	modeling, and instead relies upon an incomplete mercury mass balance to predict future conditions. It superficially references some of the large body of literature related to sulfate, pH, dissolved organic carbon, iron, and microbial activity, but in some cases erroneously interprets it.	mechanistic model because it incorporates the important input and removal processes for mercury, it is transparent with regard to data inputs, it typically provides conservative estimates of aqueous mercury concentrations, and it allows for easy assessment of the effect of changing parameter values on mercury concentrations. Further, the NorthMet Project Proposed Action is not anticipated to be a major discharger of mercury into the environment. The RO treatment is expected to discharge mercury at or below the mercury standard of 1.3 ng/L, which includes all surface water that would be discharged at the Plant Site, including water used for flow augmentation. Mercury at the Mine Site is projected to decrease due to the NorthMet Project Proposed Action and the combined contributions from the Embarrass River and Partridge River are unchanged when modeled at the St. Louis River at the Fond du Lac reservation boundary. Therefore, the potential effects are expected to be less than significant, and the mass balance approach is appropriate to provide a reasonable estimate of potential contributions for purposes of environmental review given these circumstances. Regarding mercury concentrations in fish, the scientific community's understanding of the relationship between total mercury, sulfate, methylmercury, etc., is evolving, and the science is complex. That said, changes in mercury concentration in fish is thought to be ultimately proportional to the% increase in mercury load (MPCA 2006a); therefore, sophisticated modeling of methylation and bioaccumulation may not lead to more accurate results, but instead could lead to erroneous conclusions.	
19682	The SDEIS assumes that existing tailings in the LTV Tailings Basin will indefinitely adsorb mercury. However, Table 4.2.2-34 Summary of Surface Water Quality Monitoring Data for the Tailings Basin Surface Seeps clearly demonstrates that existing seepage exceed the GLI standard, and are higher than many of the data shown for most of the tributary streams. Given the lack of confidence in predicted seepage capture rates, Tailings Basin seepage is another source that has been greatly underestimated in the SDEIS analysis.	The MDNR has found that taconite tailings appear to be a sink for mercury in full-scale actual tailings basins in northern Minnesota, at least similar to other media like soils, as evidenced by lower mercury concentrations in waters seeping from tailings basins (specifically at U.S. Steel's Minntac Mine and Northshore Mining's Northshore Mine) than in either precipitation input or pond water in the tailings basin. The loss of mercury through adsorption to solids in the tailings basin and subsequent burial in the sediments results in an overall permanent retention of mercury within the basin and decreases the mercury load released to receiving waters. MDNR research demonstrates that mercury released to surface waters during taconite processing is insignificant with respect to mercury concentrations found in local precipitation and existing background surface waters. The FEIS relies on revised cross-section models from the SDEIS to	PD 08 WR 018 WR 021

Comment ID	Comment	Response	Theme(s)
		evaluate containment systems on the north, northwest, and west sides of the Tailings Basin, which are documented in PolyMet 2015i (as cited in the FEIS). These new models consider the presence of an upper more-permeable bedrock zone directly below the slurry wall, with hydraulic properties based on 2014 packer tests conducted in five boreholes along the proposed containment system alignment. Sensitivity analyses have included variable bedrock hydraulic conductivity and different upper bedrock zone thicknesses up to 100 feet. The model results predict that the overall capture efficiencies of the proposed Tailings Basin containment systems would be substantially greater than 90%. This analysis supports the conclusion that the assumption of 90% or greater capture efficiency is justified. Water captured by the containment system would be treated by the WWTP thereby lowering mercury levels once again before water is discharged to the environment. The target mercury WWTP effluent concentration is 1.3 ng/L which would meet the GLI standard.	
19683	The SDEIS evaluation of mercury impacts is deficient, and the conclusion of no mercury impacts downstream in the St. Louis River watershed is not supported by the information presented. This issue remains a significant impact to reservation and treaty resources.	As summarized in FEIS Section 6.2.3.3.4, the NorthMet Project Proposed Action is predicted to result in a net overall decrease of mercury loadings of approximately 1.0 grams per year (i.e., a net decrease of 1.2 grams per year in the Partridge River and a net increase of 0.2 grams per year in the Embarrass River), which is indistinguishable from natural background variability. Therefore, the NorthMet Project Proposed Action would not contribute to cumulative effects on mercury loading to the St. Louis River. Supporting information is provided in FEIS Section 6.2.3.3.4.	MERC 19
19684	Project's effect on wild rice waters sulfate loadings, compliance points, seasonal discharge. The Band has consistently challenged the conclusion that the NorthMet Project will not result in damage to wild rice waters in the Partridge and Embarrass Rivers and their watersheds. Our skepticism arises from growing knowledge of the extent to which state and federal regulatory agencies have consistently failed to enforce standards and regulations on the mining industry that are intended to protect wild rice. We have exhaustively commented on the specific threats of this project from the very beginning of our involvement as a cooperating agency, and our	Neither seasonal application of the wild rice standard nor non-mechanical treatment systems are part of the NorthMet Project Proposed Action, which relies solely on mechanical treatment and year-round application of the sulfate standard. Non-mechanical treatment may be considered during operations and closure if pilot studies demonstrate their utility and cost-effectiveness for water treatment and water disposal. For purposes of the FEIS, the MPCA has provided guidance as to what waters in the Embarrass and Partridge rivers are waters used for production of wild rice to which the current 10 mg/L wild rice sulfate standard applies. The MPCA reviewed all available relevant information in making their recommendation; however, that recommendation in itself is a policy decision of the MPCA that is not part of the EIS process.	WR 153 WR 154

Comment ID	Comment	Response	Theme(s)
	previous concerns are carried forward to the SDEIS, despite new engineering controls and water treatment. It is commendable that PolyMet has committed to constructing wastewater treatment plants that include reverse osmosis, which has the potential to meet the low sulfate effluent limit if designed and operated properly, including at the Mine Site at year 1. But the damage to wild rice will be just as real and just as permanent if it results from inadequate regulatory controls, as if it results from inadequate engineering controls. In order to effectively apply the standard, the period when wild rice may be susceptible to high sulfate needed to be determined. MPCA produced draft staff recommendations (MPCA 2012b; MPCA 2012a) that included reviews of supporting research findings and related information. The MPCA's recommendations were that the 10 mg/L sulfate standard is applicable for portions of the Partridge River and Embarrass River used for the production of wild rice and that in the portions of the Partridge River, the 10 mg/L sulfate standard is applicable from April 1 through August 31. As stated in earlier comments, recent research does not support seasonal-only restrictions on sulfate loading. There is no time of year when high sulfate discharges do not result in the generation of highly toxic sulfide in the sediments, and consequently, no time of year when wild rice is not susceptible to high sulfate.		
19685	The results over the 4 years of surveys indicate some variability in the location and density of observed wild rice and in associated water column sulfate concentrations between survey years. The 2012 survey showed generally fewer and less dense stands of wild rice than were observed in the 2009 to 2011 surveys...No wild rice was observed in Spring Mine Creek, Trimble Creek, or	For purposes of the FEIS, the MPCA has provided guidance as to what waters in the Embarrass and Partridge rivers are waters used for production of wild rice to which the current 10 mg/L wild rice sulfate standard applies. The MPCA reviewed all available relevant information in making their recommendation; however, that recommendation in itself is a policy decision of the MPCA that is not part of the EIS process.	WR 154

Comment ID	Comment	Response	Theme(s)
	Unnamed Creek near the Plant Site and they are not recommended as waters used for production of wild rice (Barr 2009b; Barr 2011a; Barr 2012a; MPCA 2012b). Section 4.2.2 provides a discussion on wild rice survey results and water quality standards (see Figure 4.2.2-3)….The co-lead and cooperating agencies are all well aware of the historic flood event this region experienced in June 2012; tribal and state rice harvesters reported widespread resource losses (thousands of acres) across many of the region's wild rice lakes and flowages. It is not surprising that the 2012 surveys of wild rice waters impacted by mine discharges showed fewer, less dense stands of wild rice than in previous years…Minnesota tribes have engaged in consultation with the MPCA on this culturally vital issue and provided recommendations for better protection of the wild rice that remains across a much-diminished range. The tribal cooperating agencies have engaged in consultation with the federal co-lead agencies under Section 106 of the National Historic Preservation Act, continually elevating the need for protection of all remaining wild rice in the 1854 Ceded Territory. During consultation the Bands have provided information about tribal wild rice harvest in the Embarrass River far upstream of where the MPCA has recommended as "waters used for the production of wild rice." The wild rice sulfate standard must apply throughout the Embarrass River watershed.		
19686	The scant remaining stands [of wild rice] in the upper reaches [of the Embarrass River] have already been severely impacted by previous mining disturbances and continued releases of high-sulfate water, and are in need of restoration.	In 1973, Minnesota adopted a water quality standard of 10 mg/L applicable to "water used for production of wild rice during periods when the rice may be susceptible to damage by high sulfate levels." Water quality and quantity modeling predictions for SW-005 and PM-13 indicate that the project would not result in adverse impacts to wild rice. These locations are the nearest downstream locations in the Partridge and Embarrass Rivers respectively and are recommended by MPCA to be	PER 10 WR 154 WR 157

Comment ID	Comment	Response	Theme(s)
		considered as waters used for the production of wild rice. Impacts on wild rice further downstream in these waters, or on wild rice resources regionally throughout the treaty areas, would not be expected.	
19687	In MPCA-recommended wild rice waters along the Partridge and Embarrass rivers, the sulfate concentration already exceeds 10 mg/L, so it must be demonstrated that the NorthMet Project Proposed Action would have an acceptably high probability of not increasing sulfate concentrations in these areas. This contorted interpretation of compliance under the Clean Water Act is not defensible. The NorthMet Project Proposed Action must meet MN WQS, including the sulfate criterion to protect wild rice.	Federal Regulations 40 CFR 122.4(i) and 40 CFR 122.44(d)1 have the primary purpose of ensuring that impaired waters are not further degraded before a TMDL is complete. Enacted in the early 1980s, these regulations fulfill the Clean Water Act objective to restore and maintain the chemical, physical, and biological integrity of the nation's waters. 40 CFR. § 122.4(i) prohibits the net increase of any pollutant that will cause or contribute to a numeric or narrative water quality standard violation. 40 CFR. § 122.44(d) requires effluent limits in permits to ensure discharges do not cause, have a reasonable potential to cause, or contribute to the violation of a numeric or narrative water quality standard.	PER 10 WR 153 WR 154
19688	As stated previously, our concerns for protecting wild rice within this region of the 1854 Ceded Territory is based as much upon inadequate implementation of MN WQS protections, as upon the high likelihood that surface and groundwater discharges from the project will exceed MN WQS. We consider the high probability of continued degradation of remaining wild rice stands in the Partridge and Embarrass River watersheds as a result of the NorthMet Project to be an unacceptable environmental impact.	Water quality and quantity modeling predictions for SW-005 and PM-13 indicate that the project would not result in adverse impacts to wild rice. These locations are the nearest downstream locations in the Partridge and Embarrass Rivers respectively and are recommended by MPCA to be considered as waters used for the production of wild rice. Impacts on wild rice further downstream in these waters, or on wild rice resources regionally throughout the treaty areas, would not be expected.	PER 10 WR 156 WR 157
19689	The SDEIS does not adequately discuss impacts to traditional uses such as hunting and trapping, nor does it adequately discuss impacts to traditional game and furbearer populations. This is a major discrepancy in these documents as healthy wildlife populations, particularly game and furbearer species, and access to them is critical for the exercise of treaty rights for tribal members.	Potential effects from the NorthMet Project Proposed Action on game species are discussed in FEIS Section 5.2.5. The potential cultural effects on the Bands from the NorthMet Project Proposed Action on game species are discussed in FEIS Section 5.2.9.2.2.	CR 01
19690	Fond du Lac's comments on the DEIS regarding the existing wildlife corridors are still applicable: they are fundamentally inadequate to maintain habitat connectivity across the heavily disturbed	The FEIS wildlife sections include an analysis of the wildlife corridors, including their use by various species. *Minnesota Rules* 6132.2700 require that a project site be reclaimed once mining has ceased. The goals of such reclamation are to "control erosion, to	WI 02 WI 03

Comment ID	Comment	Response	Theme(s)
	Mesabi Iron Range. As evidenced from aerial photographs, they're narrow and often heavily intruded upon by roads, utility corridors, mine pits and urban development. These features serve as barriers to many kinds of wildlife. While the existing corridors may function well enough for large, mobile species like deer or wolves, they are inadequate for smaller, less mobile species	screen mining areas from non-compatible uses, and to provide for subsequent land uses such as wildlife habitat or timber production." The rules also include requirements about the characteristics and planting schedule for vegetation used in reclamation. Mitigation measures for wildlife species would be considered during the Endangered Species Act Section 7 consultation process.	
19691	The SDEIS concedes that increasing development of urban areas alongside the corridors will render some of the existing corridors less suitable for wildlife in the future. Increased urban development and associated transportation and utility infrastructure should be expected if the project provides the economic benefits stated in the SDEIS. Yet there is no mitigation proposed or even evaluated in the SDEIS for this environmental impact.	The FEIS wildlife sections include an analysis of the wildlife corridors, including their use by various species. *Minnesota Rules* 6132.2700 require that a project site be reclaimed once mining has ceased. The goals of such reclamation are to "control erosion, to screen mining areas from non-compatible uses, and to provide for subsequent land uses such as wildlife habitat or timber production." The rules also include requirements about the characteristics and planting schedule for vegetation used in reclamation. Mitigation measures for wildlife species would be considered during the Endangered Species Act Section 7 consultation process.	WI 02 WI 03
19692	The Band specifically requests that state and federal regulatory agencies work with the tribal agencies to establish dedicated and protected wildlife corridors and enhance reclamation of existing mine lands to mitigate wildlife impacts within the 1854 Ceded Territory.	The FEIS wildlife sections include an analysis of the wildlife corridors, including their use by various species. *Minnesota Rules* 6132.2700 require that a project site be reclaimed once mining has ceased. The goals of such reclamation are to "control erosion, to screen mining areas from non-compatible uses, and to provide for subsequent land uses such as wildlife habitat or timber production." The rules also include requirements about the characteristics and planting schedule for vegetation used in reclamation. Mitigation measures for wildlife species would be considered during the Endangered Species Act Section 7 consultation process. The Cultural Resources section of the Final EIS Chapters 4 and 5 addresses the federal Co-lead Agencies' federal tribal trust responsibilities under the 1854 Treaty. These sections, along with other relevant natural resources sections of Chapters 4, 5, and 6, also address effects on, and any proposed mitigation for effects on cultural resources and culturally significant natural resources. Mitigation for effects on cultural resources and culturally significant natural resources is considered to the extent possible within the parameters of the statutes and regulations providing the federal authorities for the NorthMet project review.	WI 03 CR 01

Comment ID	Comment	Response	Theme(s)
19693	from the Band's perspective, perhaps the most significant deficiency in the SDEIS analysis is of wildlife impacts is its failure to critically analyze potential impacts to moose.	FEIS Sections 4.2.5, 4.3.5, 5.2.5, and 5.3.5 (Wildlife) have been updated to include the new state endangered, threatened, and special concern (ETSC) status listings from August 19, 2013, as well as new federal status listing changes. The FEIS includes a more robust analysis on effects to moose, including habitat and displacement.	WI 01
19694	The tribal cooperating agencies have consistently raised impacts to moose as an issue of critical importance throughout the DEIS, SDEIS, Section 106 consultation, and 'sieve list' meeting processes. It is not acceptable to defer full consideration of this culturally significant species until the FEIS. We have valid concerns about the project's impact on moose habitat at a time when their population is crashing, and they should be addressed immediately.	FEIS Sections 4.2.5, 4.3.5, 5.2.5, and 5.3.5 (Wildlife) have been updated to include the new state ETSC status listings from August 19, 2013, as well as new federal status listing changes. The FEIS includes a more robust analysis on effects to moose, including habitat and displacement.	CR 03
19695	the Band's concern for project impacts to moose is not simply potential effects to hunting zones and seasons; we are gravely concerned about protecting sustainable moose populations for future generations	FEIS Sections 4.2.5, 4.3.5, 5.2.5, and 5.3.5 (Wildlife) have been updated to include the new state endangered, threatened, and special concern (ETSC) status listings from August 19, 2013, as well as new federal status listing changes. The FEIS includes a more robust analysis on effects to moose, including habitat and displacement.	WI 03
19696	This discussion [in the SDEIS] contains substantially outdated information regarding sturgeon reintroduction, both in the St. Louis River estuary and upstream of the Minnesota Power dams on the Fond du Lac Reservation.	FEIS Section 4.2.6.1.4 has been edited to state that lake sturgeon have been documented near Floodwood, MN, per 2012 - 2014 FDL sturgeon data.	AQ 02
19697	Uncontrolled contaminant loading from existing mine facilities, along with elevated constituents from the Proposed Project, have the potential to affect the successful establishment of a sustainable lake sturgeon fishery throughout the St. Louis River. This potential impact should be fully evaluated in the SDEIS.	Existing data review indicates recruitment and a viable population of lake sturgeon do exist in the St. Louis River Watershed. The NorthMet Project Proposed Action is not considered to have the potential for cumulative effects on hydrology and water quality in the St. Louis River Watershed. As a result, no affects to lake sturgeon population within the St. Louis River Watershed system would occur.	AQ 02
19698	The SDEIS states that the property boundaries at both the Plant Site and Mine Site are used to define the maximum extent of NorthMet air impacts that would have the potential to affect historic properties, because the project is predicted	The NorthMet project would have fugitive dust emissions. To evaluate the impact of those fugitive dust emissions, air quality modeling was conducted to assess impacts from those emissions. The modeled results determined impacts to be below applicable air quality standards. The FEIS used the evaluation criteria available to determine impacts. Secondary ambient air	AIR 05 AIR 08 WR 151

Comment ID	Comment	Response	Theme(s)
	to meet ambient air quality standards at those boundaries. The Band asserts that these property boundaries cannot arbitrarily be used for acid dust and metal deposition boundaries because there are no ambient air quality standards for these pollutants. While secondary ambient air quality standards do exist for vegetation, these are not to be used for deposition. It doesn't make sense to use or reference an ambient air quality standard for purposes of studying deposition because "ambient air quality" is a concentration of a pollutant found in a unit of air. "Deposition" is a concentration of a pollutant that settles out of the air onto a surface. Therefore, compliance with traditional ambient air quality modeling and the range where such compliance occurs cannot be used with regard to the deposition of these pollutants on the ground, water surfaces, and vegetation.	quality standards are used to provide public welfare protection, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings. Significant impact on environmental resources or historic properties from dust is not expected because areas with the potential to generate dust would be controlled by a Fugitive Dust Control Plan and any dust leaving the site would most likely come from sources that would be characterized as having low sulfide/low metal content, All active areas at the Mine Site and Plant Site would be subject to a Fugitive Dust Control Plan approved by the MPCA, which describes management of fugitive dust generated from unpaved roads across the NorthMet Project Proposed Action area, rock dumping and loading locations on the Mine Site, and areas potentially subject to wind erosion on the Plant Site (see Sections 4.1.6 and 4.3.9 of PolyMet 2015a, as cited in the FEIS). FEIS Sections 5.2.3.2.2 and 5.2.3.2.4 includes a discussion on the potential indirect deposition effects on wetlands from particulate emissions from the Mine Site, Transportation and Utility Corridor, and the Plant Site. The FEIS has been revised to clarify the assessment results. The deposition modeling results for dust, metals, and sulfur would likely not have an adverse effect on wetlands; however, the modeling only indicated those areas that had deposition rates greater than 100 percent of background deposition. These specific wetlands areas would be identified for consideration in any future monitoring to be conducted for the NorthMet Project Proposed Action. Please refer to theme WET 11 for more information.	
19700	The SDEIS also states that "Within the property boundary, modeling shows where fugitive dust from the Plant Site, Tailings Basin, and Mine Site stockpiles is predicted to settle. Outside of these areas, modeling does not indicate potential effects on historic properties from dust deposition." Again, it is inappropriate to use areas that show compliance with ambient air quality standards to show "no effects from dust and metal deposition", because ambient air quality and impacts caused by deposition are two separate concepts.	The NorthMet project would have fugitive dust emissions. To evaluate the impact of those fugitive dust emissions, air quality modeling was conducted to assess impacts from those emissions. The modeled results determined impacts to be below applicable air quality standards. The FEIS used the evaluation criteria available to determine impacts. Secondary ambient air quality standards are used to provide public welfare protection, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings. Significant impact on environmental resources or historic properties from dust is not expected because areas with the potential to generate dust would be controlled by a Fugitive Dust Control Plan and any dust leaving the site would most likely come from sources that would be characterized as having	AIR 05 WR 151

Comment ID	Comment	Response	Theme(s)
		low sulfide/low metal content, All active areas at the Mine Site and Plant Site would be subject to a Fugitive Dust Control Plan approved by the MPCA, which describes management of fugitive dust generated from unpaved roads across the NorthMet Project Proposed Action area, rock dumping and loading locations on the Mine Site, and areas potentially subject to wind erosion on the Plant Site (see Sections 4.1.6 and 4.3.9 of PolyMet 2015a, as cited in the FEIS). FEIS Sections 5.2.3.2.2 and 5.2.3.2.4 includes a discussion on the potential indirect deposition effects on wetlands from particulate emissions from the Mine Site, Transportation and Utility Corridor, and the Plant Site. The FEIS has been revised to clarify the assessment results. The deposition modeling results for dust, metals, and sulfur would likely not have an adverse effect on wetlands; however, the modeling only indicated those areas that had deposition rates greater than 100 percent of background deposition. These specific wetlands areas would be identified for consideration in any future monitoring to be conducted for the NorthMet Project Proposed Action. Please refer to theme WET 11 for more information.	
19701	Second, and more importantly, it is simply not true that "modeling does not indicate potential effects on historic properties from dust deposition". Figure 4.2.9-4 shows areas where the Fugitive Dust Area of Potential Effect extends outside both the Plant and Mine Sites.	Significant dust related impact on environmental resources or historic properties located out of the project boundary is not expected because project areas with the potential to generate dust would be controlled by a Fugitive Dust Control Plan and any dust leaving the site would most likely come from sources that would be characterized as having low sulfide/low metal content, All active areas at the Mine Site and Plant Site would be subject to a Fugitive Dust Control Plan approved by the MPCA, which describes management of fugitive dust generated from unpaved roads across the NorthMet Project Proposed Action area, rock dumping and loading locations on the Mine Site, and areas potentially subject to wind erosion on the Plant Site (see Sections 4.1.6 and 4.3.9 of PolyMet 2015a, as cited in the FEIS).	AIR 05 WR 151
19702	The SDEIS states that modeled annual dust deposition rates were compared to an "annual effects-level deposition rate" (background) of 365 g/m2/yr. This same "annual effects-level	The assessment approach for deposition of dust, metals, and sulfur to wetlands presented in FEIS Sections 5.2.3.2.2 and 5.2.3.2.4 was a summary from the *NorthMet Project Wetlands Data Package* (PolyMet 2015b, as cited in the FEIS) which includes a citation of the 365 g/m2/yr.	AIR 05 WR 151 WET 11

Comment ID	Comment	Response	Theme(s)
	deposition rate" was given in the PSDEIS in May of 2013, but without providing a reference for how this number was derived.		
19703	direct physical effects of mineral dusts on vegetation can be seen at a surface load of 7 g/m2 and chemical effects of reactive materials can be seen at 2 g/m2 . These levels indicate that the proposed "impact" level of 365 g/m2/yr may be too high.	Minnesota's acid deposition standard recognized that aquatic systems were more sensitive to sulfur inputs and that a wet sulfate deposition standard of 11 kilogram/hectare/year (kg/ha/yr) (3.6 kg/ha/yr wet sulfur) was considered protective of chemistry and biota (MPCA 1985). Others identified that a wet sulfate deposition standard of 15 kg/ha/yr (approximately 5 kg/ha/yr wet sulfur) would be protective of the aquatic systems (MPCA 1985). Sulfate dosing of wetlands in the Marcell Experimental Forest near Grand Rapids that was more than four times background (approximately 28 kg/ha/yr wet sulfate; approximately 9 kg/ha/yr as wet sulfur) did not identify any vegetation-related affects due to the additional sulfur (Jeremiason et al. 2006). At 100 percent of background, the "total" potential sulfur deposition (wet + dry) estimated for the NorthMet Project Proposed Action would be approximately 3.2 kg/ha/yr (background + NorthMet Project Proposed Action). Given that higher doses of sulfur are considered protective of aquatic chemistry and biota, and/or did not show any toxic effects to wetland vegetation, the potential particle-bound sulfur that may be contributed to wetlands by the NorthMet Project Proposed Action would not be expected to result in any adverse effects to vegetation. The fugitive dust would not be reasonably expected to be toxic to the touch and would not be reasonably expected to be directly toxic to vegetation, as it is typically part of road construction materials and/or tailings. The wetland dust deposition analysis identified that metals are expected to be particle-bound, within the mineral matrix of the rock particle. Therefore, the mineral particle must undergo physical or chemical weathering to release the metals. This is typically a slow release over time, measured in years. Metals deposited or applied to mineral and wetland soils have been shown to be sequestered in the upper soil layers and not be available to vegetation. Because of the potential small amounts of metals from fugitive dust that may be available in surface soils for uptake by plants, and the sequestering of most of the metals in soil should they be weathered out of the dust over time, the potential for the metals to be toxic to vegetation is very low. Monitoring of the areas estimated to have metal deposition greater than 100 percent of background would occur as part of the wetland monitoring program which would assess if potential indirect effects occur	AIR 04 WET 11

Comment ID	Comment	Response	Theme(s)
		as a result of the NorthMet Project Proposed Action.	
19704	Further, as the Band commented on the PSDEIS, the modeled deposition rates do not include the effects of contamination from other sources, such as pit leaks and seepage, nor are cumulative impacts from all of these sources included in Chapter 6.	The Co-lead Agencies considered the information included in the Tribal Cooperating Agencies' cumulative effects assessment and found no compelling information or analysis to change the original approach or conclusions.	CU 12
19705	The SDEIS statement that "all of the receptor nodes with the highest model-estimated deposition rates were located within the ambient air boundary" is incorrect, especially given that the following paragraph contradicts this statement by saying "of the 234 acres of wetlands, (that could be potentially indirectly affected) 228 acres would be located within the Mine Site ambient air boundary". While only 3% of the affected acres are outside of the boundary, these two statements should be reconciled. This same comment was made by the Band previously while reviewing the PSDEIS. The inaccuracy serves to diminish consideration of any impacts.	FEIS Sections 5.2.3.2.2 and 5.2.3.2.4 includes a discussion on the potential indirect deposition effects on wetlands from particulate emissions from the Mine Site, Transportation and Utility Corridor, and the Plant Site. The FEIS has been revised to clarify the assessment results. The deposition modeling results for dust, metals, and sulfur would likely not have an adverse effect on wetlands; however, the modeling only indicated those areas that had deposition rates greater than 100 percent of background deposition. These specific wetlands areas would be identified for consideration in any future monitoring to be conducted for the NorthMet Project Proposed Action.	WET 11
19706	SDEIS Figure 5.2.3-22 depicts receptors outside the plant site that are predicted to receive dust deposition rates higher than 50% of background. Since the SDEIS asserts that only those areas receiving deposition greater than 100% of background will be affected, it is unclear why Figure 5.2.3-22 shows areas receiving more than 50% of this value.	The FEIS indicates that dust deposition was highest in three locations: southwest corner, northwest of the Plant Site; southeast corner; and the northeast corner, towards Area 5. The FEIS also states that all receptors have model-estimated dust deposition of 50% or less of the effects-level background. FEIS Figure 5.2.3-22 depicts those three locations that would receive dust deposition of 50% or less and is not intended to depict areas receiving deposition greater than 100% of background.	WET 11
19707	SDEIS Figure 5.2.3-23 depicts receptors outside the plant site that are predicted to receive metal deposition rates higher than 100% of background, but there is no discussion regarding monitoring or management actions to quantify or mitigate affects. Other SDEIS text is confusing or contradictory; from SDEIS 5-302: "all receptors have model-estimated dust deposition of 50% or	FEIS Sections 5.2.3.2.2 and 5.2.3.2.4 includes a discussion on the potential indirect deposition effects on wetlands from particulate emissions from the Mine Site, Transportation and Utility Corridor, and the Plant Site. The FEIS has been revised to clarify the assessment results. The deposition modeling results for dust, metals, and sulfur would likely not have an adverse effect on wetlands; however, the modeling only indicated those areas that had deposition rates greater than 100 percent of background deposition. These specific wetlands areas would be identified for	WET 11

Comment ID	Comment	Response	Theme(s)
	less of the effects-level background of 365 g/m2/yr", but the very next sentence states "At the Plant Site, there would be two locations showing model-estimated deposition rates greater than 100% of background deposition". Later in the same paragraph "…the modeling only indicated those areas that had deposition rates greater than 100% of background deposition". It appears as though one statement may address dust deposition and the other metals deposition, but this is unclear.	consideration in any future monitoring to be conducted for the NorthMet Project Proposed Action. Please refer to theme WET 11 for more information on deposition.	
19708	The SDEIS discussion on fugitive dust is quite often confusing. There should be clarification between when the text is referring to sulfide dust and when it is talking about metallic dust. The text apparently switches between the two without explanation. Also, the text is not clear which air emissions sources were modeled with regard to fugitive dust.	FEIS Sections 5.2.3.2.2 and 5.2.3.2.4 includes a discussion on the potential indirect deposition effects on wetlands from particulate emissions from the Mine Site, Transportation and Utility Corridor, and the Plant Site. The discussions is divided into a discussion on 1) fugitive dust and 2) metals and sulfide dust emissions. The deposition modeling results for dust, metals, and sulfur would likely not have an adverse effect on wetlands; however, the modeling only indicated those areas that had deposition rates greater than 100 percent of background deposition. These specific wetlands areas would be identified for consideration in any future monitoring to be conducted for the NorthMet Project Proposed Action. Please refer to theme WET 11 for more information on deposition.	WET 11
19709	From the SDEIS, "90% of the receptor nodes with the highest model-estimated deposition rates are located within the ambient air quality boundary". As the Band has commented before, this is impossible to verify, as no map of the location of the receptor nodes has been included. Also, 90% of the area predicted to be impacted does not lie within the ambient air quality boundary; it appears to be only about 60% contained to the ambient air quality boundary (SDEIS Figure 5.2.3-22).	FEIS Sections 5.2.3.2.2 and 5.2.3.2.4 show the deposition impacts on wetlands from particulate emissions from the Mine Site, Transportation and Utility Corridor, and the Plant Site. The receptor nodes are depicted on Large Figure 15 and 16 of the *NorthMet Project Wetlands Data Package* (PolyMet 2015b, as cited in the FEIS).	WET 11
19710	the co-lead's only 'mitigation' for fugitive sulfide dust is recommending future wetlands monitoring.	The indirect effects analyses performed for the FEIS were not performed to characterize impacts but were done to inform where monitoring should take place for those areas that were identified as having a potential for indirect wetland effects. As a result of these analyses performed to determine where monitoring should occur, quantification of wetland types and acres of potential indirect wetland effects were also generated. FEIS Section 5.2.3	WET 11

Comment ID	Comment	Response	Theme(s)
		provides these quantitative values of potential indirect wetland effects. FEIS Section 5.2.3.3 (wetland mitigation and monitoring), has been revised to include additional details on the proposed monitoring and wetland adaptive plan. The wetland mitigation and monitoring would be reviewed and approved by the appropriate regulatory agencies responsible for authorizing the permit application during the permitting process. Monitoring is proposed within all wetlands containing a potential indirect wetland impact factor rating of 3 to 5 and a sampling of those wetlands with factor ratings of 1 or 2 as described in FEIS Section 5.2.3.3 (see Figures 5.3.2-31 and 5.2.3-32).	
19711	the Proposed Project suggests water spraying for areas of fugitive dust release during dry periods as mitigation. In the case of dust that may have high acidic content, this would be a poor choice for management action, as the addition of water to the dust would likely create or accelerate toxic run-off.	All active areas at the Mine Site and Plant Site would be subject to a Fugitive Dust Control Plan (FDCP) approved by the MPCA, which would discuss dust mitigation beyond water spray as a control technique for mitigating impacts from dust with acidic content. Reducing vehicle travel speeds, limiting blasting on days with low wind speed, and including chemical dust suppressants would also be in the FDCP. The FDCP would be part of the air quality permit public notice documents. (see Sections 4.1.6, and 4.3.9, in PolyMet 2015a, as cited in the FEIS). Fugitive dust from the project could generally be characterized as low sulfide/low metal. Using water spray on unvegetated surfaces would be appropriate because this would reduce the potential for dust generation and transport off site where it would not be managed. Water that contacts dust falling on disturbed areas within the Project Site would be treated before discharged. The effect of dust falling on the disturbed portions of the Mine Site would be controlled by the perimeter dike and ditch system, which would route runoff to the WWTF (Section 4.1.5.3 and Large Figures 19 through 21 of PolyMet 2015a, as cited in the FEIS). Please refer to theme WET 11 for more information.	WET 11 WR 151
19712	The Band does not agree with the statement that “no significant reactive airborne fugitive dust from the rail transport is expected”. The SDEIS minimizes the potential adverse impacts from constant rail corridor spillage during the life of the mine project by claiming “Any spillage of the ore fines is expected to be within 2 meters of the rail line, along the path”. The Band is concerned with the effect of any spillage on water run-off, as has	The NorthMet Project Proposed Action description in the FEIS includes routine inspections of the Transportation and Utility Corridor to identify accumulations of dust or ore spillage. Regarding dust, given the majority of the dust that could leave the NorthMet Project area could be characterized as low sulfide/low metal, potential impacts would be controlled by: 1) the commitment to treat all runoff from disturbed areas as process wastewater, and 2) the facilities would be subject to an air quality Fugitive Emissions Plan. Significant	WR 151

Comment ID	Comment	Response	Theme(s)
	been seen with other mines in the US: "The Fugitive Dust Risk Management Plan (FDRMP) for Red Dog Operations, Alaska (August 2008, draft) states: "Elevated metal concentrations have been identified in tundra in areas surrounding the DMTS, primarily as a result of deposition of fugitive dust originating from the DMTS corridor, which is used to transport zinc and lead ore concentrates from the Red Dog Mine, operated by Teck Cominco Alaska Incorporated (Teck Cominco)."	impact on water resources or historic properties is not expected. All active areas at the Mine Site and Plant Site would be subject to a Fugitive Dust Control Plan approved by the MPCA, which describes management of fugitive dust generated from unpaved roads across the NorthMet Project area, rock dumping and loading locations on the Mine Site, and areas potentially subject to wind erosion on the Plant Site (see Sections 4.1.6, and 4.3.9, in PolyMet 2015a, as cited in the FEIS). Regarding potential spillage, any significant accumulations would be removed by a combination of machines and hand work. Ore transport would be by special railcars that minimize dust and spillage, where, since the SDEIS, PolyMet has committed to retrofit the railcars to better control spillage and develop an ore management/transport plan for monitoring site conditions. It is unlikely that there would be sufficient spillage to affect the quality of surface water or groundwater. See FEIS Section 5.2.2.3.2. See FEIS Section 3.2.2.4 for more information on the railcars, and Sections 5.2.3 and 5.2.7 for impacts of railcar spillage and dust on wetlands and air quality, respectively. The effect of dust falling on the disturbed portions of the Mine Site would be controlled by the perimeter dike and ditch system, which would route runoff to the WWTF (Section 4.1.5.3 and Large Figures 19 through 21 of PolyMet 2015a, as cited in the FEIS).	
19713	There are other invalid and/or inconsistent statements throughout the SDEIS related to air quality. The SDEIS states "The NorthMet Project area has been designated by the USEPA as attainment for all air quality pollutants". To be clear, attainment designations for the new short-term standards for NOx and SO2 have not yet been completed for the State of Minnesota. Also, 90% control efficiency is assumed for haul roads at the Mine Site, but only 80% control is assumed for unpaved roads at the Plant Site.	In FEIS Section 5.2.7.1.1, the statement, "The NorthMet Project area has been designated by the USEPA as attainment for all air quality pollutants" has been revised to read, "The NorthMet Project area has been designated by the USEPA as attainment or unclassified for all air quality pollutants." The proposed project can have multiple control efficiencies for the various road segments located at the site. The MPCA approved Fugitive Dust Control Plan (FDCP) would have the control efficiencies and the required dust suppression details outlined within the document. The FDCP would be part of the air quality permit public notice documents.	AIR 12
19714	The Band has continually questioned the Page 5-411 states that "The modeling results for the Mine Site receptors…indicate that the highest modeled 24-hour H2H PM-10 concentration was 27 ug/m3 for the year 8 operating scenario and 29 ug/m3 for the year 13 operating scenario". Yet the 29 ug/m3 result not shown in Table 5.2.7-11, even though	• The H2H PM10 concentration of 29 µg/m3 for the year 13 operating scenario was added in FEIS Table 5.2.7.11.	AIR 12

Comment ID	Comment	Response	Theme(s)
	this value is nearly the PM-10 24-hour increment limit (30 ug/m3).		
19716	From Table 6.2-22, cumulative inhalation risks for cancer are four times greater than the guideline of 1E-05. Although much of this risk comes from existing facilities, this number indicates that the area cannot sustain pollution that adds to what is already there without compromising health.	Please also see Response to Comment ID 2879. The commenter is correct that the estimated inhalation cancer risk from the combination of background air data and modeled facility data are above the facility risk guideline for cancer risk. This is consistent with estimates for air data across the state of Minnesota, with levels generally higher in urban areas and lower in rural areas. The estimation of cancer risk from air concentrations is a mathematical exercise and is not equal to actual increases in cancer. Also, these estimates based on environmental hazards must be considered against the background cancer risk in Minnesota from all causes (genetics, tobacco, nutrition, etc.). For example, the background incidence in males is about 1 in a population of 2 (http://www.health.state.mn.us/divs/eh/risk/rules/air/hrvsonar.pdf).	HU 05
19717	The Band has also continued to raise concerns for amphibole fibers, and what we perceive as insufficient analysis in the SDEIS. According to the SDEIS, the BACT-like fine particulate controls will control the release of more than "99.9% of amphibole fibers that are emitted from controlled sources", not "99.9% of fibers in the ore". The second statement is incorrect, because some sources of fibers from the ore are uncontrolled, like blasting operations, or are unable to be controlled up to 99.9%, like haul roads, tailings, crushing and screening, and stockpiles.	FEIS Section 5.2.7.1 has been revised to incorporate additional information about limiting fugitive dust as a surrogate to limit potential fiber emissions. All active areas at the Mine Site and Plant Site would be subject to a Fugitive Dust Control Plan approved by the MPCA, which describes management of fugitive dust generated from unpaved roads across the NorthMet Project area, rock dumping and loading locations on the Mine Site, and areas potentially subject to wind erosion on the Plant Site (see Sections 4.1.6, and 4.3.9, in PolyMet 2015a, as cited in the FEIS). Compliance with the requirements for blasting, found in *Minnesota Rules*, Chapter 6132, will minimize fugitive dust from blasting operations.	AIR 03
19718	The SDEIS states that the Biwabik Iron Formation (which has been found to contain amphibole fibers) slopes under the Duluth Complex at the Mine Site, coming within 100 feet of the area that is planned to be mined. The Band's previous comments regarding unexamined hydrological connections between geologic layers or formations are also applicable in this instance. With fractured bedrock present, that could establish a hydrological connection, and 100 feet would be an insufficient barrier. Additionally, these types of	The NorthMet Project Proposed Action would mine ore from the Duluth Complex, which has been shown to contain amphibole mineral fibers, though to a lesser extent than found in the Biwabik iron formation. The Duluth complex may contain geologic heterogeneities near the proposed project site, which could result in variability in both the concentrations of and type of fiber contained within the oar. The results of the analysis for quantification and identification of fibers collected from samples taken from PolyMet's various floatation tests (SGS 2004, Barr 2007) were used only to confirm the presence of amphibole minerals in the ore and should not be used as a predictor of potential facility emissions. It is not possible to quantify the amount of fibers that may be emitted from the facility with any	WR 012 WR 107

Comment ID	Comment	Response	Theme(s)
	formations are characteristically not homogeneously distributed, meaning that pockets of fibers could be found unexpectedly. While it is true that some information on the occurrence of amphibole fibers has been gathered from the site, the drill locations were chosen with regard to studying minerals of economic interest, and did not specifically target locations where fibers may be expected to occur.	predictive accuracy. Any decisions as to the stringency of ambient air quality monitoring for fibers would be made during the air permitting process, during which there will be an opportunity for public participation.	
19719	The SDEIS maintains that the Minnesota Department of Health has reported that males within the area of the taconite mining and milling industry had more than two times the mesothelioma rate than the rest of the state. Actually, the report from the epidemiologic study of Minnesota iron mine workers states that it is three times the rate found in the rest of the state.	Both the MDH's study of cancer incidence rates in Northeastern Minnesota and the U of M's Taconite Miners Health Study found an increased risk of certain respiratory cancers in iron range mine workers when compared to incidence experienced in Minnesota as a whole. However, neither study was able to definitively link the exposure to occupational amphibole mineral fibers with this observed increase in risk. The design limitations of these epidemiologic studies did not allow for the development of data that could address the potential toxicity that amphibole mineral fibers may present to either those that work directly with mining operations or who live within the surrounding communities.	HU 05
19720	Page 5-443 The SDEIS assures that ambient air monitoring for amphibole fibers would be conducted following facility start-up. While no schedule of frequency or duration for amphibole fibers monitoring has been proposed in the SDEIS, the Band continues to assert, as we have throughout the environmental review process, that monitoring will need to continue over the life of the mine, as no one can predict when fibers might be contacted and released.	Decisions on ambient air quality monitoring for fibers would be made during air permitting and there would be an opportunity for public participation via that process.	AIR 03
19722	The tribal cooperating agencies were not permitted to participate in the Geotechnical Stability IAP workgroup, so we are at a disadvantage for understanding how some of the profound geotechnical stability risks identified for the PolyMet project as defined in the 2009 DEIS were resolved for the 2013 SDEIS.	The proposed design and management of the proposed waste management facilities has evolved throughout the EIS. These modifications have resulted in improved expected stability as well as enhanced environmental outcomes (such as water impacts). Notable enhancements to the design of the proposed waste management facilities since the DEIS include: - improving stability at the Tailings Basin by adding rock buttressing along the northern edge, and adding cement deep soil mixing in the fines and slimes layers along the northern sections of the LTVSMC tailings basin;	GT 14

Comment ID	Comment	Response	Theme(s)
		- moving the Hydrometallurgical Residue Facility from on top of the LTVSMC tailings basin, to a site adjacent to the LTVSMC tailings basin, and designing the Hydrometallurgical Residue Facility as a double-lined facility constructed using the downstream construction method; - designing the Category 1 Stockpile as a permanent feature with a containment system for groundwater runoff and seepage, and geomembrane cover for closure; and - designing the Category 2/3 and 4 waste stockpile as temporary features, with liners, and to reclaim (progressive reclamation) the stockpiles by placing the waste rock as backfill in the East and Central pits. FEIS Sections 2.3, 2.4 and 3.2.3 provide an overview of the evolution of the NorthMet Project Proposed Action. Details of the current NorthMet Project Proposed Action are provided in Section 3.2. Section 5.2.14 provides details of the design factors, management, and modeling results pertaining to geotechnical stability of the waste material storage facilities.	
19723	we do not share PolyMet's confidence in being able to virtually eliminate leakage to groundwater from any type of containment system. Some leakage must always be assumed, and given the site-specific conditions for the proposed location of the HRF, the risk for highly contaminated seepage to exit the HRF and flow to wetlands in the Embarrass River watershed.	The Hydrometallurgical Residue Facility would be double-lined to minimize release of water that has contacted the hydrometallurgical residue. The double liner would consist of a composite liner system utilizing a geomembrane liner above a geosynthetic clay liner with a second liner placed above the first, separated by a leakage collection system. This would substantially remove all hydraulic head from the lower liner and thereby virtually eliminate leakage from the Hydrometallurgical Residue Facility. It is expected that no water would be released directly from the Hydrometallurgical Residue Facility, so, appropriately, leakage from the Hydrometallurgical Residue Facility is not included in modeling. PolyMet initiated laboratory testing to consider the chemical compatibility of the potential geosynthetic liner to be used with leakage from residue (PolyMet 2014r, as cited in the FEIS). Results indicated that a polymer-treated geosynthetic liner should be used that is manufactured specifically in anticipation of the chemical characteristics of the liquid and the pore water that would be contained within the facility. The hydraulic conductivity of the soil leakage collection system is not expected to degrade over time. Typical liner performance assumes a 500-year service life of the geomembrane; therefore, hydraulic conductivity of the liner is not expected to degrade over that time. Specific attributes would be determined during the geosynthetic clay layer development to achieve the desired performance before final installation. Findings of studies on geosynthetic liners indicate that performance is minimally affected by	WET 12

Comment ID	Comment	Response	Theme(s)
		freeze-thaw cycles (PolyMet 2014c). At the Hydrometallurgical Residue Facility, the majority of the geosynthetic liner system would be below the water elevation, and therefore not exposed to freeze-thaw cycles.	
19724	[A] 'natural low point in the topography' is an open water wetland (as prominently displayed in the left photograph on the cover of the SDEIS) with distinct natural drainage channels.	This comment has been received and acknowledged by the Co-lead Agencies. The Co-Lead Agencies believe the identification of wetlands at the NorthMet Project area are accurately and adequately depicted in Section 4.2.3 for the purpose of the EIS.	WET 17
19725	A 0.03-acre area of sedge/wet meadow within the Tailings Basin and a 28.6 acre area of shallow marsh within the Hydrometallurgical Residue Facility are exempt from state and federal wetland regulations as they are both located within the Cliffs Erie Permit to Mine Ultimate Tailings Basin Limit Boundary. The significance of the site topography and natural drainage features is more relevant to our concerns than the regulatory status of the wetlands. The SDEIS simply does not address the potential lack of integrity or risk of failure when constructing a hazardous waste facility within a wetland. Assumptions about hydraulic head being removed from the lower liner are not reassuring when the lower liner (geosynthetic clay) has been installed within a wetland and natural drainage ravine.	The Hydrometallurgical Residue Facility would be constructed over the LTVSMC emergency basin. This site is known to have suitable subsurface conditions, and would minimize impacts to ecosystems and water resources as compared to a new site, since it is already disturbed. The two liner layers on the Hydrometallurgical Residue Facility would be separated by a leakage collection system, which is designed to collect any potential leakage from the bottom of the cell. Each liner layer would consist of a geomembrane layer above a geosynthetic clay layer. A drainage collection system would also be installed during reclamation to collect drainage above the upper liner. The cap would consist of a geotextile fabric, overlain by a clay barrier layer, and a 40-mil low-density polyethylene layer. This would be covered with additional LTVSMC coarse tailings or common borrow and cover soils to sustain a vegetated cover. During reclamation and long-term closure, leakage would be routed and cycled through the Plant Site WWTP. The FEIS includes details from the updated Residue Management Plan. The liner system components have been selected specifically to perform well given the characteristics of the residue, which consists primarily of gypsum. The liner system components selected for the Hydrometallurgical Residue Facility are routinely used for similar facilities in other industries and have demonstrated the expected levels of performance. The design produces a liner system with virtually no leakage due to the system's ability to maintain a very low hydraulic head on the composite liner portion of the overall liner system. In order to install liners, the existing ground would be cleared and either dewatered or built up with fill material. It is not possible to install liners on saturated ground or in standing water. If needed to address foundation conditions, wick drains, including a granular drainage layer and geogrid reinforcement as needed, will be incorporated during construction. If after installation and placement of waste material, there is some head buildup below the liner (unlikely), the direction of leakage would be upward	PD 18 WR 126

Comment ID	Comment	Response	Theme(s)
		through the liner and into the facility collection system, not downward into groundwater. The Residue Management Plan presents the planned Hydrometallurgical Residue Facility monitoring and maintenance plan. Additional monitoring and maintenance requirements would be outlined by the responsible regulatory agency as part of facility permitting. Two submittals titled "PolyMet Information on HRF Residues" were provided to the Co-lead Agencies on August 5, 2014. The documentation summarized the results of two rounds of testing conducted in 2005 and 2009 respectively on the residue that is to be discharged to the Hydrometallurgical Residue Facility. It also reviewed the testing results against the regulations under the federal Resource Conservation and Recovery Act (RCRA). Mining wastes associated with extraction, beneficiation, and processing of ores and minerals are typically excluded from the RCRA definition of hazardous waste (40 CFR 261.4(b)(7)). PolyMet has conducted environmental testing to compare the properties of the hydrometallurgical residue with the RCRA hazardous waste thresholds. Comparison of the results from this testing with the RCRA hazardous waste thresholds shows that the hydrometallurgical residue does not have any toxicity characteristics of a hazardous waste. The MPCA concurs with this assessment.	
19726	The potential for substantial volumes of seepage flowing from the Tailings Basin to the HRF has not been addressed in the SDEIS; this represents a potential structural hazard.	Seeps have been observed along the southern edge of the LTVSMC Tailings Basin Cell 2W. These seeps have diminished since the termination of the LTVSMC operations and are expected to remain minimal as Cell 2W is not proposed for use as part of the NorthMet Project Proposed Action. The design of the Hydrometallurgical Residue Facility acknowledges the presence of this seep by including a collection drain that would collect water from the seep below the proposed constructed embankment and liner systems to transmit the collected seep to the exterior of the facility. This seepage collection system would include a layer of free-draining soil which would reduce the potential for phreatic build-up below the liner. Details on this design consideration are provided in Section 5.1 of the Geotechnical Data Package, Volume 2 (PolyMet 2014c, as cited in the FEIS). Geotechnical stability of the Hydrometallurgical Residue Facility is summarized in FEIS Section 5.2.14.2.3. Details are provided in the Geotechnical Data Package, Volume 2 (PolyMet 2014c, as cited in the FEIS). Design, construction, monitoring, maintenance, and adaptive management are addressed in the Residue Management Plan (PolyMet	GT 11 WR 066

Comment ID	Comment	Response	Theme(s)
		2014r, as cited in the FEIS).	
19727	But we have no assurance that the HRF is designed to structurally withstand thousands of gallons per day of Tailings Basin seepage along the dikes that do not have seepage capture features installed.	The current Hydrometallurgical Residue Facility design acknowledges the presence of an active seep in the proposed area of construction. As such, a collection drain has been designed to collect water from the active seep below the proposed constructed embankment and liner systems, and to transmit the collected seep to the exterior of the facility. This seepage collection system would include a layer of free-draining soil which would reduce the potential for phreatic build-up below the liner. Details on this design consideration are provided in Section 5.1 of the Geotechnical Data Package, Volume 2 (PolyMet 2014c). FEIS Section 4.2.14.3 describes the details of the existing conditions at the location of the proposed Hydrometallurgical Residue Facility, including the fact that it is proposed to be constructed at the location of the LTVSMC Emergency Basin. FEIS Section FEIS 3.2.2.3.7 broadly describes the Hydrometallurgical Residue Facility, while Section 5.2.14.2.3 provides details on the construction, operation, monitoring, and maintenance for geotechnical stability, including potential liquefaction. Additional technical details on design and construction, factors of safety analysis, operation and management, and reclamation and closure are found in the Geotechnical Data Package, Volume 2 (PolyMet 2014c) the Residue Management Plan (PolyMet 2014r).	GT 11
19728	the co-lead agencies' approach to predicting indirect impacts to wetlands and their resulting conclusions, [is] an overly simplistic method based upon a flawed concept of hydrology at the mine site.	When an agency is evaluating reasonably foreseeable significant adverse effects on the human environment in an EIS and there is incomplete or unavailable information because the overall costs of obtaining it are exorbitant or the means to obtain it are not known, NEPA directs the agency to make it clear that such information is lacking, discuss the relevance of the lacking information, and discuss any information relevant to evaluation of the future impacts. In these cases, NEPA also directs the agency to evaluate these impacts based upon theoretical approaches or research methods generally accepted in the scientific community provided that the analysis of the impacts is supported by credible scientific evidence, is not based on pure conjecture, and is within the rule of reason. The Co-lead Agencies believe this is the case for evaluating indirect wetland effects. The Co-lead Agencies have thoroughly considered throughout the development of the EIS and through the wetland Impact Assessment Planning Work Group how to assess potential indirect wetland effects. As a result, strengths and weaknesses of the approach used, as well as other suggested approaches, have been carefully considered. The Co-	WET 08

Comment ID	Comment	Response	Theme(s)
		lead Agencies believe that the analog method used in the SDEIS to assess potential indirect effects from mine dewatering is adequate. Further, the FEIS has been revised to address concerns raised by the Bands regarding the assertion that ombrotrophic bogs would not be impacted by mine dewatering. FEIS Section 5.2.3.2.2 applies a more conservative assumption of the potential indirect effects for all bog communities within the 0-1,000-ft analog zone. Specifically, ombrotrophic bogs were reclassified from the "no effect" category to the "low likelihood" category, the same status as that assigned to minerotrophic bogs. The complex mixes of bedrock, surficial deposits, and wetland soils at the Mine Site impede the ability to reasonably model (e.g., using MODFLOW) and accurately assess the potential effect of pit dewatering on wetlands. In light of this modeling limitation, wetlands were divided into zones based on distance from the open pit. The closer a wetland was to the pit during dewatering, the greater the water table drawdown would be and the greater potential there would be for hydrologic effects on overlying wetlands. These impact assessment methodologies are presented in FEIS Sections 5.2.2.3.2 and 5.2.3.1.2. The Co-lead Agencies are not relying solely on the potential impact zones determined in the analog method for the FEIS but are monitoring wetlands for potential indirect effects. In the event that the required wetland monitoring identifies additional indirect effects, permit conditions would likely include a plan for adaptive management practices to be implemented. Additional compensatory mitigation would be required if indirect wetland impacts are identified during monitoring and annual reporting.	
19729	The purpose of an EIS is to be "forward looking" by predicting potential impacts and adequate mitigation for those impacts; this SDEIS is deficient in that respect. The USACE has not yet developed a monitoring plan to assess after-the-fact Project impacts to wetlands, but maintains that will be the way to best determine and mitigate indirect wetland impacts. The Band is not aware of any previous instance for which the USACE St. Paul District Office has required reasonably foreseeable indirect wetland impacts to be later mitigated as direct effects based upon monitoring.	FEIS Section 5.2.3.3 has been revised to include more information on the monitoring and mitigation plan for the potential indirect wetland effects.	COE 02 WET 02
19730	Given the persistent major differences of opinion between the co-lead agencies and the tribal	FEIS Section 3.2.2.4 states that compensatory wetland mitigation for the NorthMet Project Proposed Action is expected to be approved and	FIN 03

Comment ID	Comment	Response	Theme(s)
	cooperating agencies, the Band specifically requests that financial assurance for potential indirect wetland effects and monitoring be secured.	constructed in advance of any authorized direct wetland impacts and would therefore not require financial assurance. If issued, USACE permits would require mitigation for indirect wetland effects. Guidance for USACE permits that are conditioned to include any type of financial assurance to ensure that required compensatory mitigation is completed can be found in FEIS Section 5.2.3.3.2, or at: • 33 CFR Parts 325 and 332, Compensatory Mitigation for Losses of Aquatic Resources; Final Rule, dated April 10, 2008. Financial assurances are specifically discussed at 33 CFR 332.3(n). • Regulatory Guidance Letter No. 05-1 Date: 14 February 2005 titled: Guidance on the Use of Financial Assurances, and Suggested language for Special Conditions for Department of the Army [i.e., USACE] Permits Requiring Performance Bonds, provides additional guidance on the use of financial assurances.	
19731	Nearly 2,000 acres of coniferous bog wetlands will be directly impacted by mine pit(s) and stockpiles, or indirectly impacted due to drawdown and/or pollution. This is particularly significant to the Band because many tribally harvested resources are only available in coniferous bogs, and restoration of coniferous bogs is a very difficult and long process that has extremely low success rates.	The Co-lead Agencies/ obligation is to ensure that Band members have ample opportunity to exercise their treaty-reserved usufructuary rights; that federal lands are managed to maintain both the diversity and abundance of natural resources; and that the Bands' usufructuary rights to collect resources are not impaired. The Land Exchange Proposed Action was analyzed to understand the potential effect posed to usufructuary rights. The Co-lead Agencies have consulted, and continue to consult with the Bois Forte Band of Chippewa, the Grand Portage Band of Lake Superior Chippewa, and the Fond du Lac Band of Lake Superior Chippewa, the three principle Bands that retain usufructuary rights in the proposed project area. In addition, the Co-lead Agencies have consulted with the GLIFWC and the 1854 Treaty Authority, the principal natural resource agencies representing the aforementioned Bands Through consultation, the Co-lead Agencies understand that the Bands' principle interest with regards to the Land Exchange Proposed Action are the following: to retain or increase the amount of public land within the 1854 Treaty Ceded Territory, shoreline wetlands, culturally important natural resources used in exercising treaty rights of hunting, fishing and gathering, cultural or religious resources, and access to culturally important natural resources and cultural or religious properties. The Co-lead Agencies have a fiduciary obligation to understand and consider the effects that the Land Exchange Proposed Action would have on Band members exercising their Treaty rights in the 1854 Ceded Territory. While the Land Exchange Proposed Action would remove certain lands from federal ownership, this loss is potentially offset by	WET 13

Comment ID	Comment	Response	Theme(s)
		incoming private lands that would become part of the federal estate within the 1854 ceded territory. Outside of the Land Exchange Proposed Action, the Co-lead Agencies have also analyzed the potential effects posed by the Proposed Connected Actions. The potential affects posed to natural resources and cultural resources of importance to the Bands have been disclosed and would be considered during the Co-lead Agency decision process.	
19732	The proposed mitigation plan is inadequate; it allows for the vast majority of mitigation and/or restoration credits to come from outside the Partridge, Embarrass, and St. Louis River watersheds. There is no justifiable reason to permit out-of-watershed mitigation when in-watershed opportunities still exist…	FEIS Section 5.2.3.3.2 includes a discussion on the wetland mitigation study limits and the site selection process. The compensatory wetland mitigation site selection for the NorthMet Project Proposed Action began in 2005 and has gone through a rigorous site selection evaluation. Prior to the 2008 Federal Mitigation Rule, the Aitkin and Hinckley sites were selected, initial approvals by the USACE were received, and substantial investments were made by PolyMet to develop both sites for compensatory mitigation. The USACE guidance prior to the implementation of the 2008 Federal Mitigation Rule was to look for mitigation sites that could provide the following: restoration of historical wetlands, high probability of success, achieve at least partial in-kind mitigation and sites that had ditched and/or tiled peatlands to provide for restoration. When the 2008 Final Mitigation Rule went into effect, the USACE informed PolyMet of the priority for siting any future compensatory mitigation within the St. Louis River/ Great Lakes Basin. The Zim Site was subsequently proposed as a third site. Please refer to the response to theme WET 03.	WET 03
19733	The Band objects to the approval of any further out-of-watershed mitigation credits or restoration for impacts to irreplaceable high quality aquatic resources of national importance, which include all remaining unimpacted wetlands within the St. Louis River watershed/Lake Superior Basin.	FEIS Section 5.2.3.3.2 includes a discussion on the wetland mitigation study limits and the site selection process. The compensatory wetland mitigation site selection for the NorthMet Project Proposed Action began in 2005 and has gone through a rigorous site selection evaluation. Prior to the 2008 Federal Mitigation Rule, the Aitkin and Hinckley sites were selected, initial approvals by the USACE were received, and substantial investments were made by PolyMet to develop both sites for compensatory mitigation. The USACE guidance prior to the implementation of the 2008 Federal Mitigation Rule was to look for mitigation sites that could provide the following: restoration of historical wetlands, high probability of success, achieve at least partial in-kind mitigation and sites that had ditched and/or tiled peatlands to provide for restoration. When the 2008 Final Mitigation Rule went into effect, the USACE informed PolyMet of the priority for siting any future compensatory mitigation within the St. Louis River/ Great Lakes Basin. The Zim Site was subsequently proposed as a third site.	WET 03

Comment ID	Comment	Response	Theme(s)
		Please refer to the response to theme WET 03.	
19734	Tribal cooperating agencies believe the CEA for land use should encompass the 1854 Ceded Territory, as the signatory Bands have lost access to substantial portions of the 1854 CT and the resources within.	The cumulative effects section in the FEIS (Section 6.1.1.1) describes the rationale how the cumulative effects assessment areas (CEAAs) were identified. The CEAAs for individual resource areas vary based on the potential for cumulative effects and not on a single overall assessment area. Table 6.1.1-2 of the FEIS summarizes the spatial areas utilized for each resource area. Please also refer to the response to themes CR 02 and CR 03. The federal Co-lead Agencies considered an expanded area for analysis of cumulative effects on cultural resources and natural resources of significance to the Bands including use of a portion of the 1854 Ceded Territory as the CEAA. By evaluating the effects of the NorthMet Project Proposed Action along with other past, present, and reasonably foreseeable future projects in the context of a much larger area with a much larger number of resources similar to those affected by the NorthMet Project Proposed Action, the effect of the NorthMet Project Proposed Action on those resources is diminished. The cumulative effects analysis focuses on the specific resources, or types of resources, affected by the NorthMet Project Proposed Action within an area that is geographically meaningful considering the project under review. The Cultural Resources section of FEIS Chapter 6 addresses the Co-lead Agencies' determination of the NorthMet Project Proposed Action's cumulative areas of potential effect.	CU 01 CR 01 CR 03
19735	The tribal cooperating agencies believe the water quality and hydrologic cumulative effects analysis should incorporate the entire St. Louis River watershed. This watershed has experienced substantial historic, current and proposed expanded mining activities, as well as other industrial, agricultural and urban development. In addition to the direct surface water and wetland impacts (loss and/or degradation) from these activities, nearly half of the watershed has experienced hydrologic alteration from extensive ditching.	The cumulative effects section in the FEIS (Section 6.1.1.1) describes the rationale how the cumulative effects assessment areas (CEAAs) were identified. The CEAAs for individual resource areas vary based on the potential for cumulative effects and not on a single overall assessment area. Table 6.1.1-2 of FEIS summarizes the spatial areas utilized for each resource area. Please also refer to Section 8.3, MDO 12 for the Co-lead Agencies' rationale for the CEAA identified for water resources.	CU 01
19736	Tribal cooperating agencies consider a 216,300 acre area bounded by the St Louis River, Lake Superior, Lake Vermilion and the Beaver Bay to Vermilion Trail to be a Tribal Historic District, and the pertinent area for consideration of	The historic district proposed by the Grand Portage Band in a June 27, 2013 letter was addressed. The federal Co-lead Agencies have considered an expanded area for analysis of cumulative effects on cultural resources and natural resources of significance to the Bands, including use of the 1854 Ceded Territory as the CEAA. Use of the 1854 Ceded Territory as the	CR 03 CR 04

Comment ID	Comment	Response	Theme(s)
	cumulative effects to cultural resources.	CEAA for cultural resources would actually diminish the significance of any cumulative effects. By evaluating the effects of the NorthMet Project Proposed Action along with other past, present, and reasonably foreseeable future projects in the context of a much larger area with a much larger number of resources similar to those affected by the NorthMet Project Proposed Action, the effect of the NorthMet Project Proposed Action on those resources is diminished. The cumulative effects analysis focuses on the specific resources, or types of resources, affected by the NorthMet Project Proposed Action within an area that is geographically meaningful considering the project under review. Cumulative effects are discussed and addressed differently based on the affected resource. Discussions related to socioeconomics, for instance, use an expanded analysis area compared to other resources. Such expanded analysis areas are used as appropriate. The Cultural Resources sections in FEIS Chapters 4, 5, and 6 address the Co-lead Agencies' determination of the NorthMet Project Proposed Action's direct, indirect, and cumulative areas of potential effect.	
19737	Inadequate cumulative effects analysis, across all resource categories. Cumulative effects result in a relentless, unmitigated diminishment of treaty resources and access to those resources. Yet across virtually all resource categories, the SDEIS predicts that there will be no adverse impacts as a result of the NorthMet Project Proposed Action; this conclusion then enables the co-leads to determine 'no cumulative effects' from the project and the land exchange. But those initial no-impact predictions are contingent upon assumptions that all best management practices, engineering controls and mitigation measures discussed throughout the SDEIS will be successfully and flawlessly implemented, and that the NorthMet Project will comply with all applicable federal state and local regulations and permit requirements, particularly water quality standards. The tribal cooperating agencies have provided extensive comments and analyses over the course of the DEIS and SDEIS processes that support our misgivings for this circular logic. We presented a	The FEIS does not conclude there would be no adverse impacts or there would be no cumulative effects from the NorthMet Project Proposed Action or Land Exchange. The rationale for the geographic and temporal scope of the cumulative effects analysis is well documented in Chapter 6. Table 6.2-1 has been updated to include additional projects that have been identified since publication of the SDEIS. In addition, FEIS Section 6.1.1.2.1 has expanded descriptions regarding the actions included the cumulative effects assessment. FEIS Section 6.2.9 describes specific cumulative effects for cultural resources, including effects to treaty-protected resources and access to those resources. The FEIS's estimates of predicted water quality impacts represent years of study and deliberation and are expected to be reasonable estimates of actual impacts in the event the project is constructed. The NorthMet Project Proposed Action has undergone substantial changes throughout this time to improve predicted water quality, most notably the addition on reverse osmosis treatment plants and water capture systems, liners and covers. The FEIS discloses the probability of water quality impacts and identifies mitigation measures that can be implemented in the event they are needed.	WR 044 WR 045 WR 049

Comment ID	Comment	Response	Theme(s)
	substantial alternative analysis of cumulative effects from the NorthMet Project Proposed Action as part of our commenting during the preliminary SDEIS review. Key concepts from our tribal CEA include: The tribal cooperating agencies' review of the water modeling data packages for the NorthMet Project Proposed Action led to our conclusion that GoldSim did not accurately predict existing conditions, and cannot be relied upon to accurately predict future project conditions.	The FEIS Mine Site GoldSim model was recalibrated to provide a better correspondence between predicted and observed water chemistry data in the Partridge River for existing conditions. This calibration considered new surface water chemistry data collected through the end of 2013. For Colby Lake, a new chemical source term was added to the Mine Site GoldSim model and calibrated to measured concentrations in the lake to ensure there was an adequate basis for assessing Proposed Action potential impacts	
19738	While any individual mine may not have significant impacts on plants, wildlife or the landscape, the cumulative impacts of thousands of acres of habitat loss and degradation correspond to a legitimate, significant concern for treaty-protected resources and access to them.	Table 6.2-1 has been updated to include additional projects that have been identified since publication of the SDEIS. In addition, FEIS Section 6.1.1.2.1 has expanded descriptions regarding the actions included the cumulative effects assessment. FEIS Section 6.2.9 describes specific cumulative effects for cultural resources, including effects to treaty-protected resources. Please also refer to the responses to themes CR 02, VEG 08, and WI 09.	CU 11
19739	General reluctance to share information with non-Band members is often prevalent [at NorthMet Project meetings] as well as cultural restrictions on who (inside and outside the Band) can legitimately and safely be trusted with sensitive information.	Refer to FEIS section 1.2 for roles and responsibilities of the agencies, and Chapter 2 for an overview of the EIS process undertaken. The federal Co-lead Agencies have made a reasonable and good-faith effort to identify cultural resources potentially affected by the NorthMet Project Proposed Action. The federal Co-lead Agencies have actively consulted with the federally recognized Bands that have expressed an interest in consulting on the NorthMet Project Proposed Action. Historic properties affected by the NorthMet Project Proposed Action have been identified and the impacts to those properties have been assessed through the traditional Section 106 methods/process. This also includes an assessment of actual use of those historic properties, as well as other resources in the APE, by tribal members. In addition to traditional methods, elder interviews were conducted in 2010 and 2011 with members of the Bois Forte, Fond du Lac, and Grand Portage. Elders recalled that some Band members had utilized the general NorthMet Project area for hunting, fishing, and plant gathering of wild rice, maple-sugar, berries, and birch bark; however, they could not provide specific locations or uses within the NorthMet Project area. The federal Co-lead Agencies also conducted reconnaissance of trail corridors with participation from the Bands. The purpose of the traditional research and survey was to provide historic documentation and context for and to	NEPA 14

Comment ID	Comment	Response	Theme(s)
		identify places important to the Bands. The elder interviews were to be used to further identify and understand tribal use areas and places of importance. The field investigation component was informed by the results of those efforts.	
19740	The Area of Potential Effect (APE) for cultural resources divided the project into two separate sections surrounding the proposed mine site and the proposed plant site should be revised. "Figure 4.2.9-1, Cultural Resource Analysis-Area of Potential Effect" needs only to have the two areas joined to compose an APE that reflects an undertaking as defined in Section 106 of the National Historic Preservation Act of 1966...])." An APE that encompasses the Mine and Plant sites and surrounding area affected by operations would better describe the undertaking for cultural resource investigations.	The APE is based on extensive modeling and other analysis completed for the NorthMet Mining Project and Land Exchange, and includes an area much broader than the Plant Site and Mine Site. Since the SDEIS, the APE has been modified to encompass the proposed Mine Site and Plant Site, the Dunka Road corridor, several federal parcels included in the Land Exchange Proposed Action, and the Colby Lake Pumphouse and pipeline.	CR 02
19741	The Beaver Bay to Lake Vermilion Trail requires further clarification...There has been no rigorous attempt to research the BBLVT by the Bands or Lead Agencies, although the Superior National Forest Heritage Program reviewed the GLO plats and conducted field investigations on SNF land. Additional fieldwork should be conducted in the spring or fall when ephemeral features such as foot trails are less easily concealed by vegetation and more easily discerned.	The federal Co-lead Agencies believe that the work to justify consideration of the BBLV Trail Segment as an historic property is complete. There has been sufficient background research and fieldwork completed to date as discussed in FEIS Section 4.2.9.2.3. Additional research and fieldwork may be part of any resolution of adverse effect.	CR 04
19742	The proximity of the plant site to the Sugarbush and the cumulative effects of dust on leaves, trees and understory flora have not been examined in detail and their long term effects may well be detrimental to vegetation, other than maples, that comprise the Sugarbush."	As discussed in FEIS Section 5.2.9.2.1 , the federal Co-lead Agencies have determined that the NorthMet Project Proposed Action would adversely affect the Spring Mine Lake Sugarbush. As part of an MOA, the federal Co-lead Agencies would ensure the avoidance, minimization, and/or mitigation of impacts to cultural resources that may be encountered, such as unauthorized collection, during construction or operation of the NorthMet Project Proposed Action. The federal Co-lead Agencies, in consultation with the Bands, SHPO, and PolyMet, are currently working to resolve adverse effects on this property.	CR 02 CR 03 CR 05
19743	The SDEIS must be revised to fully evaluate	Neither Minnesota Rules nor CEQ regulations require the Co-lead	ALT 20

Comment ID	Comment	Response	Theme(s)
	reasonable alternatives in the SDEIS, including identifying the federal agency preferred alternative and the LEDPA.	Agencies to identify a preferred alternative in the SDEIS (40 CFR 1502.14(e)). The FEIS includes available details regarding the identification of an Agency Preferred Alternative. The FEIS contains sufficient information to identify and substantiate the Least Environmentally Damaging Preferred Alternative (LEDPA). The LEDPA is the only alternative that is permittable pursuant to the Clean Water Act (CWA) Section 404(b)(1) Guidelines. The applicant must clearly demonstrate that the preferred alternative in the FEIS is the LEDPA, in that there is not a practicable alternative that would have less adverse impact on the aquatic ecosystem and no other significant adverse environmental consequences. An alternative is practicable if it is available and capable of being done after taking into consideration cost, existing technology, and logistics. The USACE is not required to identify a LEDPA in the FEIS; the final determination on the LEDPA would be made in the ROD for the USACE which serves as the USACE's decision document and the basis for the Department of the Army permit decision. FEIS Section 7.5 includes additional information about the Area of Potential Effect (APE) and LEDPA. The USFS would utilize the FEIS to show the factors relating to how the public interest would be served by the Land Exchange, and the ROD for the USFS would incorporate the findings of those factors and identify the preferred alternative. The MDNR is not required to identify a preferred alternative under MEPA. The FEIS Sections 3.2 and 3.3 further detail this process. The agency preferred alternative and LEDPA process are described in FEIS Sections 7.4 and 7.5. The ROD for the USACE would include the Section 404(b)(1) analysis and the public interest review, and would determine the LEDPA. Furthermore, the ROD for the USACE cannot be finalized until 30 days after release of an FEIS. Any comments received during the 30 day period may be considered in the ROD for the USACE. The ROD for the USACE would recommend issuance, issuance with conditions, or denial of the Project.	COE 04
19744	No mitigation has been identified in the SDEIS for this permanent loss of lands and resources (natural and cultural) to the 1854 Ceded Territory. The public interest determination must include a specific finding that "The intended use of the conveyed Federal land will not substantially	The Cultural Resources sections of FEIS Chapters 4 and 5 address the federal Co-lead Agencies' federal tribal trust responsibilities under the 1854 Treaty. These sections, along with other relevant natural resources sections of FEIS Chapters 4, 5, and 6, also address effects on, and any proposed mitigation for effects on cultural resources and culturally significant natural resources. Mitigation/compensation for effects on	CR 01 LAN 05

Comment ID	Comment	Response	Theme(s)
	conflict with established management objectives on adjacent Federal lands, including Indian Trust lands" (36 C.F.R. 254.3(b)(2)(ii)). This threshold has not been met, and the Fond du Lac Band objects to the implementation of the Land Exchange Proposed Action.	cultural resources and culturally significant natural resources is considered to the extent possible within the parameters of the statutes and regulations providing the federal authorities for the NorthMet project review The federal Co-lead Agencies' obligation is to ensure that Band members have ample opportunity to exercise their treaty-reserved usufructuary rights; that federal lands are managed to maintain both the diversity and abundance of natural resources; and to ensure that the Bands' usufructuary rights to treaty resources are not impaired. The Cultural Resources sections of FEIS Chapters 4 and 5 address these federal tribal trust responsibilities under the 1854 Treaty. The Land Exchange Proposed Action was analyzed to understand the potential effects on usufructuary rights. The Co-lead Agencies have consulted, and continue to consult with the Bois Forte Band of Chippewa, the Grand Portage Band of Lake Superior Chippewa, and the Fond du Lac Band of Lake Superior Chippewa, the three principle Bands that retain usufructuary rights in the proposed project area. In addition, the Co-lead Agencies have consulted with the Great Lakes Indian Fish and Wildlife Commission and the 1854 Treaty Authority, the principal natural resource agencies representing the aforementioned Bands. Through consultation, the Co-lead Agencies understand that the Bands' principle interest with regards to the Land Exchange Proposed Action are the following: to retain or increase the amount of public land within the 1854 Treaty Ceded Territory, shoreline wetlands, culturally important natural resources used in exercising treaty rights of hunting, fishing, and gathering, cultural or religious properties, and access to culturally important natural resources and cultural or religious properties. The Co-lead Agencies have a fiduciary obligation to understand and consider the effects that the Land Exchange Proposed Action would have on Band members exercising their Treaty rights in the 1854 ceded territory. While the Land Exchange Proposed Action would remove certain lands from federal ownership, this loss is potentially offset by incoming private lands that would become part of the federal estate within the 1854 Ceded Territory. Outside of the Land Exchange Proposed Action, the Co-lead Agencies have also analyzed the potential effects posed by the Proposed Connected Actions. The potential affects posed to natural resources and cultural resources of importance to the Bands have been disclosed and would be considered during the Co-lead Agency decision process. Land exchanges do not include mitigation; instead, the resource values and	

Comment ID	Comment	Response	Theme(s)
		public objectives of the non-federal lands must equal or exceed the resource values and public objectives of the federal lands. See FEIS Section 1.4.3. Mitigation for cultural resources as a result of the NorthMet Project Proposed Action is discussed in Section 5.2.9 of the FEIS. The NorthMet Project Proposed Action mining activities would result in a loss of bogs; however, as part of the NorthMet Proposed Action, the Applicant is required to provide compensatory mitigation for wetland impacts in accordance with state and federal permits. One of the proposed mitigation sites for wetland impacts (Zim Site) would be a compensation site for the loss of bogs, and would be located within the 1854 Ceded Territory. The Lake County lands were tax forfeit lands that were offered for sale by the County through a public auction. The Lake County lands would still be accessible to the Bands for their use if the exchange took place, because the lands would become part of the SNF managed lands. No heritage surveys were conducted on the non-federal lands. If any cultural resources are located on the non-federal lands, those cultural resources would be transferred to federal ownership. Such transfer would not adversely affect the heritage resource, but would provide greater preservation protection under federal law. The non-federal lands that contain wild rice beds would not be affected as a result of the Land Exchange Proposed Action or Land Exchange Alternative B, because no activities are proposed on these lands and the proposed mining activities would not affect these lands. As noted in the FEIS, the Land Exchange Proposed Action and Land Exchange Alternative B would increase wild rice stands within the federal estate. FEIS Sections 5.3.2 and 5.3.4 clarify that, although the Land Exchange would result in an increase in wild rice stands within the federal estate boundaries, there would be no change to the existing public access to Tract 1 wild rice stands via the Pike River. Consequently, there would be no increase in wild rice harvest opportunities for the public. No wild rice stands are known to occur on the federal lands, and suitable habitat is limited. Please refer to the response to theme LAN 01 for more information on the public interest determination.	
19745	Summary: Based upon our extensive evaluation of the SDEIS and supporting technical documents, we conclude that there will undoubtedly be significant and unmitigated impacts to natural and cultural resources that the tribal cooperating	FEIS Section 4.2.9.2.3 provides a detailed discussion and analysis of the area in which cultural resources may be affected by the undertaking. The APE takes into account both direct and indirect effects using a geographically expansive area that accounts for direct effects as well as	FIN 06 PER 03 WR 035 WR 037

Comment ID	Comment	Response	Theme(s)
	agencies have consistently elevated to the attention of the co-lead agencies. There will be significant and unmitigated tribal resource losses within the 1854 Ceded Territory and the Lake Superior basin, including the St. Louis River watershed. The NorthMet Project Proposed Action and Land Exchange Proposed Action would decrease the amount of land available for public access and use, and would decrease portions of the 1854 Ceded Territory available for use by the Bands. The SDEIS must be revised, with significant additional study, to appropriately evaluate closure, mitigation, reclamation, and perpetual treatment cost estimates. The SDEIS requires substantially more public transparency and less equivocation on what is arguably one of the most fundamental issues at stake for this project: perpetual treatment.	visual, audible, atmospheric, hydrological, and water quality effects. The APE is based on extensive modeling and other analysis completed for the NorthMet Mining Project and Land Exchange, and includes an area much broader than the Plant Site and Mine Site. Since the SDEIS, the APE has been revised slightly to include the Dunka Road corridor, several federal parcels included in the Land Exchange Proposed Action, and the Colby Lake Pumphouse and pipeline. It is acknowledged that operation, maintenance and periodic replacement of environmental controls would be required during closure. Financial Assurance would be required under the State's Permit to Mine to perform these activities on a continuous and/or periodic basis for as long as these activities are needed. The FEIS includes available details regarding financial assurance (Section 3.2.2.4). Final details on the cost estimates, timeframes, contingency plan amounts, and calculations that would be required for the project would be addressed during permitting. In addition, see the response to theme WR 035.	CR03
19746	The SDEIS does not provide sufficient information for the public to understand whether the NorthMet Project Proposed Action will be required to remediate these and other AOCs before commencing project operations, or be allowed to defer remediation until closure.	FEIS Table 4.2.1-2: NorthMet Project Proposed Action Area of Concern Summary List for Voluntary Investigation and Cleanup Program, has been updated in the FEIS to show the current status and additional information where available. Costs for assessment, investigation, and cleanup are not available. The April 6, 2010, Consent Decree is a court registered agreement between Cliffs Erie LLC and the MPCA to resolve alleged violations of Cliffs Erie's NPDES/SDS permits for its Hoyt Lakes and Dunka mining area facilities. The Consent Decree addresses issues at the Tailings Basin (including outfall SD026) and discharges from the Cliffs Erie Area 5 mining area (SD033). While the latter area is not part of the NorthMet Project Proposed Action, PolyMet has entered into an agreement with Cliffs Erie, whereby it would be transferred to PolyMet upon issuance of permits for the NorthMet Project Proposed Action. Until that time, Cliffs Erie retains responsibilities for permit-related activities at both the Tailings Basin and Area 5. While certain Consent Decree-related activities have been in progress or have been completed for these areas since the SDEIS, there has been no change in ownership or responsible parties since that time.	HAZ 05
19747	Based upon our extensive evaluation of the SDEIS and supporting technical documents, we conclude that there will undoubtedly be significant and	The Co-lead Agencies acknowledge that bedrock is variably fractured. The effects of fracturing are incorporated into the bulk hydraulic conductivity values used to characterize bedrock. This is common practice in large-scale	WR 012

Comment ID	Comment	Response	Theme(s)
	unmitigated impacts to natural and cultural resources that the tribal cooperating agencies have consistently elevated to the attention of the co-lead agencies. There will be significant and unmitigated tribal resource losses within the 1854 Ceded Territory and the Lake Superior basin, including the St. Louis River watershed. The NorthMet Project Proposed Action and Land Exchange Proposed Action would decrease the amount of land available for public access and use, and would decrease portions of the 1854 Ceded Territory available for use by the Bands…There is a demonstrated need for significant improvements to the modeling evaluations. The lack of fracture and fault analysis is also major deficiency of this SDEIS.	evaluations of bedrock hydraulics. The Co-lead Agencies acknowledge that structural faults may exist between mine facilities and perennial streams that receive groundwater discharge. Because the landscape is covered with surficial deposits and there few bedrock outcrops, the existence of faults is conjectural and locations at best can only be inferred. It is unknown if faults (if and where they exist) behave as conduits or barriers to groundwater flow. Given these uncertainties, it is unlikely that any reasonable field program would be able to identify the existence, location, and hydraulic characteristics of faults that may or may not be present at the site. The Co-lead Agency approach is to set up a robust monitoring program during operations and closure to provide direct or indirect evidence on the existence of hydrologically significant faults. If significant faults are identified (that is, faults which could lead to violation of water quality standards), then adaptive measures would be employed to mitigate the fault-related effects.	
19748	Based upon our extensive evaluation of the SDEIS and supporting technical documents, we conclude that there will undoubtedly be significant and unmitigated impacts to natural and cultural resources that the tribal cooperating agencies have consistently elevated to the attention of the co-lead agencies. There will be significant and unmitigated tribal resource losses within the 1854 Ceded Territory and the Lake Superior basin, including the St. Louis River watershed. The NorthMet Project Proposed Action and Land Exchange Proposed Action would decrease the amount of land available for public access and use, and would decrease portions of the 1854 Ceded Territory available for use by the Bands. We consider the high probability of continued degradation of remaining wild rice stands in the Partridge and Embarrass River watersheds as a result of the NorthMet Project to be an unacceptable environmental impact...The water quality analysis is fundamentally inadequate; it must be redone	Water quality modeling predictions for SW-005 and PM-13 indicate that the NorthMet Project Proposed Action would not result in significant adverse impacts to water quality. These evaluation locations are the nearest downstream locations from the NorthMet Project Proposed Action in the Partridge and Embarrass Rivers respectively that are recommended by MPCA staff to be considered as waters used for the production of wild rice for purposes of the FEIS. Impacts on wild rice further downstream in these waters, or on wild rice resources regionally throughout the treaty areas, would not be expected.	WR 115 WR 157

Comment ID	Comment	Response	Theme(s)
19749	The SDEIS evaluation of mercury impacts is deficient, and the conclusion of no mercury impacts downstream in the St. Louis River watershed is not supported by the information presented.	As summarized in FEIS Section 6.2.3.3.4, the NorthMet Project Proposed Action is predicted to result in a net overall decrease of mercury loadings of approximately 1.0 grams per year (i.e., a net decrease of 1.2 grams per year in the Partridge River and a net increase of 0.2 grams per year in the Embarrass River), which is indistinguishable from natural background variability. Therefore, the NorthMet Project Proposed Action would not contribute to cumulative effects on mercury loading to the St. Louis River. Supporting information is provided in FEIS Section 6.2.3.3.4.	MERC 19
19750	We consider the high probability of continued degradation of remaining wild rice stands in the Partridge and Embarrass River watersheds as a result of the NorthMet Project to be an unacceptable environmental impact.	This comment states that the continued degradation of wild rice stands in the Partridge and Embarrass Rivers will result from the NorthMet Mining project. Since no specific information was provided, no changes were made to the EIS. See also response to comment 19748.	PER 10 VEG 04
19751	The most significant deficiency in the SDEIS analysis of wildlife impacts is its failure to critically analyze potential impacts to moose.	FEIS Sections 4.2.5, 4.3.5, 5.2.5, and 5.3.5 (Wildlife) have been updated to include the new state endangered, threatened, and special concern (ETSC) status listings from August 19, 2013, as well as new federal status listing changes. The FEIS includes a more robust analysis on effects to moose, including habitat and displacement.	WI 01
19752	Uncontrolled contaminant loading from existing mine facilities, along with elevated constituents from the Proposed Project, have the potential to affect the successful establishment of a sustainable lake sturgeon fishery throughout the St. Louis River. This potential impact should be fully evaluated in the SDEIS.	Existing data review indicates recruitment and a viable population of lake sturgeon do exist in the St. Louis River Watershed. The NorthMet Project Proposed Action is not considered to have the potential for cumulative effects on hydrology and water quality in the St. Louis River Watershed. As a result, no affects to lake sturgeon population within the St. Louis River Watershed system would occur.	AQ 02
19753	A cumulative analysis of fibers expected from the site along with fibers currently being emitted from other sources should be performed. Human health risk assessments should be expanded to include scenarios of worker exposure to amphibole fibers. Fugitive dust impacts must be evaluated for human health and environmental impacts.	FEIS Section 5.2.7.5.3 contains information on amphibole mineral fibers resulting from mining activities. The exact human health risk of amphibole mineral fiber exposure is not known, and it is not possible to quantify amphibole mineral fiber emissions. Section 5.2.7.5.3 includes information on activities that can minimize fiber emissions, ongoing ambient monitoring to collect baseline mineral fiber data, and information on the commitment to continue fiber emission monitoring after start-up of the NorthMet Project Proposed Action for comparison to the baseline. Amphibole mineral fiber emissions would also be addressed during air permitting. Off-site worker exposure is discussed in the air section of FEIS Chapter 5, specifically in sections 5.2.7.5.2 and 5.2.7.5.3. On-site worker health and	AIR 03 HU 04

Comment ID	Comment	Response	Theme(s)
		safety is regulated by other agencies such as the MSHA, NIOSH, and the OSHA.	
19754	The SDEIS simply does not address the potential lack of integrity or risk of failure when constructing a hazardous waste facility within a wetland.	Based on MPCA preliminary analysis of the material being placed in the Hydrometallurgical Residue Facility, it is not expected to be classified as a hazardous waste facility subject to RCRA. Samples would be collected routinely to confirm that physical and chemical characteristics of residue and materials disposed of in the Hydrometallurgical Residue Facility are not characteristically hazardous, subject to RCRA, and are in compliance with the Permit to Mine and NPDES/SDS permits. FEIS Section 4.2.14.3 describes the details of the existing conditions at the location of the proposed Hydrometallurgical Residue Facility, including the fact that it is proposed to be constructed at the location of the LTVSMC Emergency Basin. The LTVSMC emergency tailings would be consolidated and compacted prior to the construction of the proposed facility. New dams would be located beyond the extent of the emergency basin and founded on existing silty sand, gravel glacial till, and Giants Range granite. The Hydrometallurgical Residue Facility would be constructed using the downstream method and stability modeling indicates that the Hydrometallurgical Residue Facility would meet the required factors of safety. Construction monitoring and mitigation plans would require further detail during permitting to evaluate consolidation of the LTVSMC tailings, settlement for the Hydrometallurgical Residue Facility, and performance of the wick drains. For more information, see the responses to themes GT 11 and GT 15. Geotechnical stability of the Hydrometallurgical Residue Facility is summarized in FEIS Section 5.2.14.2.3. Details are provided in the Geotechnical Data Package, Volume 2 (PolyMet 2014c). Design, construction, monitoring, maintenance, and adaptive management are addressed in the Residue Management Plan (PolyMet 2014r).	GT 07 GT 15
19756	The Band specifically requests that financial assurance for potential indirect wetland effects and monitoring be secured.	FEIS Section 3.2.2.4 states that compensatory wetland mitigation for the NorthMet Project Proposed Action is expected to be approved and constructed in advance of any authorized direct wetland impacts and would therefore not require financial assurance. If issued, USACE permits would require mitigation for indirect wetland effects. Guidance for USACE permits that are conditioned to include any type of financial assurance to ensure that required compensatory mitigation is completed can be found in	FIN 03

Comment ID	Comment	Response	Theme(s)
		FEIS Section 5.2.3.3.2, or at: - 33 CFR Parts 325 and 332, Compensatory Mitigation for Losses of Aquatic Resources; Final Rule, dated April 19, 2008. Financial assurances are specifically discussed at 33 CFR 332.3(n). - Regulatory Guidance Letter No. 05-1 Date: 14 February 2005 titled: Guidance on the Use of Financial Assurances, and Suggested language for Special Conditions for Department of the Army [i.e., USACE] Permits Requiring Performance Bonds, provides additional guidance on the use of financial assurances.	
19757	The Band objects to the approval of any further out-of-watershed mitigation credits or restoration for impacts to irreplaceable high quality aquatic resources of national importance, which include all remaining unimpacted wetlands within the St. Louis River watershed/Lake Superior Basin.	FEIS Section 5.2.3.3.2 includes a discussion on the wetland mitigation study limits and the site selection process. The compensatory wetland mitigation site selection for the NorthMet Project Proposed Action began in 2005 and has gone through a rigorous site selection evaluation. Prior to the 2008 Federal Mitigation Rule, the Aitkin and Hinckley sites were selected, initial approvals by the USACE were received, and substantial investments were made by PolyMet to develop both sites for compensatory mitigation. The USACE guidance prior to the implementation of the 2008 Federal Mitigation Rule was to look for mitigation sites that could provide the following: restoration of historical wetlands, high probability of success, achieve at least partial in-kind mitigation and sites that had ditched and/or tiled peatlands to provide for restoration. When the 2008 Final Mitigation Rule went into effect, the USACE informed PolyMet of the priority for siting any future compensatory mitigation within the St. Louis River/ Great Lakes Basin. The Zim Site was subsequently proposed as a third site. Please refer to the response to theme WET 03.	WET 03 WET 14
19758	Tribal cooperating agencies believe the CEAA for land use should encompass the 1854 Ceded Territory, as the signatory Bands have lost access to substantial portions of the 1854 CT and the resources within.	The cumulative effects section in the FEIS (Section 6.1.1.1) describes the rationale for the identification of CEAAs. The CEAAs for individual resource areas vary based on the potential for cumulative effects, and not on a single overall assessment area. FEIS Table 6.1.1-2 summarizes the spatial areas used for each resource area. Please refer to the responses to themes CR 02 and CR 03.	CU 01
19759	The tribal cooperating agencies believe the water quality and hydrologic cumulative effects analysis should incorporate the entire St. Louis River watershed.	The cumulative effects section in the FEIS (Section 6.1.1.1) describes the rationale for the identification of CEAAs. The CEAAs for individual resource areas vary based on the potential for cumulative effects, and not on a single overall assessment area. FEIS Table 6.1.1-2 summarizes the spatial areas used for each resource area. Please also refer to Section 8.3, MDO12 for the Co-lead Agencies' rationale for the CEAA identified for	CU 01

Comment ID	Comment	Response	Theme(s)
		water resources.	
19760	Tribal cooperating agencies consider a 216,300 acre area bounded by the St Louis River, Lake Superior, Lake Vermilion and the Beaver Bay to Vermilion Trail to be a Tribal Historic District, and the pertinent area for consideration of cumulative effects to cultural resources.	The historic district proposed by the Grand Portage Band in a June 27, 2013 letter was addressed. The federal Co-lead Agencies do not believe that this area meets the definition of a district, nor does it have sufficient integrity as a district to qualify for inclusion in the NRHP. The federal Co-lead Agencies have considered an expanded area for analysis of cumulative effects on cultural resources and natural resources of significance to the Bands, including use of the 1854 Ceded Territory as the CEAA. Use of the 1854 Ceded Territory as the CEAA for cultural resources would actually diminish the significance of any cumulative effects. By evaluating the effects of the NorthMet Project Proposed Action along with other past, present, and reasonably foreseeable future projects in the context of a much larger area with a much larger number of resources similar to those affected by the NorthMet Project Proposed Action, the effect of the NorthMet Project Proposed Action on those resources is diminished. The cumulative effects analysis focuses on the specific resources, or types of resources, affected by the NorthMet Project Proposed Action within an area that is geographically meaningful considering the project under review. Cumulative effects are discussed and addressed differently based on the affected resource. Discussions related to socioeconomics, for instance, use an expanded analysis area compared to other resources. Such expanded analysis areas are used as appropriate. The Cultural Resources sections in FEIS Chapters 4, 5, and 6 address the Co-lead Agencies' determination of the NorthMet Project Proposed Action's direct, indirect, and cumulative areas of potential effect.	CR 03 CR 04

Comment ID	Comment	Response	Theme(s)
Comments from GLIFWC (Submission ID 42952)			
2924	In the SDEIS or supporting documents, there is no discussion of tailings pond water exiting the basin into this topographically closed area. There is no accounting for contaminants moving eastward, and there is no description of their possible impact on receiving ground or surface waters.	The FEIS contains new text describing pond leakage and how the chemistry of this leakage would affect chemical concentrations at the Tailings Basin toes. In general, the chemistry of water at the Tailings Basin toes results from a combination of chemical-loading from pond leakage, meteoric infiltration, chemical release from currently existing LTVSMC tailings, and chemical release from future NorthMet Project Proposed Action-related tailings. See FEIS Section 5.2.2.2.1 for additional information. The 6.5-inches-per-year pond leakage flux is not computed, but is a stated engineering performance specification. The hydraulic conductivity that achieves this leakage flux is computed using a Darcy's law calculation. The GoldSim model contains algorithms that can allow the pond to overflow during periods of high rainfall, so the model does in fact evaluate pond overflow. The pond size and design are such that the GoldSim model predicts that the pond never overflows during the 200-year simulation period. The FEIS acknowledges that there would be future leakage from the tailings pond and the GoldSim model performs calculations to estimate this flow rate. The FEIS Plant Site MODFLOW model was modified from the SDEIS to include: 1) the presence of surficial deposits below the East Embankment, 2) boundary conditions (drain and/or river cells) along the embankment toe to allow the potential for surface seepage, and 3) hydrologic inputs to account for the presence of the proposed drainage swale. See FEIS Section 5.2.2.3.3 and PolyMet 2015j and PolyMet 2015i (both as cited in the FEIS) for more information.	WR 054 WR 057
2925	Because of the no-flow boundaries, the model output files (NorthMet Model Files DVD, BARR July 2012) show extremely unrealistic groundwater heads in the aquifer surrounding the east side of the FTB.	In response to these issues, the Plant Site MODFLOW model was modified and recalibrated as follows: 1) Updated areal distribution of surficial deposits and bedrock outcrops, 2) established surficial deposits below and adjacent to the East Embankment, 3) used drain or river cells along the East Embankment to allow surface seepage of tailings water, 4) incorporated the hydrologic effects of the future swale to drain surface water from the East Embankment area, 5) recalibrated model material properties and boundary conditions using all available data through 2013 (this is mostly new hydraulic head information), and 6) expanded the use of river and drain cells to provide a more accurate representation of wetlands outside the Tailings Basin. As a result of these changes, the FEIS Plant Site MODFLOW model no	WR 093 WR 097

Comment ID	Comment	Response	Theme(s)
		longer has a no-flow boundary condition at the toe of the East Embankment, and river and/or drain cells in surficial deposits are in place to allow the potential for surface seepage along the embankment toes (See Attachment A, Plant Site Water Modeling Data Package [PolyMet 2015j, as cited in the FEIS]). The model was checked to ensure that hydraulic heads in the tailings and adjacent surficial deposits were not well above ground surface. In the FEIS Plant Site MODFLOW model, storage coefficients for the surficial deposits and bedrock outcrops were assigned and/or calibrated to be more in line with literature values for these types of materials.	
2950	Staff continue to believe that the underground mine and west pit backfill alternatives have not been properly explored given the environmental benefits they could bring to the project. Our comments stand as detailed in Appendix C.	The Co-lead agencies considered the information provided by the Tribal Cooperating Agencies in SDEIS Appendix C, and considered both Underground Mining and Backfilling the West Pit as potential alternatives; however, they did not pass screening analysis and were therefore eliminated from detailed analysis in the EIS. The screening process and results for these potential alternatives is described in FEIS Section 3.2.3. See the response to theme ALT 01 for more details on the Underground Mining Alternative and ALT 03 for more details on the West Pit Backfill Alternative.	ALT 01 ALT 03
2951	In addition, there are a number of alternatives that the SDEIS fails to explore. These include paste backfill, immediate operation of the RO treatment facility at the mine site, etc. Additional details are found in the comments submitted by the Fond du Lac Band.	The Co-lead Agencies considered many potential alternatives and mitigation measures including several options for tailings and water management throughout the development of the EIS. As described in Chapter 2 of the FEIS, consideration of these alternatives and mitigation measures influenced the development of the NorthMet Project Proposed Action. Section 3.2.3 of the FEIS describes the alternatives considered and either adopted or eliminated (with reason) from detailed analysis in the EIS. See the response to themes ALT 06 and ALT 13 for more details on several other alternatives, including paste tailings, RO treatment, etc.	ALT 06 ALT 13
2952	Unfortunately the SDEIS has no serious analysis of a No Action Alternative. Section 5.2.2.4 is less than 1 page long and gives a very general and hypothetical discussion. It in no way represents a serious analysis of a No Action Alternative. The SDEIS needs to have modeling of a No Action Alternative	FEIS Section 3.2.3.2 discusses how the Consent Decree under the NorthMet Project No Action Alternative would require Cliffs Erie to complete closure and reclamation activities at the Plant Site. This would include completing activities for the localized affected areas under the Minnesota Voluntary Investigation and Cleanup (VIC) Program, removal of the former Plant Site building, and management of seepage at the Tailings Basin embankment. FEIS Table 3.2-1 shows that under the NorthMet Project No Action Alternative, there would be no mining activities, and that existing management and land use of the federal lands would continue. The NorthMet Project No Action Alternative is also	ALT 14

Comment ID	Comment	Response	Theme(s)
		analyzed under each resource area in FEIS Chapter 5, and summarized in FEIS Table 7.2-1.	
2953	The concerns regarding the cumulative effects analysis have not been resolved. The information provided in Appendix C is still applicable to the SDEIS.	The Co-lead Agencies considered the information included in the Tribal Cooperating Agencies' cumulative effects assessment and found no compelling information or analysis to change the original approach or conclusions.	CU 12
2959	The ACOE and Forest Service's position in the SDEIS is that these items can addressed at a later time by the Minnesota Department of Natural Resources in the review of future mining permits. This action is an ill-conceived attempt to abdicate their federal trust responsibility to protect the habitats that support treaty harvests. Despite their attempts, the ACOE and Forest Service cannot delegate their federal trust responsibility to protect habitats that sustain treaty harvests to state of Minnesota when it undertakes the process of permitting the mine.	The Cultural Resources sections in FEIS Chapters 4 and 5 address the federal Co-lead Agencies' federal tribal trust responsibilities under the 1854 Treaty. These sections, along with other relevant natural resources sections of FEIS Chapters 4, 5, and 6, also address effects on and any proposed mitigation for cultural resources and culturally significant natural resources. Mitigation/compensation for effects on cultural resources and culturally significant natural resources is considered to the extent possible within the parameters of the statutes and regulations pertaining to the federal authorities for the NorthMet Project Proposed Action review. Effects on historic properties would be fully considered prior to the issuance of any permit or land exchange, pursuant to the NHPA and its implementing regulations. Effects on cultural resources and culturally significant natural resources are addressed in the Cultural Resources sections in FEIS Chapters 4, 5, and 6.	CR 01
2961	The superficial estimate of financial assurance provides inadequate detail as to how any of the cost estimates were developed. The DEIS provided a discussion about the options for financial assurance instruments however any substantial discussion of costs and assumptions on the metrics were not provided and instead postponed until the permitting phase of this Project.	FEIS Section 3.2.2.4 provides available details regarding financial assurance. Additional details on the cost estimates, timeframes, contingency plan amounts for unforeseen challenges, and calculations that would be required for the project would be addressed during permitting. Table 3.2-15 provides financial assurance cost estimates for various years of closure, as well as monitoring and mitigation costs. Section 3.2.2.4.1 discusses what activities would be considered in cost estimates, and that cost estimates would be updated annually under the Permit to Mine. Section 3.2.2.4.2 discusses the types of financial assurance instruments that could be used in combination to assure the project. Additional details on the cost estimates, methods, and instruments that would be required for the project, and how the instruments would be updated and dedicated to the project would be addressed during permitting.	FIN 05 FIN 08
2963	The Executive Summary fails to provide: 1) an estimated cost for reclamation, 2) an estimated cost for post-closure maintenance and water treatment, 3) any realistic estimate as to the length of time that post-closure maintenance and water	FEIS Section 3.2.2.4 provides available details regarding financial assurance. Additional details on the cost estimates, timeframes, contingency plan amounts for unforeseen challenges, and calculations that would be required for the project would be addressed during permitting. Table 3.2-15 provides financial assurance cost estimates for various years	FIN 05 FIN 06 FIN 08

Comment ID	Comment	Response	Theme(s)
	treatment would be required, or 4) information as to how financial assurance instruments would be structured to ensure the costs of post-closure maintenance and water treatment are paid for an uncertain amount of time and for which models indicate would be longer than 200 years at the mine site and 500 years at the plant site.	of closure, as well as monitoring and mitigation costs. Section 3.2.2.4.1 discusses what activities would be considered in cost estimates, and that cost estimates would be updated annually under the Permit to Mine. *Minnesota Rules* 6132.1200, Subpart 3, states that cost estimates shall be annually adjusted, using current dollar value at the time of the estimate. FEIS Sections 3.2.2.1.10, 3.2.2.3.12, and 5.2.2.3.1 provide available information regarding long-term water treatment and maintenance. Temporal aspects of financial assurance are addressed in *Minnesota Rules* 6132.3200 Subpart 2, item E, which state that financial assurance is required for all areas that require continued maintenance following closure, and that no release from the Permit to Mine would be granted for portions of mining areas that require post-closure maintenance until the maintenance activities are no longer necessary. Section 3.2.2.4.2 discusses the types of financial assurance instruments that could be used in combination to assure the project. Additional details on the cost estimates, methods, and instruments that would be required for the project, and how the instruments would be updated and dedicated to the project would be addressed during permitting.	
2964	The SDEIS Executive Summary failed to provide either an estimated cost of reclamation or an estimated cost for post-closure maintenance and water treatment.	FEIS Section 3.2.2.4 provides available details regarding financial assurance. Additional details on the cost estimates, timeframes, contingency plan amounts for unforeseen challenges, and calculations that would be required for the project would be addressed during permitting. Table 3.2-15 provides financial assurance cost estimates for various years of closure, as well as monitoring and mitigation costs. Section 3.2.2.4.1 discusses what activities would be considered in cost estimates, and that cost estimates would be updated annually under the Permit to Mine.	FIN 05
2965	The Executive Summary also failed to explain how financial assurance instruments can be established to cover the cost of reclamation and post-closure maintenance and water treatment costs if "it is uncertain how long the NorthMet Project Proposed Action would require water treatment4".	FEIS Section 3.2.2.4 provides available details regarding financial assurance. Table 3.2-15 provides financial assurance cost estimates for various years of closure, as well as monitoring and mitigation costs. Section 3.2.2.4.1 discusses what activities would be considered in cost estimates, and that cost estimates would be updated annually under the Permit to Mine to account for the proceeding year's activities. *Minnesota Rules* 6132.1200, Subpart 3, states that cost estimates shall be annually adjusted, using current dollar value at the time of the estimate. Section 3.2.2.4.2 discusses the types of financial assurance instruments that could be used in combination to assure the project. Additional details on the cost estimates, methods, and instruments that would be required for the project, and how the instruments would be updated and dedicated to the project would be	FIN 08

Comment ID	Comment	Response	Theme(s)
		addressed during permitting. At this time, PolyMet estimates that based on preliminary information that will need to be confirmed by pilot/feasibility studies, they can transition from mechanical to non-mechanical water treatment at the Tailings Basin upon mine closure, and at the Mine Site within 30 years after mine closure.	
2966	The SDEIS provides a listing of items for which costs must be included in the financial assurance instrument (i.e. demolition of all structures and remediation of sites [fencing the perimeters, sloping and seeding the overburden, constructing outlet structures, removing culverts, etc]) yet fails to provide any estimated costs or the basis for these costs.	FEIS Section 3.2.2.4 provides available details regarding financial assurance. Additional details on the cost estimates, timeframes, contingency plan amounts for unforeseen challenges, and calculations that would be required for the project would be addressed during permitting. Table 3.2-15 provides financial assurance cost estimates for various years of closure, as well as monitoring and mitigation costs. Section 3.2.2.4.1 discusses what activities would be considered in cost estimates, and that cost estimates would be updated annually under the Permit to Mine.	FIN 05
2967	The SDEIS notes, PolyMet would ensure that the financial assurance amount is established as a function of at least three main variables: 1) extent of surface disturbance and potential releases from waste storage facilities, 2) reclamation and long-term care standards (including mechanical water treatment), and 3) reasonable assessment of the costs to execute the Contingency Reclamation Plan. The SDEIS provides no discussion as to how these variables are likely to impact overall costs of the financial assurance instrument and how large the variance of cost estimates are likely to be.	FEIS Section 3.2.2.4 provides available details regarding financial assurance. Additional details on the cost estimates, timeframes, contingency plan amounts for unforeseen challenges, and calculations that would be required for the project would be addressed during permitting. Table 3.2-15 provides financial assurance cost estimates for various years of closure, as well as monitoring and mitigation costs. Section 3.2.2.4.1 discusses what activities would be considered in cost estimates, and that cost estimates would be updated annually under the Permit to Mine. Section 3.2.2.4.2 discusses the types of financial assurance instruments that could be used in combination to assure the project. Additional details on the cost estimates, methods, and instruments that would be required for the project, and how the instruments would be updated and dedicated to the project would be addressed during permitting.	FIN 05 FIN 08
2968	The costs provided in Table 3.2-15 provide no basis for their estimation or other assumptions. The SDEIS failed to provide detailed costs for the physical closure and reclamation of the mine site that will need to be covered by Financial Assurance Instruments – a detailed discussion as to how much money will be needed from financial assurance instruments and when.	FEIS Section 3.2.2.4 provides available details regarding financial assurance. Additional details on the cost estimates, timeframes, contingency plan amounts for unforeseen challenges, and calculations that would be required for the project would be addressed during permitting. Table 3.2-15 provides financial assurance cost estimates for various years of closure, as well as monitoring and mitigation costs. Section 3.2.2.4.1 discusses what activities would be considered in cost estimates, and that cost estimates would be updated annually under the Permit to Mine. Section 3.2.2.4.2 discusses the types of financial assurance instruments that could be used in combination to assure the project. Additional details on the cost estimates, methods, and instruments that would be required for the project, and how the instruments would be updated and dedicated to the	FIN 05 FIN 08

Comment ID	Comment	Response	Theme(s)
		project would be addressed during permitting.	
2969	Cost to be covered by Financial Assurance need to include detailed information and cover the following areas: 1) interim operations and maintenance for agencies when a company declares bankruptcy and leaves the site, 2) water management and treatment, 3) removal of hazardous wastes and substances, 4) demolition, removal and disposal of facilities and equipment, 5) earthwork (sloping, backfill, grading), 6) revegetation, 7) long-term operations and maintenance, 8) Monitoring costs, 9) detailed inflation estimates, 9) provide a cash flow analysis, and 10) detail assumptions in the determination of risk and uncertainty.	FEIS Section 3.2.2.4 provides available details regarding financial assurance. As stated in *Minnesota Rules* 6132.1200, Subpart 5, financial assurance criteria require that funds must not be dischargeable through bankruptcy and are fully binding and enforceable under state and federal law. *Minnesota Rules* 6132.1200, Subpart 7 state that the Permit to Mine could be suspended or revoked if the proponent does not comply with financial assurance criteria. The Commissioner may also order imposition of a civil penalty in such a situation, under *Minnesota Rules* 6132.5100. Additional details on the legal framework for the financial assurance required for the project would be addressed during permitting. Also see the response to theme FIN 08, which addresses long-term financial assurance assumptions and instruments/investments. Additional details on the cost estimates, timeframes, contingency plan amounts for unforeseen challenges, and calculations that would be required for the project would be addressed during permitting. Specific infrastructure timelines and life expectancies of equipment would be accounted for during permitting as well. Table 3.2-15 provides financial assurance cost estimates for various years of closure, as well as monitoring and mitigation costs. Section 3.2.2.4.1 discusses what activities would be considered in cost estimates, and that cost estimates would be updated annually under the Permit to Mine. *Minnesota Rules* 6132.1200, Subpart 3, states that cost estimates shall be annually adjusted, using current dollar value at the time of the estimate.	FIN 03 FIN 05
2970	In addition to providing detailed cost estimation, the final EIS needs to clearly identify and communicate assumptions regarding inflation rates, rates of return, contingencies, and labor rates. Closure and maintenance costs will need to be covered years into the future, so a net present value must be included in the final EIS.	FEIS Section 3.2.2.4 provides available details regarding financial assurance. Additional details on the cost estimates, timeframes, contingency plan amounts for unforeseen challenges, and calculations that would be required for the project would be addressed during permitting. Table 3.2-15 provides financial assurance cost estimates for various years of closure, as well as monitoring and mitigation costs. Section 3.2.2.4.1 discusses what activities would be considered in cost estimates, and that cost estimates would be updated annually under the Permit to Mine. Section 3.2.2.4.2 discusses the types of financial assurance instruments that could be used in combination to assure the project. Additional details on the cost estimates, methods, and instruments that would be required for the project, and how the instruments would be updated and dedicated to the project would be addressed during permitting.	FIN 05 FIN 08

Comment ID	Comment	Response	Theme(s)
2971	The SDEIS provides a listing of contingencies that may have to be covered by financial instruments… Unfortunately the SDEIS provides no discussion as to any of the costs of the contingencies that are identified. The SDEIS also fails to discuss how financial instruments would be structured to meet those contingencies or the assumptions made by PolyMet to ensure an adequate stream of revenue is available to meet closure and maintenance costs	FEIS Section 3.2.2.4 provides available details regarding financial assurance. Additional details on the cost estimates, timeframes, contingency plan amounts for unforeseen challenges, and calculations that would be required for the project would be addressed during permitting. Table 3.2-15 provides financial assurance cost estimates for various years of closure, as well as monitoring and mitigation costs. Section 3.2.2.4.1 discusses what activities would be considered in cost estimates, and that cost estimates would be updated annually under the Permit to Mine. Section 3.2.2.4.2 discusses the types of financial assurance instruments that could be used in combination to assure the project. Additional details on the cost estimates, methods, and instruments that would be required for the project, and how the instruments would be updated and dedicated to the project would be addressed during permitting.	FIN 05 FIN 08
2973	The SDEIS notes, PolyMet may cancel financial assurance only upon approval by the MDNR after it is replaced by an alternative mechanism or after being released (in whole or in part) from financial assurance. The SDEIS fails to discuss any federal oversight of this process and how the federal government will meet its trust responsibility in protecting habitats that support off-reservation treaty harvests.	Section 3.2.2.4 discusses financial assurance requirements of the Project, and the response to Theme FIN15 addresses federal requirements for financial assurance. The Cultural Resources sections in FEIS Chapters 4 and 5 address the federal Co-lead Agencies' federal tribal trust responsibilities under the 1854 Treaty. These sections, along with other relevant natural resources sections of FEIS Chapters 4, 5, and 6, also address effects on and any proposed mitigation for cultural resources and culturally significant natural resources. Mitigation/compensation for effects on cultural resources and culturally significant natural resources is considered to the extent possible within the parameters of the statutes and regulations pertaining to the federal authorities for the NorthMet Project Proposed Action review.	CR 01
3049	Depending on the exact placement of the drain cells, the modified modeling [GLIFWC conducted] resulted in an estimate of 588 to 847 gpm of flow through the east berm of the basin. This flow is on a scale similar to the flow predicted for the south berm discharge at SD026 (570 gpm, RS13B Draft-01; or 540 gpm, Polymet 2013j). That the predicted discharges at the south berm and at the east berm are similar is logical because both areas are underlain by bedrock valleys filled with high conductivity surficial deposits. In the context of the predicted total discharge from the FTB at year 20 (3340 gpm,	The Plant Site MODFLOW model was modified for the FEIS to better represent natural and NorthMet Project Proposed Action-related conditions. These include: 1) more accurate representation of surficial deposits and bedrock outcrops around the perimeter of the Tailings Basin, 2) more extensive distribution of drain and/or river cells to provide for potential surface seepage and distribution of wetlands, 3) more appropriate storage coefficients, and 4) steady-state and transient calibrations using new data extending through the end of 2013. Many of the improvements pertained to the East Embankment area of the Tailings Basin, where it is acknowledged that tailings water seepage would be likely to occur and model changes were made to simulate this seepage more accurately.	WR 102

Comment ID	Comment	Response	Theme(s)
	RS13B; or 3230 gpm, Polymet 2013j) the 588-847 gpm prediction suggests that approximately 1/5 of the FTB water would exit through the east berm.		
3054	NorthMet water management plan version 2 states that the south side seepage capture facility is already operational. The SDEIS further states that the system is operating effectively and capturing all seepage out of the south end of the facility. This statement is factually incorrect.	FEIS text has been changed to acknowledge that the south side Tailings Basin containment system is not capturing all seepage from the southern end of the Tailings Basin. Cliffs Erie is currently addressing this issue by upgrading the performance of the existing capture system and, if necessary, constructing new systems to enhance capture. If 100% capture is not attained by the Cliffs Erie upgrades, PolyMet has committed to installing additional systems in Second Creek to achieve this level of performance regardless of the types of measures required.	WR 117
3055	The SDEIS discusses Cliffs Erie site, identifies 62 Areas of Concern (AOC's), and discusses PolyMets role in site remediation. The SDEIS failed to provide any information as to cost estimates for addressing the legal requirements for mitigating the AOC's as identified. This information is needed to ascertain if the proposed project would further contaminant AOC's and increase clean-up/remediation costs.	FEIS Table 4.2.1-2: NorthMet Project Proposed Action Area of Concern Summary List for Voluntary Investigation and Cleanup Program, has been updated in the FEIS to show the current status and additional information where available. Costs for assessment, investigation, and cleanup are not feasible to provide (Personal communication, Email from Jim Robin, MPCA, to ERM, October 27 & 29, 2014). The April 6, 2010, Consent Decree is a court registered agreement between Cliffs Erie LLC and the MPCA to resolve alleged violations of Cliffs Erie's NPDES/SDS permits for its Hoyt Lakes and Dunka mining area facilities (State of Minnesota v. Cliffs Erie, L.L.C. 2010, as cited in the FEIS). Of particular relevance to the NorthMet project, the Consent Decree addresses issues at the current Cliffs Erie tailings basin (including outfall SD026) and discharges from the Cliffs Erie Area 5 mining area (SD033). The tailings basin is part of the NorthMet Project Proposed Action whereas Area 5 is not; however, PolyMet has entered into an agreement with Cliffs Erie where both areas would be transferred to PolyMet upon issuance of project permits. Until that time, Cliffs Erie retains responsibilities for permit-related activities at the tailings basin and Area 5. While certain Consent Decree-related activities have been in progress or have been completed for these areas since the SDEIS, there has been no change in ownership or responsible parties since that time (Personal communication, Email from Jim Robin, MPCA, to ERM, October 27 & 29, 2014).	HAZ 05
12501	The importance of baseflow in understanding site hydrogeology is hard to overstate. Unfortunately, the quality of flow data collected at the Polymet site is poor and fraught with uncertainty. Because there has not been a Polymet stream gage at the	Groundwater baseflows used in the SDEIS are best-estimate values and are retained in the FEIS. This is because the SDEIS groundwater baseflow values were based on 1) winter 1986-87 and winter 1987-88 stream gaging in the Partridge River at SW-006 that occurred when there were no discharges from Northshore and 2) 1942 to 1963 gaging data in the	WR 003

Comment ID	Comment	Response	Theme(s)
	site and Northshore pit dewatering has occurred into the Partridge at varying and uncertain times, all flow data from the site is suspect. Simple upstream, at-site, and downstream flow measurement would have provided higher quality data but was never collected by the applicant nor required by the state.	Embarrass River, which includes years prior to the LTVSMC Tailings Basin startup (1957). When expressed as a groundwater baseflow yield per unit area, the similar results for both watersheds (approximately 0.05 cfs per square mile) supports the approach used. The yield per unit area is similar to other watersheds in Northern Minnesota. Studies have shown that streamflow characteristics in this part of Minnesota have not changed systematically over the last 50 years. The only other available gaging data is from a station installed during 2011 at SW-003 on the Partridge River. Interpretation of groundwater baseflow at SW-003 is not reliable for use in the GoldSim modeling of groundwater baseflow due to the complicating effects of Northshore Pit pumped discharges, seepage from the Northshore Western Pond, and complex storage and release mechanisms in the wetlands that receive these flows. More broadly, groundwater baseflow discharge varies with time and is a reflection of longer-term weather and climatic conditions. The variability of groundwater baseflow discharge is demonstrated by the examination of estimated values for several years using different methods. Evaluation of these values affirms continued reliance on the 1986-87 USGS data for the FEIS is reliable. To better understand the relationship of groundwater baseflow to the GoldSim model's water quality impact projections, a sensitivity analysis for the Mine Site was conducted to evaluate if predicted NorthMet Project Proposed Action impacts are sensitive to groundwater baseflow values. The sensitivity analysis considered the relationship of various model inputs to groundwater baseflow including hydraulic conductivity, recharge, and surface runoff chemical concentrations. The results indicate that modeled groundwater and surface water concentrations are sensitive to changes in baseflow. However, the NorthMet Project Proposed Action's ability to meet groundwater quality and surface water quality evaluation criteria is not sensitive to changes in baseflow. Evaluation criteria can be found in Section 5.2.2.	
12502	The mine site water modeling data package very clearly states (SDEIS reference Polymet 2013i, pg 123 & 133) that the 1 cfs added to Goldsim modeling was to account for constituents added to the Partridge by pit dewatering from Northshore; It is not relevant to baseflow calculations nor is it relevant to determination of aquifer conductivity	The 1 cfs added to GoldSim modeling was to account for constituents added to the Partridge River by pit dewatering and other discharges from the Northshore Mine. It is not part of groundwater baseflow as defined in the Mine Site GoldSim model and is therefore not relevant to determination of aquifer hydraulic conductivity, areal recharge, or groundwater travel times. This variable was updated to be 2.6 cfs at a sulfate concentration of 28 mg/l in the FEIS Mine Site GoldSim model..	WR 005

Comment ID	Comment	Response	Theme(s)
	or groundwater travel times.		
12504	Polymet Modeling of Flow from the Basin: Polymet modeling with MODFLOW (RS13 Attachment A-6 2007; RS13B Attachment A-6 2008; Polymet 2013j Attachment A 2011), for the FTB has prevented any discharge of basin water to the east by erecting a no-flow boundary at the surface of the berm and at the ground surface. This no-flow boundary is an artificial construct that has no basis in reality. In reality, flow to the east will be controlled by the relative head pressures and the conductivity of the materials in the FTB, beneath the FTB and in the berms.	In response to these issues, the Plant Site MODFLOW model was modified and recalibrated as follows: 1) Updated areal distribution of surficial deposits and bedrock outcrops, 2) established surficial deposits below and adjacent to the East Embankment, 3) used drain or river cells along the East Embankment to allow surface seepage of tailings water, 4) incorporated the hydrologic effects of the future swale to drain surface water from the East Embankment area, 5) recalibrated model material properties and boundary conditions using all available data through 2013 (this is mostly new hydraulic head information), and 6) expanded the use of river and drain cells to provide a more accurate representation of wetlands outside the Tailings Basin. As a result of these changes, the FEIS Plant Site MODFLOW model no longer has a no-flow boundary condition at the toe of the East Embankment, and river and/or drain cells in surficial deposits are in place to allow the potential for surface seepage along the embankment toes (See Attachment A, Plant Site Water Modeling Data Package [PolyMet 2015j, as cited in the FEIS])). The model was checked to ensure that hydraulic heads in the tailings and adjacent surficial deposits were not well above ground surface. In the FEIS Plant Site MODFLOW model, storage coefficients for the surficial deposits and bedrock outcrops were assigned and/or calibrated to be more in line with literature values for these types of materials.	WR 093
12510	Geology Beneath the East Berm: Examination of the geologic data for the site indicates that the east berm of the FTB sits on a bedrock valley filled with surficial material that is 25 to 50 feet deep. The bedrock valley under the east berm is the historical stream channel for Trimble Creek prior to the creation of the current tailings basins (Figure 1). The thickness of the surficial material under the east berm is indicated as 25 to 50 feet in the depth to bedrock map of the SDEIS Figure 4.2.2.-12 (Figure 2) and in the depth to bedrock map MN Geological Survey M-126. The distribution of bedrock under the FTB has been represented in 2 ways during Polymet MODFLOW modeling. Technical document RS13	The Tailings Basin design and footprint used in the FEIS Plant Site MODFLOW model was updated from the version used in the SDEIS to address this comment.	WR 094

Comment ID	Comment	Response	Theme(s)
	of Nov. 16, 2007 Attachment A-6 Fig. 4-2 showed bedrock in the 2007 MODFLOW model as extending under the eastern quarter of the tailings basin. In technical document RS13b of Sept. 8, 2008 Attachment A-6 Fig. 4-7h, bedrock in the 2008 model did not extend under the basin but rather showed the basin to be underlain with surficial material. The text of RS13b, section 4.6.1 of Attachment A-6 states: "The location of the bedrock hills that flank the Tailings Basin to the east and south were updated. The location of the bedrock hills is used in the model to define the extent of the low hydraulic conductivity zone that represents the bedrock. Because the footprint of the Tailings Basin – Mitigation Design is closer to these hills on the southeast side of the footprint than was the footprint for the proposed design, it was important to get the location of these hills as accurate as possible. The location of the bedrock hills was defined using information from the Minnesota Geological Survey's map M-164. The resulting zones of hydraulic conductivity can be seen on Figure 4-7." The extent of the tailings basin footprint represented in RS13b is the same extent as currently proposed in the SDEIS. However, evaluation of flow from the basin using MODFLOW and Goldsim appears to have fallen back to the 2007 representation of the basin footprint and of the underlying bedrock (see GLIFWC comment re: SDEIS modeling and mitigation basin design).		
12520	Conceptual Model of East Berm: A conceptual diagram of the east berm is provided below. The head difference between the top of the basin (~1720 ft), the head pressures expected in the surficial deposits below the center of the basin	The Plant Site MODFLOW model was modified for the FEIS to better represent natural and NorthMet Project Proposed Action-related conditions. These include: 1) more accurate representation of surficial deposits and bedrock outcrops around the perimeter of the Tailings Basin, 2) more extensive distribution of drain and/or river cells to provide for potential surface seepage and distribution of wetlands, 3) more appropriate storage	WR 054 WR 056 WR 102 WR 105

Comment ID	Comment	Response	Theme(s)
	(1700 ft; RS13b, 2008), and the head pressure at the toe of the basin (1660 ft) will push water toward the toe of the east berm. The 25-50 feet of surficial deposits in the bedrock valley under the east berm will conduct water under the east berm and beyond. Revised MODFLOW Modeling of Discharge from East Berm: In order to investigate the approximate magnitude of discharge that would exit the east berm of the FTB, we conducted modified MODFLOW modeling of basin flows in year 20 of the project. To simulate the basin but without the no-flow boundary imposed in previous Polymet modeling, we used the 2008 Polymet MODFLOW model (RS13B Draft-01), with the sole modification being the placement of model drain cells at the east berm. The original 2008 model predicted flows of 3340 gpm from the basins, 570 of which was predicted to flow to the seepage barrier on the south side of the basins (SD026) but no flow to the east because of the no-flow boundary instituted in that model (RS13B Draft-01). Our placement of drain cells in the east berm area of the MODFLOW model enabled water to move east from the berm, rather than reverse flow to the north, west and south as was dictated by the no-flow boundary. The use of drain cells at the east berm to allow eastward movement of water is an identical approach as that implemented by Polymet for the south berm of the tailings basin where the discharge to SD026 is modeled by drain cells. Depending on the exact placement of the drain cells, the modified modeling resulted in an estimate of 588 to 847 gpm of flow through the east berm of the basin. This flow is on a scale similar to the flow predicted for the south berm discharge at SD026 (570 gpm, RS13B Draft-01; or	coefficients, and 4) steady-state and transient calibrations using new data extending through the end of 2013. Many of the improvements pertained to the East Embankment area of the Tailings Basin, where it is acknowledged that tailings water seepage would be likely to occur and model changes were made to simulate this seepage more accurately. These changes in response to the comment improve the SDEIS MODFLOW model that limited tailings seepage on the east side of the Tailings Basin.	

Comment ID	Comment	Response	Theme(s)
	540 gpm, Polymet 2013j). That the predicted discharges at the south berm and at the east berm are similar is logical because both areas are underlain by bedrock valleys filled with high conductivity surficial deposits. In the context of the predicted total discharge from the FTB at year 20 (3340 gpm, RS13B; or 3230 gpm, Polymet 2013j) the 588-847 gpm prediction suggests that approximately 1/5 of the FTB water would exit through the east berm. Implication of Faulty Modeling of Discharge to the East: At least three problems arise from the current situation of SDEIS modeling of the FTB with a no-flow boundary on the east and inaccurate representation of bedrock: 1) There is no contaminant transport modeling or evaluation of the water leaving the east side of the basin. Without substantial engineering to remove the water, a lake toward the 1680 foot contour would form (Figure 4) until water spilled toward Spring Mine Lake. The Flotation Tailings Management Plan (Polymet 2013m, page16) discusses the need for a drainage swale to release stormwater from the topographically closed area to the east of cell 1E. In the SDEIS or supporting documents, there is no discussion of tailings pond water exiting the basin into this topographically closed area. There is no accounting for contaminants moving eastward, and there is no description of their possible impact on receiving ground or surface waters. 2) There are potential receiving surface waters near to the east berm; wetlands at the toe of the east berm, Spring Mine Lake & Spring Mine Creek to the east, and wetlands and an unnamed creek to the north of the proposed drainage swale. 3) The Polymet MODFLOW modeling was designed to prevent any water from leaving the east side of the basin by establishing no-flow		

Comment ID	Comment	Response	Theme(s)
	boundaries on that side of the model. Because of the no flow boundaries, the model output files (NorthMet Model Files DVD, BARR July 2012) show extremely unrealistic groundwater heads in the aquifer surrounding the east side of the FTB. For example, the Polymet MODFLOW 2011 model predicts groundwater head to be over 1800 ft in elevation where the ground elevation is 1660 ft on the east side of the tailings basin. A model with such distorted groundwater head predictions is unlikely to produce accurate flow information, rendering the flowpaths to the north, west and south and flow quantities used by Goldsim in the SDEIS unreliable. Realistic flow modeling of the proposed FTB must be conducted to determine flow directions, flow quantities and travel rates for environmental impact prediction. Information on water flow direction and quantity is also needed so that water management plans can be formulated.		
12525	SDEIS MODFLOW Modeling Appears to be of Fatally Flawed and Discarded Tailings Basin Design. Modeling in the SDEIS appears to be of a Flotation Tailings Basin (FTB) design that was discarded several years ago and does not model the currently proposed basin design. The 2007 FTB design, that is modeled in Attachment A (2011) of Polymet 2013j, was deemed to be "fatally flawed" by the MNDNR (Mitigation Table, Arkley email of 2008/12/09) and was replaced by the "mitigation" design developed in 2008. GLIFWC staff have posed a series of questions to the lead agencies regarding the modeling for water quantity and flow direction at the FTB. ERM has provided a series of written responses to those questions. The 2014-03-10 Response 4 from ERM re: the Plant Site MODFLOW modeling identified Attachment A of the Water Modeling Data package of March 2013 (SDEIS reference Polymet	The Tailings Basin design and footprint used in the FEIS Plant Site MODFLOW model was updated from the version used in the SDEIS to address this comment.	WR 094 WR 098

Comment ID	Comment	Response	Theme(s)
	2013j) as the documentation of the tailings basin flow modeling for the SDEIS. Careful examination of the scant information in the above referenced Attachment A (2011) indicates that the modeling done in 2011 for that attachment was not of the FTB as currently proposed. The footprint modeled for attachment A is the footprint of an early FTB proposal from 2007 (Figure 5) that was supplanted by the FTB design developed during the "Mitigation Options" process of 2008. The 2008 mitigation FTB design (Figure 6) is the current design footprint assumed in the text of the SDEIS (SDEIS Fig. 3.2-23). In addition to using a discarded FTB design footprint, the modeling in Attachment A also used a crude representation of bedrock that was supplanted by a more refined bedrock representation during the modeling of the 2008 mitigation design (RS13B Draft-01, 2008). The diagrams and model files supporting Appendix A (2011) further demonstrate that the modeled footprint is of the 2007 fatally flawed FTB design (see footprints in layer 1 of 2007 (Figure 7) and 2011(Figure 8) models, attached), instead of the mitigation basin design (see footprint in layer 1 of 2008 model, (Figure 9)). The rejected basin design had a smaller footprint and did not extend as far to the south and south-east. Unlike the current design, the rejected design did not cover the ash disposal site in the south-east end of the FTB. It appears that the SDEIS Goldsim (water quality) modeling is based on MODFLOW (water quantity) modeling of an old FTB design that was deemed fatally flawed and is not modeling the currently proposed FTB design.		
12541	Perpetual Water Treatment The proposed Polymet project would require long term treatment of water at both the plant and mine sites. This treatment would be needed for centuries but the lead agencies have not required that the	Although precise estimates cannot be developed, the FEIS modeling indicates that the East Pit, West Pit, and Category 1 Stockpile would be permanent features that would provide solute-loading for a minimum of 200 years at the Mine Site. Similarly, the Tailings Basin is a permanent feature that would provide solute loading for a minimum of 500 years at the	FIN 05 WR 035 WR 036 WR 037

Comment ID	Comment	Response	Theme(s)
	applicant provide an estimate of when treatment would no longer be needed. Therefore, as articulated in Chapter C, GLIFWC staff maintain that water treatment for the proposed Polymet mine is perpetual. GLIFWC staff are gravely concerned that the lead agencies are attempting to minimize the issue of perpetual/long term treatment by using vague and confusing language in the SDEIS. In addition, the language the lead agencies have used has changed during the development of the document even though the model results have not. The SDEIS states on page 5-7: "Mechanical water treatment is part of the modeled NorthMet Project Proposed Action for the duration of the simulations (200 years at the Mine Site, and 500 years at the Plant Site). The duration of the simulations was determined based on capturing the highest predicted concentrations of the modeled NorthMet Project Proposed Action. It is uncertain how long the NorthMet Project Proposed Action would require water treatment, but it is expected to be long term; actual treatment requirements would be based on measured, rather than modeled, NorthMet Project water quality performance, as determined through monitoring requirements." (Emphasis added) In response to comments on the PSDEIS (Comment GLIFWC1) the Co-Lead agency disposition states: "Modeling predicts that treatment activities will be a minimum 200 years at the Mine Site and a minimum of 500 years at the Plant Site. While long-term, these time frames are not necessarily perpetual. The owning company would be held accountable to maintenance and monitoring required under permit and would not be released until all conditions are met" (Appendix C SDEIS) (Emphasis added)	Plant Site. It is acknowledged that operation, maintenance and periodic replacement of environmental controls would be required during closure. Financial Assurance would be required under Minnesota's Permit to Mine to perform these activities on a continuous and/or periodic basis for as long as these activities are needed. FEIS Section 3.2.2.4 provides available details regarding financial assurance. Additional details on the cost estimates, time frames, contingency plan amounts for unforeseen challenges, and calculations that would be required for the project would be addressed during permitting. Specific infrastructure timelines and life expectancies of equipment would be accounted for during permitting as well. Table 3.2-15 provides financial assurance cost estimates for various years of closure, as well as monitoring and mitigation costs. FEIS Section 3.2.2.4.1 discusses what activities would be considered in cost estimates, and that cost estimates would be updated annually under the Permit to Mine. *Minnesota Rules* 6132.1200, Subpart 3 states that cost estimates shall be annually adjusted, using current dollar value at the time of the estimate. The liner and cover systems selected for waste containment are selected on the basis of numerous factors discussed in the Rock and Overburden Management Plan and FEIS Sections 3.2.2.1.8 and 3.2.2.3.10. The WWTP and WWTF would undergo continued inspection and maintenance during operations, long-term treatment, and in closure. The WWTP and WWTF replacement costs would be included in long-term financial assurance estimates. The USEPA guidance on utilization of adaptive management defines it as a decision making process that can be adjusted in the face of uncertainties as outcomes from management actions and other events become better understood. *Minnesota Rules* 6132.1200, Subparts 4 and 5, require the MDNR to evaluate financial assurance cost estimates, terms, and conditions using individuals with documented experience in the relevant field. Those individuals would consider all relevant information in making their evaluations. In addition, see the response to theme WR 035.	

Comment ID	Comment	Response	Theme(s)
	It is impossible to reconcile these 2 statements. We agree that the duration of simulations were based on capturing the highest predicted concentrations of the modeled action. However, those concentrations require water treatment to avoid violating water quality standards. This treatment is at minimum 200 years at the mine site and 500 years at the plant site. As the lead agencies indicate, these time estimates are only minimums and there is no information that points to a time when water treatment would not be needed. Finally, while the maximum contaminant plume is predicted to occur at the 200 and 500 year mark for the mine and plant sites respectively, this does not mean that contaminants immediately drop to zero. The reduction would be gradual and perhaps last for another few centuries. In addition the SDEIS states on page 5-56: "The attenuation effect resulting from sorption is significant enough that arsenic, copper, and nickel are not predicted to travel from source areas to any evaluation locations or the Partridge River within the 200 year model simulation period (Barr 2013f). Analytical calculations suggest that the travel times for these solutes would be in the order of thousands of years." This statement suggests that water treatment activities would be required far beyond the 200 year time frame at the mine site and would be on the order of thousands of years. Therefore, the only logical conclusion is that water treatment is perpetual at this project. It is also important to note that, in the response to GLIFWC comments on the PSDEIS, the lead agencies acknowledge monitoring and maintenance requirements during the same 200 (mine site) and 500 (plant site) year timeframe. The SDEIS requires substantially more transparency on one of the most fundamental		

Comment ID	Comment	Response	Theme(s)
	issues at stake for this project. The fundamental question is: how long will the company be required to operate and maintain expensive mechanical treatment to meet water quality standards? This singular issue has significant repercussions for the public interest determination		
12544	Indirect Wetland Impacts. The methods used in the analysis of indirect wetland impacts in the SDEIS are essentially the same as the 2009 DEIS. GLIFWC staff reiterate the comments we have provided in the past that the method is overly simplistic, based on a flawed conceptual understanding of hydrology at the mine site and inadequate for the NEPA process of a large scale sulfide mine. The SDEIS has underestimated baseflow at the mine site. The entire conceptual model of perched wetlands with hydrology that is completely decoupled from groundwater was supported by the use of unrealistically low baseflow numbers. Now that the applicants XP-SWMM model has been discredited and that it is obvious that the movement of groundwater at the mine site is 3 times greater than the SDEIS indicates, the assumption that wetlands will not be impacted by groundwater drawdown should be abandoned. The higher baseflow numbers support the independent analysis of indirect wetland impacts provided by the tribal cooperating agencies in Appendix C. The lead agencies have also based their analysis on the Bog Memo prepared by the Army Corps of Engineers (Eggers, Steve (2011) MEMORANDUM SUBJECT: Distinguishing Between Bogs That Are Entirely Precipitation Driven Versus Those with Some Degree of Mineral Inputs from Groundwater and/or Surface Water Runoff). This memo uses plant community information to determine the degree of hydrologic connectivity between a wetland and groundwater.	Groundwater baseflows used in the SDEIS are best-estimate values and should be retained in the FEIS. This is because the SDEIS groundwater baseflow values were based on 1) winter 1986-87 and winter 1987-88 stream gaging in the Partridge River at SW-006 that occurred when there were no discharges from the Northshore Mine and 2) 1942 to 1963 gaging data in the Embarrass River, which includes years prior to the LTVSMC Tailings Basin startup (1957). When expressed as a groundwater baseflow yield per unit area, the similar results for both watersheds (approximately 0.05 cfs per square mile) supports the approach used. The yield per unit area is similar to other watersheds in Northern Minnesota. Studies have shown that streamflow characteristics in this part of Minnesota have not changed systematically over the last 50 years. The only other available gaging data is from a station installed during 2011 at SW-003 on the Partridge River. Interpretation of groundwater baseflow at SW-003 is not reliable for use in the GoldSim modeling of groundwater baseflow due to the complicating effects of Northshore Mine probable maximum precipitation pumped discharges, seepage from the Northshore Western Pond, and complex storage/release mechanisms in the wetlands that receive these flows. More broadly, groundwater baseflow discharge varies with time and is a reflection of longer-term weather and climatic conditions. The variability of groundwater baseflow discharge is demonstrated by the examination of estimated values for several years using different methods. Evaluation of these values affirms continued reliance on the 1986-87 USGS data for the FEIS is reliable. To better understand the relationship of groundwater baseflow to the GoldSim model's water quality impact projections, a sensitivity analysis for the Mine Site was conducted to evaluate if predicted NorthMet Project Proposed Action impacts are sensitive to groundwater baseflow values. The sensitivity analysis considered the relationship of various model inputs to groundwater baseflow including hydraulic conductivity, recharge, and surface runoff chemical concentrations. It also reflected consideration of	WET 08 WR 003 WR 175

Comment ID	Comment	Response	Theme(s)
	The conclusions in the memo are appropriate for a system that is not experiencing depressurization of the aquifer (drawdown). However, when mine induced drawdown occurs, new downward pressure gradients are created. Whittington and Price documented that these downward hydrologic gradients can in fact dewater wetlands that are entirely surface water dependent under normal conditions (Whittington, PN and JS Price, The effects of water table drawdown (as a surrogate for climate change) on the hydrology of a fen peatland, Canada.) HYDROLOGICAL PROCESSES, 20(17), 3589-3600. 2006). The bog memo is not an assessment of the hydrologic conditions of wetlands in a dewatered state but rather an assessment of surface hydrology under normal conditions. The indirect wetland impact analysis is should be performed using realistic hydrologic assumptions and appropriate mitigation should be required.	the flow data collected at SW-003 in requiring groundwater baseflows at all locations on the Partridge River be increased by a factor of 4 (e.g., 0.5 to 2.0 cfs at SW-003). The results indicate that modeled groundwater and surface water concentrations are sensitive to changes in groundwater baseflow. However, the NorthMet Project Proposed Action's ability to meet groundwater quality and surface water quality evaluation criteria is not sensitive to changes in baseflow. Evaluation criteria can be found in Section 5.2.2. The Co-lead Agencies are responsible for determining the requirements and adequacy of data used for the EIS. Where field measurements were not available, model assumptions were reviewed and approved for use in impact analyses. The Co-lead Agencies believe that the FEIS contains the best available data and analyses consistent with the National Environmental Policy Act and Minnesota Environmental Policy Act guidance and best practices. While the Co-lead Agencies believe that the analog method used in the SDEIS to assess potential indirect effects from mine dewatering is adequate, the FEIS has been updated with a more conservative approach to address concerns raised by the Bands. FEIS Section 5.2.3.2.2 has been updated to make a more conservative assumption of the potential indirect effects for all bog communities within the 0-1,000-feet analog zone such that all bogs are reclassified from the "no effect" category to "low likelihood" category of wetland hydrology effects. The Co-lead Agencies are not relying solely on the potential impact zones determined in the analog method for the FEIS but are monitoring wetlands for potential indirect effects. In the event that the required wetland monitoring identifies additional indirect effects, permit conditions could include a plan for adaptive management practices to be implemented. Additional compensatory mitigation will be required if indirect wetland impacts are identified during monitoring and annual reporting.	
12566	Seepage Capture Efficiency. As detailed in comments submitted to the lead agencies for the 2009 DEIS and for the current SDEIS, water quality analyses for the Partridge and Embarrass Rivers are inadequate. The results, be they deterministic (DEIS) or in the form of probability distributions (SDEIS) are based on a flawed understanding of hydrology at both mine site and	Although relatively few containment systems have been built with this degree of pumping, the conceptual hydraulics of this type of system provides evidence that it would achieve complete or nearly complete capture. The FEIS relies on revised cross-section models from the FEIS to evaluate containment systems on the northern, northwestern, and western sides of the Tailings Basin, which are documented in PolyMet 2015j (as cited in the FEIS). These new models consider the presence of an upper more-permeable bedrock zone directly below the slurry wall, with	WR 003 WR 009 WR 010 WR 013 WR 018 WR 019 WR 020 WR 099

Comment ID	Comment	Response	Theme(s)
	plant site. This flawed understanding, reflected most prominently in the errors in baseflow calculations, is carried forward to the MODFLOW hydrologic modeling. At the mine site MODFLOW under-predicts the amount of water that would flow into the mine pits and thus under-predicts the amount of water treatment needed for both short and long term closure. At the plant site, the MODFLOW model is constructed in a way that is not representative of reality and therefore yields results that are not logical. The lead agencies appear to disregard these problems because there is faith that the seepage capture and treatment systems will work at over 90% effectiveness for centuries. The SDEIS claims of long term compliance with applicable water quality standards depend entirely on this leap of faith. On conference calls scheduled to discuss these issues, the lead agency consultants have stated that the effectiveness of the capture systems have not been questioned and the lead agencies have not been able to provide any references that would support their position. We suggest that there are substantial reasons for skepticism regarding capture efficiency for the flotation tailings basin, hydrometallurgical tailings basin, and category 1 stockpile seepage capture systems. This skepticism is based on available literature and the performance of other facilities in the immediate vicinity. The EPA conducted an analysis of the effectiveness of seepage capture systems (Evaluation of Subsurface Engineered Barriers at Waster Sites, United States Environmental Protection Agency (EPA), 1998). This analysis looked at capture systems at 36 facilities and evaluated their effectiveness based on the performance requirements at each site. It is difficult to extrapolate the results of this analysis to the Polymet setting because a) the required	hydraulic properties based on 2014 packer tests conducted in five boreholes along the proposed containment system alignment. Sensitivity analyses have included variable bedrock hydraulic conductivity and different upper bedrock zone thicknesses up to 100 feet. The model results predict that the overall capture efficiencies of the proposed Tailings Basin containment systems would be substantially greater than 90%. This analysis supports the conclusion that the assumption of 90% or greater capture efficiency is justified. The FEIS describes a 2014 field program that investigated bedrock along the alignment of the proposed containment system on the northern, northwestern, and western sides of the Tailings Basin in FEIS Section 5.2.2.2.3. This investigation provided field data on bedrock hydraulic conductivity, Rock Quality Designation, and depth to top of bedrock. This information was used to develop MODFLOW cross-section models at three locations on the alignment to assess capture efficiency. The models included bedrock below the slurry wall. The FEIS has been changed to recognize that currently not all water is being pumped back to the Tailings Basin, and therefore it is being released into Second Creek. Impact assessment modeling relies on site 19649 data that indicate the bulk hydraulic conductivity of upper bedrock is two to three orders-of-magnitude lower than the hydraulic conductivity of the surficial aquifer. Thus, groundwater flow and transport at both the Mine Site and Plant Site are dominated by the hydraulics of the surficial aquifer. Bedrock plays a negligible role in transporting NorthMet Project Proposed Action Site-derived chemicals to the Partridge River and Embarrass River. It is acknowledged that there could be some hydraulic connections between bedrock and the surficial aquifer where transport is expected to be negligible. Given these factors, the approach was to not consider this possible connection in the NorthMet Project Proposed Action water quality models, but to recommend extensive monitoring during operations and closure to assess if interactions occur and if they would raise concerns for permitting agencies. If monitoring data indicate trends toward permit non-compliance, adaptive mitigation measures would be implemented to prevent or eliminate what is expected to be a small transport-related bedrock impact relative to surficial flows. See FEIS Section 5.2.2.3.5 for more information on adaptive mitigation measures and FEIS Section 5.2.2.3.6 for more information on monitoring.	WR 117 WR 123

Comment ID	Comment	Response	Theme(s)
	effectiveness varied from facility to facility; b) the way in which effectiveness was measured was different (i.e. water quality improvements downstream versus change in hydrologic head pressure) and c) data collection varied between facilities. Despite these difficulties, the report indicates that 10% of the reviewed containment systems failed to meet the desired performance objectives and required corrective action. An additional 19% of the evaluated facilities did not have sufficient data to conclude whether the containment system was operating successfully or not. Furthermore, there is no information on the effectiveness of any of these facilities at timeframes remotely comparable to the needs at Polymet. In the EPA report, long term is considered 30 years whereas the water capture needs at Polymet are perpetual for the flotation tailings basin, category 1 stockpile and hydrometallurgical tailings basin. Finally, none of the facilities in the study are as large as the one proposed at Polymet. At the tailings basin, Polymet has proposed to install a seepage collection system around the north and west sides of the facility. The scale of this engineering control is extensive. It would be approximately 5 miles long and would have to be keyed to bedrock that is 25 to 50 feet below ground surface. The most likely pathway for leakage at this barrier will be in the vicinity of the key with bedrock (EPA 1998). This feature, and the similar containment system at the Category 1 waste rock stockpile are assumed to capture 93% of water leaving the facilities for an indeterminate period of time. As previously stated, there is no scientific justification for this number. The only examples we are able to identify at this time suggest capture rates that are lower. In t	The Hydrometallurgical Residue Facility would be double-lined to minimize release of water that has contacted the hydrometallurgical residue. The double liner would consist of a composite liner system utilizing a geomembrane liner above a geosynthetic clay liner with a second liner placed above the first, separated by a leakage collection system. This would substantially remove all hydraulic head from the lower liner and thereby virtually eliminate leakage from the Hydrometallurgical Residue Facility. It is expected that no water would be released directly from the Hydrometallurgical Residue Facility. PolyMet initiated laboratory testing to consider the chemical compatibility of the potential geosynthetic liner to be used with leakage from residue (Residue Management Plan (PolyMet 2015r, as cited in the FEIS)). Results indicated that a polymer-treated geosynthetic liner should be used that is manufactured specifically in anticipation of the chemical characteristics of the liquid and the pore water that would be contained within the facility. The hydraulic conductivity of the soil leakage collection system is not expected to degrade over time. Typical liner performance assumes a 500-year service life of the geomembrane; therefore, hydraulic conductivity of the liner is not expected to degrade over that time. Specific attributes would be determined during the geosynthetic clay layer development to achieve the desired performance before final installation. Findings of studies on geosynthetic liners indicate that performance is minimally affected by freeze-thaw cycles (PolyMet 2014c). At the Hydrometallurgical Residue Facility, the majority of the geosynthetic liner system would be below the water elevation, and therefore not exposed to freeze-thaw cycles. Based on a MODFLOW groundwater model specifically developed to assess capture efficiency of the Category 1 system, it was concluded that the system would achieve an overall efficiency between 90% and 94% for groundwater flowing in surficial deposits and bedrock. The FEIS further evaluated the possibility of fractures and faults at the Mine Site and Plant Site to determine what (if any) changes need to be made to model assumptions to accurately predict potential environmental effects for purposes of environmental review. Although no change was made to the Plant Site GoldSim model, the FEIS Mine Site GoldSim model was modified to include a flow/transport zone 15 meters thick from that present in the SDEIS. The results of the analysis are included in FEIS Section 5.2.2.3.2.	
12568	Summary for Seepage Capture Comments.	The design of the tailings basin capture system includes 1) a slurry wall	WR 017

Comment ID	Comment	Response	Theme(s)
	The prediction of water quality standard compliance for this proposed project hinges on the perfect operation of the water capture systems. The reliance on this engineered containment system that uses overly optimistic capture rates and must function in perpetuity is not scientifically supported and therefore is not appropriate for the SDEIS. The water quality and quantity impacts at both plant site and mine site should be remodeled by using a range of capture efficiencies. We suggest 60%, 70%, 80% capture rates be modeled for the tailings basin and category 1 stockpile. Water quality values for each of these capture rates should be reported. This will allow the public and decision makes to have a realistic picture of the risk and uncertainty for this project. Seepage capture at the flotation tailings basin does not account for seepage out of the east side of the basin. The seepage capture system should be expanded to account for this expected discharge. A MODFLOW model was developed to assess the amount of seepage that would flow out of the basin. As detailed in GLIFWC comments, that model is designed in a way that does not conform to reality and therefore the results are unreliable.	keyed into bedrock, 2) a collection trench on the tailings side, 3) permanent pumping of the collection trench to depress the groundwater level on the tailings side, and 4) a discharge pipe on the opposite side to raise groundwater levels to near ground surface. As shown by the cross-section MODFLOW models, this design insures a reversal of hydraulic gradients across the slurry wall (complete capture in surficial deposits) and complete or very high capture efficiency in bedrock below the slurry wall. The examples cited in the comment for northeastern Minnesota are very different designs and cannot be compared to the proposed design for the Tailings Basin. Modeling performed for the NorthMet Project Proposed Action capture system indicates that the overall capture efficiency would be substantially greater than 90%. The proposed capture system for the Category 1 Stockpile is a unique design that uses a slurry wall keyed into bedrock and a pumped collection trench that maintains depressed groundwater levels on the inside (Category 1 Stockpile side) of the system. It is acknowledged that there are existing capture systems at other mine sites that do not operate with a high degree of capture, but these are different designs and cannot be directly compared to the system proposed for the Category 1 Stockpile. Based on a MODFLOW groundwater model specifically developed to assess capture efficiency of the Category 1 Stockpile system, it was concluded that the system would achieve an overall efficiency between 90% and 93% for groundwater flowing in surficial deposits and bedrock. This analysis supports the conclusion that the proposed Category 1 capture system has a high probability of meeting its performance specifications.	WR 018 WR 022 WR 035 WR 093 WR 129 WR 133
12573	Ability of Goldsim to Accurately Predict Contaminant Concentrations:. We remain concerned about the inability of Goldsim to accurately predict current and future contaminant concentrations. This is particularly troubling in the lower Partridge River (e.g. SW005) and in Colby Lake where Goldsim predictions of current conditions appear to be inaccurate. In recent conversations with the lead agencies and ERM, there has been agreement that the modeling in the SDEIS does not accurately capture the environmental conditions at Colby Lake. Additional modeling of this waterbody is needed to assess impacts of the proposed project	The Mine Site GoldSim model used for the SDEIS (Barr 2013f, as cited in the FEIS) was modified for the FEIS (Mine Site GoldSim model) (PolyMet 2014v, as cited in the FEIS) to include a new chemical loading source in Colby Lake and was calibrated to the measured chemical concentrations in Colby Lake. This calibration considered new surface water chemistry data collected through the end of 2013. The same chemical loading source was applied to both the Continuation of Existing Conditions model and NorthMet Project Proposed Action model (PolyMet 2014v, as cited in the FEIS). The chemical loading source was constant and did not exhibit seasonal or long-term variations for future conditions. Incorporation of the loading source addressed the issue by providing predicted chemical concentrations in Colby Lake for existing conditions that are similar to currently measured concentrations. The average arsenic concentration based on 33 samples in Colby Lake is 0.95 µg/L. The GoldSim	WR 049

Comment ID	Comment	Response	Theme(s)
	and to evaluate the suitability of Colby Lake water for use in augmenting the flow of other waterbodies. In addition, the discrepancies between modeled and observed data at SW005 should be addressed in detail.	Continuation of Existing Conditions (PolyMet 2014v, as cited in the FEIS) modeling scenario predicts an average concentration of 0.80 µg/L at P50 over the 200 year modeling period.	
12575	The SDEIS does not adequately address mercury concerns.	This comment has been received and acknowledged by the Co-lead Agencies. An index of information on mercury associated with the NorthMet Project Proposed Action can be found in FEIS Section 1.7.	MERC 01
12580	Wild Rice Standard. The concerns over the MPCA's interpretations and recommendations regarding the wild rice sulfate standard have not been resolved. The information provided in Appendix C is still applicable to the SDEIS. In addition, staff believe that water quality modeling underestimates the amount of sulfate at points of compliance. Even with this problem, contaminant modeling suggests that the sulfate standard will be violated in the Partridge River points of compliance approximately 10% of the time. While this may meet the lead agencies arbitrary evaluation criteria (standard met 90% of the time) it certainly is not enough to warrant the issuance of an NPDES permit. At the Embarrass River the standard is already exceeded at the point of compliance because of historic contamination from the tailings basin and the area 5 pits. It is not clear if the capture system around the tailings basin will function well enough to allow the standard to be met.	The GoldSim model results predict that for all situations where a potential impact could be attributed to the NorthMet Project Proposed Action, the expected increase in sulfate concentration at SW-005 (and SW-006) would be less than or equal to 0.1 mg/L, and this would be added to the typical annual fluctuations of sulfate concentrations of several mg/L. A practical consequence of this result is that the effects of the NorthMet Project Proposed Action would not be identifiable by even the most robust field monitoring program. The small modeled sulfate increases associated with the NorthMet Project Proposed Action are explained by the small amounts of impacted and untreated water leaving the Mine Site in the model, which only occurs as groundwater migration. For P50 best-estimate predictions of the model during all phases of the NorthMet Project Proposed Action, the maximum amount of impacted and untreated groundwater leaving the NorthMet Project Proposed Action Site is 0.031 cfs (14 gpm). The maximum impact to the Partridge River would occur when this affected groundwater is released to the Partridge River during low-flow conditions. At SW-005, the average annual 1-day low flow is estimated to be 6.9 cfs (3,100 gpm) when Northshore Mine is discharging (up to year 55) and 5.0 cfs (2,240 cfs) when only the wastewater treatment facility discharges to the Partridge River (after year 55). Given the difference between groundwater and river flows, it is apparent that the mass loading associated with groundwater flow from the Mine Site is far too small to impart a noticeable impact on sulfate concentrations in the Partridge River.	WR 152 WR 153 WR 154
12601	Impacts from Rail Car Spillage. The concerns regarding the hydrologic impacts of sulfide ore dust spillage along the rail corridor have not been resolved. The information provided in Appendix C is still applicable to the SDEIS.	The potential for rail car spillage and dust has been minimized since the SDEIS by PolyMet committing to (PolyMet 2015a): - additional rail car refurbishments as part of the NorthMet Project Proposed Action (FEIS Section 3.2.2.2.4 and PolyMet 2014a as cited in the FEIS).	PD 07 WR 151 AIR 05

Comment ID	Comment	Response	Theme(s)
		- Developing and implementing monitoring and mitigation activities with the DNR and MPCA in the permit process (including surface water quality sampling in the streams traversed by the rail line). The FEIS includes available information from the updated Project Description document. Routine inspections would be undertaken along the Transportation and Utility Corridor to identify accumulations of dust or ore spillage. Any significant accumulations would be removed by a combination of machines and hand work. It is unlikely that there would be sufficient spillage to affect the quality of surface water or groundwater. Facilities and activities with the potential to generate fugitive dust would be subject to an air quality Fugitive Dust Control Plan which would be (regulated by the MPCA) (see Section 4.1.6 and Section 4.3.9 of PolyMet 2015a, as cited in the FEIS). See FEIS Sections 5.2.2.3.2 , 5.2.3 and 5.2.7 for impacts of railcar spillage and dust on wetlands and air quality, respectively. See also the response to comment 19698.	
12602	Loss of High Biodiversity Significance Values Sites. The concerns regarding the loss of high biodiversity sites such as the 100 mile swamp, Lynx and Moose habitat and remaining wildlife corridors have not been resolved. The information provided in AppendixC is still applicable to the SDEIS.	The USGS National Atlas shows a single wetland complex (referred to as the One Hundred Mile Swamp) as straddling the major watershed divide separating the Superior Basin from the Rainy River Basin, which suggests that this wetland complex creates a conduit for water originating from the Mine Site to reach the Dunka River, and ultimately, the BWCAW. Wetlands are delineated using many factors in addition to hydrology; the delineation of the One Hundred Mile Swamp as continuous across this boundary does not equate to a hydrologic connection. There are two hydrologic barriers between the Mine Site and the Rainy River Basin, including: 1) High ground north of the Partridge River creates a watershed divide separating the Superior and Rainy River Basins, and prevents surface water from passing between the two. This major watershed divide is included in the National Atlas, as well as USGS and MDNR data sets. This divide is accurately presented in the FEIS. 2) Yelp Creek and the Partridge River encircle the north, east, and south sides of the Mine Site. These streams create a hydrologic "sink" for sources of water originating at the Mine Site. Surface runoff and groundwater in surficial deposits leaving the Mine Site would follow a gradient into Yelp Creek or the Partridge	VEG 02 WI 02 WI 03 WR 080

Comment ID	Comment	Response	Theme(s)
		River, as opposed to continuing uphill towards the watershed divide. Yelp Creek and the Partridge River extend further west (i.e., more fully encompassing the Mine Site) than is shown on the map in question. The FEIS wildlife sections include information about NorthMet Project Proposed Action impacts to wildlife habitat types and Minnesota Biological Survey (MBS) Sites of Biodiversity Significance. FEIS Sections 4.2.4 and 4.3.4 provide maps of the MBS Sites (Figures 4.2.4-1, 4.2.4-4, 4.3.4-1, 4.3.4-2). The WCA rules (including those parts applicable to mining projects under *Minnesota Rules* 8420.0930) include a special consideration for wetlands that are rare natural communities (*Minnesota Rules* 8420.0515, Subpart 3). The Permit to Mine would address special consideration of wetlands that include rare natural communities. Additional information on rare natural communities would be included in the wetland permit application as part of the Permit to Mine process for further refinement of site-specific conditions. *Minnesota Rules* 6132.2700 require that a project site be reclaimed once mining has ceased. The goals of such reclamation are to "control erosion, to screen mining areas from non-compatible uses, and to provide for subsequent land uses such as wildlife habitat or timber production." The rules also include requirements about the characteristics and planting schedule for vegetation used in reclamation. Mitigation measures for wildlife species would be considered during the Endangered Species Act Section 7 consultation process.	
12604	The Supplemental Draft Environmental Impact Statement (SDEIS) NorthMet Mining Project and Land Exchange failed to adequately address closure and maintenance costs and length of time for post-closure treatment in the context of financial assurance requirements.	FEIS Sections 3.2.2.1.10, 3.2.2.3.12, and 5.2.2.3.1 include available information regarding long-term water treatment and maintenance. Temporal aspects of financial assurance can be managed through *Minnesota Rules* 6132.3200 Subpart 2, item E, which state that financial assurance is required for all areas that require continued maintenance following closure, and that no release from the Permit to Mine would be granted for portions of mining areas that require post-closure maintenance until the maintenance activities are no longer necessary. Table 3.2-15 provides financial assurance cost estimates for various years of closure, as well as monitoring and mitigation costs. Section 3.2.2.4.1 discusses what activities would be considered in cost estimates, and that cost estimates would be updated annually under the Permit to Mine.	FIN 05
12605	Within the 54 pages of Executive Summary only a single paragraph addresses the issue of financial assurance as noted below:	FEIS Section 3.2.2.4 provides available details regarding financial assurance. Additional details on the cost estimates, time frames, contingency plan amounts for unforeseen challenges, and calculations that	FIN 08

Comment ID	Comment	Response	Theme(s)
		would be required for the project would be addressed during permitting. Specific infrastructure timelines and life expectancies of equipment would be accounted for during permitting as well. Table 3.2-15 provides financial assurance cost estimates for various years of closure, as well as monitoring and mitigation costs. Section 3.2.2.4.1 discusses what activities would be considered in cost estimates, and that cost estimates would be updated annually under the Permit to Mine. *Minnesota Rules* 6132.1200, Subpart 3 states that cost estimates shall be annually adjusted, using current dollar value at the time of the estimate. Neither NEPA nor MEPA rules require that all financial assurance mechanisms be in place before the EIS is finalized.	
12607	The SDEIS failed to clearly state how the State of Minnesota will determine the maximum bond requirements,	FEIS Section 3.2.2.4 provides available details regarding financial assurance. Additional details on the cost estimates and calculations that would be required for the project would be addressed during permitting. Table 3.2-15 provides financial assurance cost estimates for various years of closure, as well as monitoring and mitigation costs. Section 3.2.2.4.1 discusses what activities would be considered in cost estimates, and that cost estimates would be updated annually under the Permit to Mine. *Minnesota Rules* 6132.1200, Subpart 3, states that cost estimates shall be annually adjusted using current dollar value at the time of the estimate. Financial assurance is required upfront and would be updated throughout the project under the Permit to Mine, which would be required prior to the start of mining. *Minnesota Rules* 6132.1200 Subpart 4 also dictate that the Commissioner shall evaluate all financial assurance cost estimates and adjustments to cost estimates using individuals with documented experience in material handling and construction and mining costs.	FIN 05
15020	In determination of baseflow, all GLIFWC's calculations have excluded Northshore pumping from the calculation. The Dec. 17th MNDNR memo (Attachment A) also picked a period when pumping for Northshore pit dewatering was not occurring so as to calculate true baseflow. The 1 cfs added to GoldSim modeling of the Partridge, mentioned in various DNR documents, is irrelevant to the calculation of baseflow and does not solve the modeling problems in XP-SWMM, MODFLOW and by extension GoldSim. Some of the implications of incorrect baseflow are	The FEIS reflects Co-lead Agencies' reconsideration of the appropriate groundwater baseflow rate to employ in the water impact assessment modeling. Information considered included: 1) definition of groundwater baseflow; 2) potential Northshore Peter Mitchell Pit contributions to flow; 3) available data from SW-006 gage versus SW-003 gage; and 4) confounding factors. The Co-lead Agencies continued to rely on the USGS-collected data at SW-006 as the basis for determining groundwater baseflow for the water impact assessment in the EIS. To better understand how groundwater baseflow affected water quality projections, a detailed GoldSim sensitivity analysis was conducted using groundwater baseflows four times larger than the best-estimate values. As part of the sensitivity analysis, appropriate modifications were made to	WR 052

Comment ID	Comment	Response	Theme(s)
	highlighted on page 114 of the water modeling data package (March 2013), in our memo of 2012-03-02, and in GLIFWC's baseflow summary of 2014-02-13 (Attachments B, C, and D respectively).	surficial aquifer hydraulic conductivities and aerial recharge based on a recalibration of the Mine Site MODFLOW model. In addition, a recalibration was performed for surface water runoff concentrations. Results of the high groundwater baseflow rate scenario were compared with the best-estimate scenario to evaluate the degree to which predicted NorthMet Project Proposed Action impacts are sensitive to groundwater baseflow and related inputs. The FEIS reports the results of the sensitivity analysis in FEIS Section 5.2.2.3.2. The Mine Site sensitivity analysis indicate that modeled groundwater and surface water concentrations are sensitive to changes in baseflow. However, the NorthMet Project Proposed Action's ability to meet groundwater quality and surface water quality evaluation criteria is not sensitive to changes in baseflow. Evaluation criteria can be found in Section 5.2.2.	
15021	Because the implications of baseflow are substantial when it comes to a basic understanding of the mine site hydrogeology, all modeling of flow and by extension contaminant transport must be re-calibrated to the higher baseflow numbers indicated by GLIFWC's analysis of 2013-07-02 (Attachment E) and DNR's 2013-12-17 analysis (Attachment A). Page 114 of the mine site Water Modeling Data Package makes it clear that re-calibration of the MODFLOW model generates new conductivity values that are then fed into Goldsim. It states: "The revised model calibration resulted in different optimized values for the horizontal hydraulic conductivity of the surficial aquifer and bedrock, which are used to establish the distribution of values used for the probabilistic groundwater flow path modeling (Section 5.2.3.1)." It is also clear that higher hydraulic conductivities for the aquifers result in faster contaminant transport to points of evaluation.	Groundwater baseflows used in the SDEIS are best-estimate values and should be retained in the FEIS. This is because the SDEIS groundwater baseflow values were based on 1) winter 1986-87 and winter 1987-88 streamgaging in the Partridge River at SW-006 that occurred when there were no discharges from Northshore Mine and 2) 1942 to 1963 gaging data in the Embarrass River, which includes years prior to the LTV tailings basin startup (1957). When expressed as a groundwater baseflow yield per unit area, the similar results for both watersheds (approximately 0.05 cfs per square mile) supports the approach used. The yield per unit area is similar to other watersheds in Northern Minnesota. Studies have shown that streamflow characteristics in this part of Minnesota have not changed systematically over the last 50 years. The only other available gaging data is from a station installed during 2011 at SW-003 on the Partridge River. Interpretation of groundwater baseflow at SW-003 is not reliable for use in the GoldSim modeling of groundwater baseflow due to the complicating effects of Northshore Mine probable maximum precipitation pumped discharges, seepage from the Northshore Western Pond, and complex storage/release mechanisms in the wetlands that receive these flows. More broadly, groundwater baseflow discharge varies with time and is a reflection of longer-term weather and climatic conditions. The variability of groundwater baseflow discharge is demonstrated by the examination of estimated values for several years using different methods. Evaluation of these values affirms continued reliance on the 1986-87 USGS data for the FEIS is reliable.	WR 003

Comment ID	Comment	Response	Theme(s)
		To better understand the relationship of groundwater baseflow to the GoldSim model's water quality impact projections, a sensitivity analysis for the Mine Site was conducted to evaluate if predicted NorthMet Project Proposed Action impacts are sensitive to groundwater baseflow values. The sensitivity analysis considered the relationship of various model inputs to groundwater baseflow including hydraulic conductivity, recharge, and surface runoff chemical concentrations. The results indicate that modeled groundwater and surface water concentrations are sensitive to changes in baseflow. However, the NorthMet Project Proposed Action's ability to meet groundwater quality and surface water quality evaluation criteria is not sensitive to changes in baseflow. Evaluation criteria can be found in Section 5.2.2.	
15022	Although baseflow assumptions have significant effects on Goldsim modeling, the implication of re-calibrating the MODFLOW model go beyond the conductivities used in the GoldSim modeling. Higher baseflows imply higher conductivities that imply faster and greater groundwater flow rates. This affects: 1) The amount of water expected to flow into the mine pit as it is excavated. 2) The amount of drawdown of Partridge River flow that can be expected due to pit dewatering. 3) The amount of wetland dewatering that can be expected due to pit dewatering. Given the uncertainty in baseflow numbers due to the poor quality flow data, it is reasonable to re-calibrate the MODFLOW model to a range of values that included the previously assumed baseflow and the newer, higher baseflow numbers.	Mine Site groundwater baseflows used in the SDEIS and FEIS are reliable. This is because the SDEIS and FEIS groundwater baseflow values were based on winter 1986-77 and winter 1987-88 stream gaging in the Partridge River that occurred when there were no discharges from the Northshore Mine. When expressed as a groundwater baseflow yield per unit area, the similar results for both the Partridge and Embarrass River watersheds (approximately 0.05 cfs per square mile) lends credibility to the approach used. The yield per unit area is similar to other watersheds in Northern Minnesota. Interpretation of groundwater baseflow derived from new data collection at SW-003 is not reliable due to the complicating effects of Northshore Pit pumped discharges, seepage from the Northshore Western Pond, and complex storage/release mechanisms in the wetlands that receive these flows. The Mine Site MODFLOW model was re-calibrated based on new groundwater level data collected through the end of 2013; however, calibrations performed for the FEIS used the same Partridge River baseflows as were used in SDEIS. Revised hydraulic conductivities and recharge values that come from MODFLOW recalibration informed the FEIS Mine Site GoldSim model. Groundwater baseflow discharge varies with time and is a reflection of longer-term weather and climatic conditions. The variability of groundwater baseflow discharge is demonstrated by the examination of estimated values for several years using different methods. Evaluation of these values affirms that groundwater baseflows used in the Mine Site GoldSim model are reliable and appropriate for FEIS impact evaluation.	WR 003 WR 086 WR 094 WR 098 WR 165 WR 166

Comment ID	Comment	Response	Theme(s)
		PolyMet performed a groundwater baseflow sensitivity analysis for the Mine Site to evaluate if predicted NorthMet Project Proposed Action impacts are sensitive to groundwater baseflow values. The sensitivity analysis is fully considered the relationship of various model inputs to groundwater baseflow including hydraulic conductivity, recharge, and surface runoff chemical concentrations. See FEIS Section 5.2.2.3.2 regarding the results of the sensitivity analysis.	
15023	Discharge From East Berm of Flotation Tailings Basin: Significance: The contaminant transport analysis at the Flotation Tailings Basin (FTB) does not include any accounting for discharge through the east berm of the basin. There are 3 reasons why discharge through the east berm will be enough to cause environmental concern: 1) the flow distance between the final FTB pond in cell 1E and the exterior of the east berm is relatively short compared to flow distances from the pond to the north and west berms (SDEIS Figure 3.2-29). 2) the east berm is underlain with 25-50 feet of conductive surficial material (SDEIS Figure 4.2.2.-12 and Figure 2 below). 3) the basin pond level is 1720 ft, the land elevation east of the basin is 1660 ft (Lidar data: http://www.mngeo.state.mn.us/chouse/elevation/lidar.html). The elevation difference between the pond and the adjacent land surface is substantial; 1720 ft - 1660 ft = 60 ft.	It is acknowledged that there would likely be subsurface flow below the East Embankment from west to east and that surface seepage may occur at the toe. The FEIS Plant Site MODFLOW model was modified from the SDEIS to include: 1) the presence of surficial deposits below the East Embankment, 2) boundary conditions (drain and/or river cells) along the East Embankment toe to allow the potential for surface seepage, and 3) hydrologic inputs to account for the presence of the proposed drainage swale. See PolyMet 2015j (as cited in the FEIS) for more information. Similar to other locations along the perimeter of the Tailings Basin, the NorthMet Project Proposed Action was modified to include installation of a containment system along the East Embankment where it is underlain by surficial deposits. Given the hydrogeology of the area east of the Tailings Basin and the proposed swale to be constructed there, this containment system would have higher hydraulic head on the east side compared to the west (tailings) side where a pumped trench would depress the groundwater level. This would create hydraulic gradients in the slurry wall and in shallow bedrock that would drive (low) flows from east to west across the containment system. This set of hydraulics would result in complete capture of all tailings water approaching the containment system from the Tailings Basin. Because the system would achieve complete capture of tailings water, an east side chemical transport flowpath is not needed in the Plant Site GoldSim model. There is no hydrologic reason to expect that impacted water from the Tailings Basin would migrate east of the containment system.	WR 054
15024	Discharge From East Berm of Flotation Tailings Basin: Significance: Because there has been no prediction of discharge from the east side of the FTB, there was no flow path established or contaminant transport analyzed in the easterly direction. The SDEIS is completely	The FEIS Plant Site MODFLOW model was modified from the SDEIS to include: 1) the presence of surficial deposits below the East Embankment, 2) boundary conditions (drain and/or river cells) along the embankment toe to allow the potential for surface seepage, and 3) hydrologic inputs to account for the presence of the proposed drainage swale. Similar to other locations along the perimeter of the Tailings Basin, the project was modified to include installation of a containment system along	WR 054

Comment ID	Comment	Response	Theme(s)
	devoid of any mention or analysis of flow from the basin toward the east. Receiving waters for the contaminated discharge would be wetlands adjacent to the basin, Spring Mine Lake, Spring Mine Creek and wetlands to the north if a proposed stormwater drainage swale is constructed.	the East Embankment where it is underlain by surficial deposits. Given the hydrogeology of the area east of the Tailings Basin and the proposed swale to be constructed there, this containment system would have higher hydraulic head on the east side compared to the west (tailings) side where a pumped trench would depress the groundwater level. This would create hydraulic gradients in the slurry wall and in shallow bedrock that would drive (low) flows from east to west across the containment system. This set of hydraulics would result in complete capture of all tailings water approaching the containment system from the Tailings Basin. Because the system would achieve complete capture of tailings water, an east side chemical transport flowpath is not needed in the Plant Site GoldSim model. There is no hydrologic reason to expect that impacted water from the Tailings Basin would migrate east of the containment system.	

Comment ID	Comment	Response	Theme(s)
Comments from the 1854 Treaty Authority (Submission ID 42968)			
3111	Under the proposed project, it appears that long term (perhaps perpetual) water treatment, site maintenance, and monitoring will be needed after closure to protect the environment and meet water quality standards. We don't believe that this meets the goal of a maintenance free closure, which is required under MN Rule 6132.3200…Regardless of how this issue is described or strategically worded in the document, it is our understanding that the project will require long term/perpetual monitoring, maintenance, and treatment. We would argue that a timeframe of potentially hundreds of years should be considered perpetual rather than long term. This will not constitute a site that is maintenance free at closure.	*Minnesota Rules* 6132.3200, Closure and Postclosure Maintenance, identifies several goals for non-ferrous mining areas, including sites be closed so that they are maintenance-free. A maintenance-free site is the goal of the MDNR for the NorthMet Project Proposed Action, as it is for every mining site. The NorthMet Project Proposed Action includes piloting of non-mechanical treatment system to move in the direction of achieving the goal. PolyMet would include funds in its reclamation cost estimate and financial assurance package to fund mechanical water treatment for as long as necessary. Any Permit to Mine would also require PolyMet to present a plan for eventual transition from mechanical water treatment to non-mechanical treatment. PolyMet cannot be released from its responsibilities, including financial assurance requirements, until there is no longer a need for closure/post-closure treatment/maintenance. Financial assurance is a component of any Permit to Mine, to ensure necessary maintenance can be provided for as long as it necessary.	PER 04
3113	Effectiveness of the proposed water treatment and seep collection methods are vital to the project meeting water quality standards. Analysis and design detail are lacking in the SDEIS as a whole. More detail is needed on water treatment and seep collection, including long-term operation and maintenance, since they are essential components of the project meeting environmental standards.	The FEIS relies on revised cross-section models to evaluate containment systems on the northern, northwestern, and western sides of the Tailings Basin, which are documented in PolyMet 2015j (as cited in the FEIS). These new models considered the presence of an upper more permeable bedrock zone directly below the slurry wall, with hydraulic properties based on 2014 packer tests conducted in five boreholes along the proposed containment system alignment. Sensitivity analyses included variable bedrock hydraulic conductivity and different upper bedrock zone thicknesses up to 100 feet. The new models explicitly consider groundwater flow in bedrock below the slurry wall and at the contact between the slurry wall and bedrock. The model results predicted that the overall capture efficiencies of the proposed Tailings Basin containment systems (with bedrock flow) would be substantially greater than 90%. FEIS Figure 3.2-28 has been revised to show that the slurry wall is keyed into bedrock. Engineered systems can operate successfully over long periods of time if they are property monitored and maintained. FEIS Section 5.2.2 provides a comprehensive description of proposed water treatment and seep collection systems including groundwater containment and synthetic liners/covers. This includes conceptual designs and discussions of the types of monitoring used to assess performance. Detailed designs are provided in supporting documents, which are fully referenced in the FEIS. The FEIS also discusses	PD 35 WR 019 WR 128 WR 143 WR 144 WR 148

Comment ID	Comment	Response	Theme(s)
		long-term operation, maintenance, and periodic replacement of engineered systems. It is acknowledged that certain components of the engineered systems would need to be replaced when monitoring indicates that performance is marginal and not readily compensated for by adaptive mitigation measures. A detailed financial assurance analysis would be part of the permitting phase and is not a required component of the FEIS. The financial assurance process would fully consider long-term monitoring and periodic replacement of equipment including, but not limited to, water treatment hardware and synthetic liners and covers. The Financial Assurance package for the NorthMet Project Proposed Action would ensure that future funding would be available if and when adaptive mitigation measures or component replacements are needed to achieve performance specifications.	
3114	The seep collection system is modeled to have a capture efficiency of 90%. Description is needed on how this efficiency rate was determined. We question if such a high capture rate can be achieved, and it would be helpful to include examples and citations of other projects operating seep collections at that efficiency rate. Further, if such capture rates are not achieved, impacts to water quality and quantity should be described in the SDEIS.	The Co-lead Agencies acknowledge that there are existing water containment systems at other mine sites that do not operate with a high degree of capture, but these are different designs and cannot be directly compared to the system proposed for the NorthMet Project Proposed Action. The proposed containment system uses pumping on the tailings side and reinjection after treatment on the downgradient side to reverse hydraulic gradients across the slurry wall and in underlying bedrock. Relatively few containment systems have been built with this degree of pumping and reinjection to ensure effective capture. The conceptual hydraulics of this type of system provides evidence that it would achieve complete or nearly complete capture. The FEIS describes a 2014 field program that investigated bedrock along the alignment of the proposed containment system on the northern, northwestern, and western sides of the Tailings Basin in FEIS Section 4.2.2.3.1. This investigation provided field data on bedrock hydraulic conductivity, Rock Quality Designation, and depth to top of bedrock. This information was used to develop revised MODFLOW cross-section models to evaluate containment system efficiencies on the northern, northwestern, and western sides of the Tailings Basin, which are documented in the revised Plant Site Water Modeling Data Package (PolyMet 2015j, as cited in the FEIS). These revised cross section models considered the presence of an upper more permeable bedrock zone directly below the slurry wall, with hydraulic properties based on 2014 packer tests conducted in five boreholes along the proposed containment system alignment. Sensitivity analyses included	WR 018 WR 020

Comment ID	Comment	Response	Theme(s)
		variable bedrock hydraulic conductivity and different upper bedrock zone thicknesses up to 100 feet. The model results predict that the overall capture efficiencies of the proposed Tailings Basin containment systems would be substantially greater than 90%. It is the position of the Co-lead Agencies that the assumption in the Plant Site GoldSim model of 90% or greater capture efficiency is justified by the analyses performed.	
3115	Concern also exists over the methods used to estimate Partridge River baseflow (Section 5.2.2.2.2). XP-SWMM model estimates of Partridge River baseflow presented in the SDEIS have been found to be three times lower than observed values. The XP-SWMM projections, which are based on data from 17 miles away collected from 1978 to 1987, do not align with the rating curve from recent Minnesota Department of Natural Resources (MDNR) winter monitoring data, or the results of the Great Lakes Indian Fish and Wildlife (GLIFWC) projections taken from two years of recent data from the Dunka Road gage in the XP-SWMM model. Co-Lead Agencies have been working with Cooperating Agencies on this issue, but it needs to be addressed in the SDEIS regarding how it may affect modeling results. The models may be under-predicting the amount of water and contaminant load that will need to be treated and contained at the Mine Site. Questions have also arisen on data use, including if new data is being utilized and how existing data was selected (or not selected) for use.	Groundwater baseflows used in the SDEIS are best-estimate values and should be retained in the FEIS. This is because the SDEIS groundwater baseflow values were based on 1) winter 1986-87 and winter 1987-88 stream gaging in the Partridge River at SW-006 that occurred when there were no discharges from the Northshore Mine and 2) 1942 to 1963 gaging data in the Embarrass River, which includes years prior to the LTV tailings basin startup (1957). When expressed as a groundwater baseflow yield per unit area, the similar results for both watersheds (approximately 0.05 cfs per square mile) supports the approach used. The yield per unit area is similar to other watersheds in Northern Minnesota. Studies have shown that streamflow characteristics in this part of Minnesota have not changed systematically over the last 50 years. The only other available gaging data is from a station installed during 2011 at SW-003 on the Partridge River. Interpretation of groundwater baseflow at SW-003 is not reliable for use in the GoldSim modeling of groundwater baseflow due to the complicating effects of Northshore Mine pumped discharges, seepage from the Northshore Western Pond, and complex storage/release mechanisms in the wetlands that receive these flows. More broadly, groundwater baseflow discharge varies with time and is a reflection of longer-term weather and climatic conditions. The variability of groundwater baseflow discharge is demonstrated by the examination of estimated values for several years using different methods. Evaluation of these values affirms continued reliance on the 1986-87 USGS data for the FEIS is reliable. To better understand the relationship of groundwater baseflow to the GoldSim model's water quality impact projections, a sensitivity analysis for the Mine Site was conducted to evaluate if predicted NorthMet Project Proposed Action impacts are sensitive to groundwater baseflow values. The sensitivity analysis considered the relationship of various model inputs to groundwater baseflow including hydraulic conductivity, recharge, and surface runoff chemical concentrations. It also reflected consideration of the flow data collected at SW-003 in requiring groundwater baseflows at all	WR 003 WR 175

Comment ID	Comment	Response	Theme(s)
		locations on the Partridge River be increased by a factor of 4 (e.g., 0.5 to 2 cfs at SW-003). The results indicate that modeled groundwater and surface water concentrations are sensitive to changes in groundwater baseflow. However, the NorthMet Project Proposed Action's ability to meet groundwater quality and surface water quality evaluation criteria is not sensitive to changes in baseflow. Evaluation criteria can be found in Section 5.2.2.	
3116	Questions have also arisen on data use, including if new data is being utilized and how existing data was selected (or not selected) for use. Additional analyses should be performed and included in the SDEIS that investigate how the XP-SWMM model predictions may change with using the new baseflow measurements for the Partridge River to calibrate the model, and how that may affect the MODFLOW and GoldSIM model predictions.	Mine Site groundwater baseflows used in the SDEIS and FEIS are reliable. This is because the SDEIS and FEIS groundwater baseflow values were based on winter 1986-77 and winter 1987-88 stream gaging in the Partridge River that occurred when there were no discharges from the Northshore Mine. When expressed as a groundwater baseflow yield per unit area, the similar results for both the Partridge and Embarrass River watersheds (approximately 0.05 cfs per square mile) lends credibility to the approach used. The yield per unit area is similar to other watersheds in Northern Minnesota. Interpretation of groundwater baseflow derived from new data collection at SW003 is not reliable due to the complicating effects of Northshore Pit pumped discharges, seepage from the Northshore Western Pond, and complex storage/release mechanisms in the wetlands that receive these flows. The Mine Site MODFLOW model was re-calibrated based on new groundwater level data collected through the end of 2013; however, calibrations performed for the FEIS used the same Partridge River baseflows as were used in SDEIS. Revised hydraulic conductivities and recharge values that come from MODFLOW recalibration informed the FEIS Mine Site GoldSim model. Groundwater baseflow discharge varies with time and is a reflection of longer-term weather and climatic conditions. The variability of groundwater baseflow discharge is demonstrated by the examination of estimated values for several years using different methods. Evaluation of these values affirms that groundwater baseflows used in the Mine Site GoldSim model are reliable and appropriate for FEIS impact evaluation.	WR 003 WR 091 WR 165
3118	It is our understanding that MODFLOW modeling does not account for any water to move east from the tailings basin. The head differential between the tailings basin and surrounding elevation may push water through the east side of the basin,	In response to these issues, the Plant Site MODFLOW model was modified and recalibrated as follows: 1) Updated areal distribution of surficial deposits and bedrock outcrops, 2) established surficial deposits below and adjacent to the East Embankment,	WR 093

Comment ID	Comment	Response	Theme(s)
	potentially forming a lake. Significant uncertainties exist with groundwater flows and related contaminated water transport.	3) used drain or river cells along the East Embankment to allow surface seepage of tailings water, 4) incorporated the hydrologic effects of the future swale to drain surface water from the East Embankment area, 5) recalibrated model material properties and boundary conditions using all available data through 2013 (this is mostly new hydraulic head information), and 6) expanded the use of river and drain cells to provide a more accurate representation of wetlands outside the Tailings Basin. As a result of these changes, the FEIS Plant Site MODFLOW model no longer has a no-flow boundary condition at the toe of the East Embankment, and river and/or drain cells in surficial deposits are in place to allow the potential for surface seepage along the embankment toes (See Attachment A, Plant Site Water Modeling Data Package [PolyMet 2015j, as cited in the FEIS]). The model was checked to ensure that hydraulic heads in the tailings and adjacent surficial deposits were not well above ground surface. In the FEIS Plant Site MODFLOW model, storage coefficients for the surficial deposits and bedrock outcrops were assigned and/or calibrated to be more in line with literature values for these types of materials.	
3119	We disagree with the conclusion in the SDEIS that the PolyMet project will not have any impacts on surface or ground water hydrology in the Partridge and Embarrass Rivers (Section 5.2.2, page 5-8). Augmenting stream flow to tributaries with treated and Colby Lake water will impact surface water hydrology.	The FEIS assesses the potential for the NorthMet Project Proposed Action to affect surface and groundwater hydrology for the Partridge and Embarrass Rivers. The FEIS updates this analysis in FEIS Sections 5.2.2.3.2 and 5.2.2.3.3 respectively. The FEIS acknowledges that the NorthMet Project Proposed Action would alter stream flows relative to existing conditions. However, the flows would be similar to existing conditions. Where and when necessary, surface streams would receive treated augmentation water to maintain stream flow to within +/- 20% of existing flows. The augmentation water would generally consist of water obtained from the containment systems or mine pits, and treated at the WWTF or WWTP prior to discharge.	WR 107 WR 183
3121	We believe that the interaction of the project's impacts with natural variability in precipitation would be more adverse than reported in the SDEIS. This is because effects of climatic variability are additive to the project-related change, which would be especially true for drier periods.	Estimates of monthly and annual rainfall amounts were based on best available data obtained from weather stations near the NorthMet Project Proposed Action site. In the GoldSim models, these parameters were treated as uncertain inputs and assigned probability distributions to capture the range of possible future conditions. While climate change may occur in the future, it cannot be stated at this time if in the long-term there would be more or less rainfall. Thus, the probabilistic approach to rainfall used in GoldSim represents a technically defensible method for dealing with this issue.	WR 077 WR 180

Comment ID	Comment	Response	Theme(s)
		Individual storm events and frequency are not incorporated into the GoldSim models. Rainfall inputs are monthly and annual. The effects of individual storms are considered by designing facilities to handle a 100-year, 24-hour storm event based on current data. If over time, climate change causes a gradual increase in annual rainfall, the 100-year storm event would be redefined to a larger precipitation value and mine facilities would be upgraded to handle a larger storm.	
3123	It is also noted in section 5.2.3 (Wetlands) that indirect effects on wetlands are expected due to groundwater drawdown. Groundwater drawdown will impact groundwater hydrology and it's connectivity to the surficial aquifer, which will likely impact surface water hydrology.	Using an observational approach based on data from similar nearby mine sites (i.e., analog method), the Co-lead Agencies concluded that drawdowns in the surficial aquifer would not be expected to extend very far from the mine pits. This is explained by the following factors: 1) the surficial aquifer is thin and moderately permeable, 2) the surficial aquifer is subject to aerial recharge, and 3) the surficial aquifer is underlain by low-permeability bedrock that limits downward leakage from the surficial unit. These factors support the conclusion that wetland drawdown did not need to be included in the Mine Site GoldSim model. See FEIS Section 5.2.2.3.2 for more information on the analog method. It is acknowledged that there is some degree of hydraulic interaction between wetlands and the surficial aquifer at the Mine Site. However, attempts to quantitatively model the effects of these interactions on drawdown and water quality would be highly uncertain and potentially misleading. The FEIS approach was to not model hydraulic connections between wetlands and the surficial aquifer in the Mine Site GoldSim model, but rely on future monitoring and adaptive mitigation measures in the event that some wetlands are affected by the NorthMet Project Proposed Action. See FEIS Sections 5.2.2.3.6 and 5.2.2.3.5 for more information on closure monitoring and adaptive mitigation.	WET 15 WR 053 WR 086 WR 166
3124	Disagreement exists over application of the 10 mg/L wild rice sulfate standard (Section 5.2.2.1.2, page 5-21). Although some of these comments relate more to Minnesota Pollution Control Agency (MPCA) determinations and permitting issues, they are important considerations for the project to meet water quality standards and should be clearly addressed in the SDEIS. It is arbitrary to define how much rice presence is required for an area to be defined as a water used for the production of wild rice, especially given the lack	The FEIS recognizes the MPCA is overseeing a variety of studies on wild rice beds. At applicable surface water locations, the FEIS evaluated impacts using an impact criteria based on the current MPCA 10 mg/L standard for sulfate concentration in waters used for the production of wild rice This impact assessment metric is keyed to the current regulation. It is recognized that the MPCA is currently evaluating the current wild rice sulfate water quality standard and, as part of that process, new information on potential contributing factors on the growth of wild rice beds has been generated. However, that information has not yet been holistically reviewed in the context of its possible influence on the wild rice bed standard. Future change to the wild rice sulfate standard, if any, is speculative and outside	PER 10 WR 152 WR 154

Comment ID	Comment	Response	Theme(s)
	of long-term monitoring data in the receiving waters of this project. Application of this standard may be evolving/changing as research has been completed and the standard is currently being evaluated by the MPCA. Wild rice exists upstream in the Embarrass River from the draft MPCA staff recommended definitions of water used for production of wild rice (compliance points). In the Partridge River, the 2009 survey identified rice near SW-004b, also upstream of the proposed compliance point. Barr Engineering conducted the survey and has indicated a possible error in the 2009 survey, bringing into question the accuracy of these upstream wild rice locations in the Partridge River. Currently, the wild rice water quality standard is not being met in portions of the Embarrass and Partridge river systems. The SDEIS states that the wild rice sulfate standard would be met for the Embarrass River, assuming the containment and seepage collection system would capture seepage presently going to the Embarrass tributaries. However, the Partridge River will exceed the standard during low-flow conditions. We question how this will be handled in permitting.	the scope of the FEIS; applying research findings outside the basis of the current rule is not appropriate. The FEIS includes descriptions of the Plant Site WWTP and Mine Site WWTF, both of which would be capable of discharging treated wastewater at concentrations at or below 10 mg/L as demonstrated by pilot-testing already conducted. More detailed information on these treatment systems would be available as part of the permitting process. However, should a more stringent standard be developed in the future, operation of the reverse osmosis treatment systems could be adjusted to meet a more stringent effluent limit. During permitting, the MPCA would evaluate the latest water quality modeling results at the MPCA staff-recommended wild rice production water closest to the mine site, to ensure that surface water uses are being protected. Appropriate mitigation and monitoring would be required if and when a permit is drafted.	
3125	Disagreement also exists over the current MPCA staff recommendation of seasonal application of the wild rice sulfate standard from April 1 through August 31 (page 5-25). Application of this standard may be evolving/changing as research has been completed and the standard is currently being evaluated. According to SDEIS, PolyMet is seeking seasonal application [April 1 through August 31] of the standard during non-mechanical water treatment after closure. If seep collection and water treatment do not work as planned (substantial assumptions without a lot of detail), the seasonal discharge may become a larger issue. The SDEIS states that this is beyond the scope of	PolyMet is not seeking a seasonal application of the wild rice sulfate standard. Neither seasonal application of the wild rice standard nor non-mechanical treatment systems are part of the NorthMet Project Proposed Action, which relies solely on mechanical treatment and year-round application of the sulfate standard. Non-mechanical treatment may be considered during operations and closure if pilot studies demonstrate their utility and cost-effectiveness for water treatment and water disposal. The NorthMet Project Proposed Action, as proposed, relies on well-tested mitigation and mechanical treatment technologies. Non-mechanical treatment effectiveness in decreasing the concentration of sulfate and other parameters would need to be proven through bench and pilot testing before it would be relied upon to meet water quality standards.	WR 153

Comment ID	Comment	Response	Theme(s)
	the document, but we believe that it is relevant to the project meeting water quality standards and is an issue to be addressed.		
3126	We do not believe the proposed project will result in a decrease in mercury loading to the Embarrass and Partridge River aquatic systems (Section 5.2.2.3.4). For the Embarrass River, we do not believe that: 1) the tailings basin will function as a mercury sink; and 2) mercury methylation would decrease due to projected reductions in sulfate contributions. Regarding flows of the Partridge River, Embarrass River, or their tributaries, we disagree that the project would not significantly impact flow and water level fluctuations, thus leading to increased mercury methylation and bioaccumulation, which taken together may be sufficient to impact habitat leading to alterations of species composition, food web structure, and ultimately mercury bioaccumulation.	The MPCA's Cumulative Mercury Risk Estimation Method analysis for the two scenarios showed a 0.5 to 1.8% and 0.3 to 0.5% potential increase in fish mercury concentration above background. The increase is not expected to have an appreciable effect on the loading estimates from permitted discharges to the Embarrass, Partridge, or lower St. Louis rivers. Discharges are expected to meet the 1.3 ng/L standard for mercury, with an overall net decrease in mercury loading predicted for the NorthMet Project Proposed Action. FEIS Section 5.2.2.3.4 provides supporting documentation and a rationale explaining that tailings are a sink for mercury. Berndt (2003, as cited in the FEIS) further explains that the reaction of mercury in full-scale actual tailings basins (i.e., mercury assumed to be lost through adsorption to solids and then burial in the sediments) results in an overall permanent retention of mercury within the basin and decreases in mercury released to receiving waters. The overall findings in Berndt (2003) demonstrated that the release of mercury to surface waters during taconite processing was insignificant with respect to the mercury concentrations found in local precipitation and existing background surface waters. The findings are supported by surface and groundwater monitoring around the existing LTVSMC Tailings Basin, which found mercury concentrations generally averaging less than 2.0 ng/L. Additional documentation supporting sequestering of mercury in the Tailings Basin are presented in FEIS Sections 5.2.2.3.4 and 6.2.2. It is difficult to quantify the extent to which predictions of elevated mercury concentrations in the Tailings Basin surficial seepage would influence mercury methylation north of the Tailings Basin and further downstream, although the FEIS notes that sulfate can contribute to mercury methylation. The FEIS notes that the NorthMet Project Proposed Action would reduce sulfate concentrations within the Embarrass River watershed, and that this may result in downstream reductions in mercury methylation. Effects on flows (and, by extension, water surface elevations) generated by the NorthMet Project Proposed Action are anticipated to be within the natural variation of flow within the St. Louis River (e.g., less than 1% reduction in average annual flow as measured at the confluence of the Embarrass River with the St. Louis River). Therefore, no potential indirect or cumulative wetland effects are identified for the wetlands within the St.	MERC 06 MERC 20 MERC 23

Comment ID	Comment	Response	Theme(s)
		Louis River below the ordinary high water mark, from its confluence with the Embarrass River to Lake Superior, and it is not expect that the NorthMet Project Proposed Action would contribute to water level fluctuations than can promote mercury methylation. Additional information regarding water level and flows to surrounding watersheds is included in FEIS Section 5.2.2.	
3128	Potential mercury contributions from peat stored at the Overburden Laydown and Storage Area have also not been addressed.	This comment was originally presented as part of the Tribal Position Summary included in MDO #2, which was previously addressed in SDEIS Table 8-1. Further explanation is provided below. Any mercury released from the peat decomposition process is thought to occur relatively rapidly. The mercury released from organic matter decomposition and in solution would have the potential to move with precipitation that falls on the Overburden Storage and Laydown Area. The Overburden Storage and Laydown Area would be unlined; therefore, there would be some potential for seepage to enter the groundwater system from peat which has decomposed and releases as a pulse of mercury. Water contacting the Overburden Storage and Laydown Area is considered to be process water and would be routed to Pond PW-OSLA. In years 1 to 11, the water from Pond PW-OSLA would be routed to the Tailings Basin, and any mercury in the routed water would have the chance to be sequestered in the tailings. In years 12 to 20, some of the water from Pond PW-OSLA would be used to backfill the East Pit. Any mercury in the water routed to the East Pit would mix with waste rock and become sequestered at depth in the East Pit. In addition, any contributions of water in years 21 to 65 from the East Pit to the West Pit would reflect water from the East Pit and its associated watershed runoff, and would not reflect process water from Pond PW-OSLA. Because peat removal from the areas to be mined would be completed between years 5 and 11, any potential release of mercury from stored peat materials would have occurred, or be ending, by the time water is routed from Pond PW-OSLA to the East Pit beginning in year 12. All water that is discharged would be meet the GLI mercury standard of 1.3 ng/L.	MERC 20
3134	Mercury-related concerns are present for created wetlands at the East Pit and mercury concentrations in water discharged from the West Pit.	This comment was originally presented as part of the Tribal Position Summary included in MDO #2, which was previously addressed in SDEIS Table 8-1. Further explanation is provided below. Water levels in the East Pit would generally be controlled by passive wetland overflow to the West Pit. West Pit water would be treated via RO at the WWTF in closure before being discharged into West Pit Overflow	MERC 09

Comment ID	Comment	Response	Theme(s)
		Creek. Depending on seasonal weather conditions, there could be occasional pumped flows from the wetland to the WWTF or treated effluent from the WWTF could be pumped to the wetland to further control the water levels (PolyMet 2015d, as cited in the FEIS).	
3135	Air-related mercury emissions do not account for sources from energy generation or vehicle use at the site.	This comment was originally presented as part of the Tribal Position Summary included in MDO #2, which was previously addressed in SDEIS Table 8-1. Further explanation is provided below. As summarized in Section 5.2.7 of the FEIS, procedures for air quality assessments vary depending upon the level of emissions from a proposed project. The NorthMet Project Proposed Action has been defined as a synthetic minor source according to the USEPA definitions of "major" vs. "minor" sources, since the NorthMet Project Proposed Action would limit its emissions through permit restrictions to less than the defined emission levels (see Section 5.2.7 of FEIS). At the Mine Site, emissions were estimated for material handling sources associated with excavation, portable crushing and screening operations, blast hole drilling, use of unpaved roads, and vehicle exhaust. At the Plant Site, point source emissions are predicted to occur from the crushing plant, flotation operation autoclaves and other hydrometallurgical processes, process consumables handling, and combustion. Fugitive emissions are also expected to occur from raw materials handling, Plant Site roads, the Tailings Basin, and from vehicle use of Dunka Road. Additional information has been summarized below and is included in FEIS Section 5.2.7. Mercury in the ore is the primary source of mercury and air emissions of mercury are primarily associated with the Hydrometallurgical Plant (4.1 pounds/year). A small amount of mercury emissions are estimated to potentially be emitted from natural gas combustion associated with a package boiler and a natural gas fired process heater and space heaters (0.4 pounds/year). In addition, a small amount of particle-bound mercury is associated with mining, ore crushing, milling processes, flotation concentrate handling, and fugitive dust emissions from the Tailings Basin (less than 0.1 pounds/year). A relatively small amount of mercury is estimated to be associated with diesel fuel combustion in mine vehicles. Overall, total potential emissions of mercury from the NorthMet Project Proposed Action are estimated to be 4.6 pounds/year from the Plant Site, a maximum of 0.17 pounds per year from Tailings Basin construction vehicles (diesel fuel combustion emissions), and approximately 0.6 pounds/year from diesel fuel combustion at the Mine Site (Barr 2012a, as	AIR 02

Comment ID	Comment	Response	Theme(s)
		cited in the FEIS). In comparison, Minnesota's statewide mercury emissions were estimated to be 3,011 pounds in 2005 and about 2,835 pounds in 2011 (MPCA 2013). The TMDL target emissions are set at 789 pounds/year by 2025 (MPCA 2014). The NorthMet Project Proposed Action's air emissions are about 0.16% of 2011 estimated statewide emissions and about 0.6% of the TMDL statewide target emissions. As summarized in FEIS Section 5.2.7, the MPCA has conducted a review of the NorthMet Project Proposed Action mercury emissions and has determined that it would not impede the TMDL reduction goals.	
3136	For the Lake Superior watershed, any additional mercury releases to the environment are exacerbating already existing impairments including fish advisories set for recreational fishing. Increased fish mercury levels will also have direct impacts on both the cultural and recreational resources of the region.	Based on the evaluations conducted for air emissions and water discharges for the FEIS, the NorthMet Project Proposed Action is not considered to have an appreciable effect on: 1) surface water mercury concentrations, 2) fish mercury concentrations, 3) methylation of mercury, or 4) risk to people consuming fish from lakes near the NorthMet Project Proposed Action site. Two mercury air emission scenarios were evaluated. Scenario 1 is a conservative overestimation of oxidized mercury and Scenario 2 is considered to be a conservative but more likely mercury speciation for the air emissions associated with the NorthMet Project Proposed Action. The MPCA's Cumulative Mercury Risk Estimation Method (MMREM) analysis for the two scenarios showed a 0.5-1.8% and 0.3-0.5% potential increase in fish mercury concentration above background in the following five lakes: Heikkila Lake, Colby Lake, Sabin Lake, Wynne Lake, and Whitewater Lake. However, this potential change is not considered to be significant, compared to background levels. Further, discharges from the Proposed Action are expected to meet the 1.3 ng/L water quality standard for mercury, with an overall net decrease in mercury loading to the St. Louis River Watershed predicted for the NorthMet Project Proposed Action Alternative, as compared to the CEC Scenario. The Cultural Resources section of FEIS Chapters 4 and 5 addresses the Co-lead Agencies' federal tribal trust responsibilities as part of the 1854 Treaty. These sections, along with other relevant natural resources sections of Chapters 4, 5, and 6, also address effects on, and any proposed mitigation for effects on cultural resources and culturally significant natural resources that do not qualify for listing on the NRHP.	AQ 11 MERC 02
3137	Indirect impacts to wetlands from mine pit dewatering (866.9 acres with high likelihood of	When an agency is evaluating reasonably foreseeable significant adverse effects on the human environment in an EIS and there is incomplete or	WET 08

Comment ID	Comment	Response	Theme(s)
	wetland hydrology effects (Zone 1)) may be underestimated as a result of using the analog method described in the SDEIS (Section 5.2.3.2.2). We do not feel the proposed analog method of assessing potential indirect impacts from mine site pit dewatering is adequate, and as such should not be the sole means of indirect impact assessment for the SDEIS.	unavailable information because the overall costs of obtaining it are exorbitant or the means to obtain it are not known, NEPA directs the agency to make it clear that such information is lacking, discuss the relevance of the lacking information, and discuss any information relevant to evaluation of the future impacts. In these cases, NEPA also directs the agency to evaluate these impacts based upon theoretical approaches or research methods generally accepted in the scientific community provided that the analysis of the impacts is supported by credible scientific evidence, is not based on pure conjecture, and is within the rule of reason. The Co-lead Agencies believe this is the case for evaluating indirect wetland effects. The Co-lead Agencies have thoroughly considered throughout the development of the EIS and through the Wetland Impact Assessment Planning Work Group how to assess potential indirect wetland effects. As a result, strengths and weaknesses of the approach used, as well as other suggested approaches, have been carefully considered. The Co-lead Agencies believe that the analog method used in the SDEIS to assess potential indirect effects from mine dewatering is adequate. Further, the FEIS has been revised to address concerns raised by the Bands regarding the assertion that ombrotrophic bogs would not be impacted by mine dewatering. FEIS Section 5.2.3.2.2 applies a more conservative assumption of the potential indirect effects for all bog communities within the 0-1,000-ft analog zone. Specifically, ombrotrophic bogs were reclassified from the “no effect” category to the “low likelihood” category, the same status as that assigned to minerotrophic bogs. The complex mixes of bedrock, surficial deposits, and wetland soils at the Mine Site impede the ability to reasonably model (e.g., using MODFLOW) and accurately assess the potential effect of pit dewatering on wetlands. In light of this modeling limitation, wetlands were divided into zones based on distance from the open pit. The closer a wetland was to the pit during dewatering, the greater the water table drawdown would be and the greater potential there would be for hydrologic effects on overlying wetlands. These impact assessment methodologies are presented in FEIS Sections 5.2.2.3.2 and 5.2.3.1.2. The Co-lead Agencies are not relying solely on the potential impact zones determined in the analog method for the FEIS but are monitoring wetlands for potential indirect effects. In the event that the required wetland monitoring identifies additional indirect effects, permit conditions would likely include a plan for adaptive management practices to be implemented. Additional compensatory mitigation would be required if indirect wetland	

Comment ID	Comment	Response	Theme(s)
		impacts are identified during monitoring and annual reporting.	
3138	We do not feel the impact zones and distances are well described, and do not agree with the automatic exclusion of ombrotrophic wetlands from potential drawdown effects. ...GLIFWC conducted an independent assessment using the same methods as the Co-lead Agencies, along with additional analog data from other mining-impacted sites. The assessment found an estimated total of 5719.75 acres of wetlands would be potentially susceptible to severe indirect impacts from mine pit drawdown (Zone 1).	When an agency is evaluating reasonably foreseeable significant adverse effects on the human environment in an EIS and there is incomplete or unavailable information because the overall costs of obtaining it are exorbitant or the means to obtain it are not known, NEPA directs the agency to make it clear that such information is lacking, discuss the relevance of the lacking information, and discuss any information relevant to evaluation of the future impacts. In these cases, NEPA also directs the agency to evaluate these impacts based upon theoretical approaches or research methods generally accepted in the scientific community provided that the analysis of the impacts is supported by credible scientific evidence, is not based on pure conjecture, and is within the rule of reason. The Co-lead Agencies believe this is the case for evaluating indirect wetland effects. The Co-lead Agencies have thoroughly considered throughout the development of the EIS and through the Wetland Impact Assessment Planning Work Group how to assess potential indirect wetland effects. As a result, strengths and weaknesses of the approach used, as well as other suggested approaches, have been carefully considered. The Co-lead Agencies believe that the analog method used in the SDEIS to assess potential indirect effects from mine dewatering is adequate. Further, the FEIS has been revised to address concerns raised by the Bands regarding the assertion that ombrotrophic bogs would not be impacted by mine dewatering. FEIS Section 5.2.3.2.2 applies a more conservative assumption of the potential indirect effects for all bog communities within the 0-1,000-ft analog zone. Specifically, ombrotrophic bogs were reclassified from the “no effect” category to the “low likelihood” category, the same status as that assigned to minerotrophic bogs. The complex mixes of bedrock, surficial deposits, and wetland soils at the Mine Site impede the ability to reasonably model (e.g., using MODFLOW) and accurately assess the potential effect of pit dewatering on wetlands. In light of this modeling limitation, wetlands were divided into zones based on distance from the open pit. The closer a wetland was to the pit during dewatering, the greater the water table drawdown would be and the greater potential there would be for hydrologic effects on overlying wetlands. These impact assessment methodologies are presented in FEIS Sections 5.2.2.3.2 and 5.2.3.1.2. The Co-lead Agencies are not relying solely on the potential impact zones determined in the analog method for the FEIS but are monitoring wetlands for potential indirect effects. In the event that the required wetland	WET 10

Comment ID	Comment	Response	Theme(s)
		monitoring identifies additional indirect effects, permit conditions would likely include a plan for adaptive management practices to be implemented. Additional compensatory mitigation would be required if indirect wetland impacts are identified during monitoring and annual reporting.	
3140	We also disagree the Partridge River would act as a "natural barrier" to the cone of depression, which suggests that the riparian zone of the Partridge River will not be affected by groundwater drawdown (page 5-243).The upper Partridge River is located in Zone 2; GLIFWC's independent analysis estimated drawdowns of 3 to 5 feet under the river, which would severely reduce baseflow in the channel, indirectly impact riparian wetlands downstream, and affect other surface water features. GLIFWC's analysis should be considered in the SDEIS for estimating potential indirect effects on wetlands from mine pit dewatering. This would also have implications for the cumulative effects analysis presented in Chapter 6 (Section 6.2.3.4.4).	Using an observational approach based on data from similar nearby mine sites (i.e., analog method), the Co-lead Agencies concluded that drawdowns in the surficial aquifer would not be expected to extend very far from the mine pits. This is explained by the following factors: 1) the surficial aquifer is thin and moderately permeable, 2) the surficial aquifer is subject to aerial recharge, and 3) the surficial aquifer is underlain by low-permeability bedrock that limits downward leakage from the surficial unit. These factors support the conclusion that wetland drawdown did not need to be included in the Mine Site GoldSim model. See FEIS Section 5.2.3 for more information on the analog method. It is acknowledged that there is some degree of hydraulic interaction between wetlands and the surficial aquifer at the Mine Site. However, attempts to quantitatively model the effects of these interactions on drawdown and water quality would be highly uncertain and potentially misleading. The FEIS approach was to not model hydraulic connections between wetlands and the surficial aquifer in the Mine Site GoldSim model, but rely on future monitoring and adaptive mitigation measures in the event that some wetlands are indirectly affected by the Proposed Project. See FEIS Section 5.2.2.3.6 and 5.2.2.3.5 for more information on Closure monitoring and adaptive mitigation. Please refer to the responses to themes WR 086 and WR 171.	WET 10 WET 18
3141	Much of the proposed mitigation (Aitkin and Hinckley sites) for directly impacted wetlands is outside of the watershed and 1854 Ceded Territory. This is a permanent loss to these areas and should be discussed in the document. Mitigation options within the watershed and 1854 Ceded Territory should be re-visited.	FEIS Section 5.2.3.3.2 includes a discussion on the wetland mitigation study limits and the site selection process. The compensatory wetland mitigation site selection for the NorthMet Project Proposed Action began in 2005 and has gone through a rigorous site selection evaluation. Prior to the 2008 Federal Mitigation Rule, the Aitkin and Hinckley sites were selected, initial approvals by the USACE were received, and substantial investments were made by PolyMet to develop both sites for compensatory mitigation. The USACE guidance prior to the implementation of the 2008 Federal Mitigation Rule was to look for mitigation sites that could provide the following: restoration of historical wetlands, high probability of success, achieve at least partial in-kind mitigation and sites that had ditched and/or tiled peatlands to provide for restoration. When the 2008 Final Mitigation Rule went into effect, the USACE informed PolyMet of the priority for	WET 03

Comment ID	Comment	Response	Theme(s)
		siting any future compensatory mitigation within the St. Louis River/Great Lakes Basin. The Zim Site was subsequently proposed as a third site. Initially, no practicable compensation sites were found in the St. Louis River Watershed, but subsequently, the Zim Site was found and incorporated as part of the compensatory mitigation plan. Although the 2008 Federal Mitigation Rule and 2009 USACE St. Paul District Policy do not require wetland mitigation sites to stay within the 1854 Ceded Territory, the Zim Site is located within the 1854 Ceded Territory. The permanent functional loss of wetlands within the St. Louis River Watershed/Great Lakes Basin would be considered by the USACE in its DA permit decision and has been accounted for in the proposed mitigation credits by PolyMet. Please refer to the response to theme WET 03.	
3143	Upfront mitigation for wetlands susceptible to severe indirect impacts is currently not proposed, and we believe that the USACE should require up front mitigation for all severely impacted wetlands. We also contend that additional up front mitigation should be considered for wetlands that are classified in the moderate to severe category, with robust monitoring being required for wetlands in the moderate category.	FEIS Section 5.2.3.3 has been revised to include more information on the monitoring and mitigation plan for the potential indirect wetland effects. The indirect effects analyses performed for the EIS were not performed to characterize impacts but were done to inform where monitoring should take place for those areas that were identified as having a potential for indirect wetland effects. As a result of these analyses performed to determine where monitoring should occur, quantification of wetland types and acres of potential indirect wetland effects were also generated. FEIS Section 5.2.3 provides these quantitative values of potential indirect wetland effects. Potential indirect wetland effects from the NorthMet Project Proposed Action were assessed as a result from one of the following six factors: 1) wetland fragmentation; 2) change in wetland hydrology from changes in watershed area; 3) changes in wetland hydrology from groundwater drawdown resulting from open pit mine dewatering; 4) changes in wetland hydrology from groundwater drawdown resulting from operation of the Plant Site, including groundwater mounding and seepage containment; 5) changes in stream flow near the Mine Site and Plant Site and associated effects on wetlands abutting the streams; and 6) change in wetland water quality related to atmospheric deposition of dust and rail car spillage associated with Mine Site and Plant Site operations. The assessments provided wetland type and acreage for all six factors; however, only wetland acreages were provided for factor 6 (change in wetland water quality related to atmospheric deposition of dust and rail car spillage associated with Mine Site and Plant Site operations).The identification of specific mitigation for indirect effects and a monitoring plan is not a	WET 01 WET 02

Comment ID	Comment	Response	Theme(s)
		requirement for an EIS; however, the FEIS has been updated with additional information on the approach for determining mitigation if the monitoring shows indirect effects are occurring. The monitoring and mitigation for potential indirect effects would be determined during permitting. FEIS Section 5.2.3.3 has been revised to include more information on the monitoring and mitigation plan for potential indirect wetland effects. The proposed wetland impact, avoidance, minimization, mitigation and monitoring plan presented in the FEIS would be reviewed, modified as required, and approved during permitting; therefore, this information could change during permitting.	
3144	Section 5.2.9.2.2 (Wildlife) does not contain information on game species such as moose, deer, grouse, waterfowl, furbearers, etc. These species are important to the Bands for the exercise of treaty rights, and further analysis is needed.	The FEIS wildlife sections provide an analysis of wildlife species used for subsistence/harvest, as well as those culturally important to the Bands. FEIS Section 4.2.9.3.3 identifies species potentially harvested in the 1854 Ceded Territory, while FEIS Section 5.2.9.2.2 explains that a lack of data regarding use of such species in the NorthMet Project area likely indicates limited present day use in that area due to general inaccessibility. FEIS Section 5.2.5.2.5 discusses the types of potential effects to common and/or game species, which are similar to effects on ETSC species. The FEIS has been revised to include additional detail regarding moose, and this discussion has been moved to the state ETSC species discussion, due to its new state listing status. The response to theme CR 01 also discusses effects to resources important to the Bands.	CR 01 WI 09
3145	This section also contains language about "1854 Treaty Authority-regulated species". We suggest removing or altering this language. The Fond du Lac Band also exercises treaty rights in the 1854 Ceded Territory, and has their own regulations. Further, the 1854 Treaty Authority maintains seasons and limits on some species, but these are not the only species of importance.	Text has been added to clarify the definition of "1854 Treaty Authority-regulated species" in Section 5.2.9.2.2. As discussed in this section, Fond du Lac has its own regulations applicable to the 1854 Ceded Territory. The discussion of "1854 Treaty Authority-regulated" species or resources is not inclusive of all species important to the Bands. Instead, the lists serve as the most updated and best available data for the most common game species or tribally harvested resources on the 1854 Ceded Territory.	EDIT 01
3146	The project would result in one more piece of the 1854 Ceded Territory permanently altered and impacted. When taken in combination of all the mining operations across the Iron Range and other general development, the Ceded Territory and related exercise of treaty rights have been significantly impacted.	The Cultural Resources sections of FEIS Chapters 4 and 5 address the federal Co-lead Agencies' federal tribal trust responsibilities under the 1854 Treaty. These sections, along with other relevant natural resources sections of FEIS Chapters 4, 5, and 6 also address effects on, and any proposed mitigation for effects on cultural resources and culturally significant natural resources. Mitigation/compensation for effects on cultural resources and culturally significant natural resources is considered to the extent possible within the parameters of the statutes and regulations	CR 01

Comment ID	Comment	Response	Theme(s)
		providing the federal authorities for the review of the NorthMet Project Proposed Action.	
3147	The SDEIS states on page 4-340 that subsistence activity (including hunting, fishing, and plant gathering) accounted for approximately one meal per week among the survey respondents… Our interpretation and analysis of the results would likely show an increased consumption rate from what is reported in the SDEIS.	The NorthMet Project Proposed Action is within the 1854 Ceded Territory. FEIS Section 4.2.10.1.6, as well as Table 4.2.9-1 in FEIS Section 4.2.9 summarize available information about subsistence patterns and resources within the 1854 Ceded Territory. Construction of the NorthMet Project Proposed Action would make the Mine Site unavailable for subsistence use. The degree to which construction of the NorthMet Project Proposed Action would affect individual subsistence resources (i.e., fish, game, and plant species) outside of the Mine Site, Transportation and Utility Corridor, and Plant Site is discussed in FEIS Section 5.2.9 (Cultural Resources). FEIS Section 5.2.10.2.6 discusses consumption of fish. Increased mercury concentrations and associated increases in mercury bioaccumulation in fish tissue could constitute an EJ impact for Band members and other subsistence consumers of fish.	SO 09
3148	The SDEIS also states that harvest for all species (including big game and trapping) have generally declined since 1994. We believe that this statement is inaccurate and also seems to minimize the importance of the exercise of treaty rights.	The statement that harvest for all species (including big game and trapping) have generally declined since 1994 is based on the citation Edwards 2012 (as cited in the FEIS). The 1854 Treaty as it relates to subsistence and the Project Area is described in Section FEIS 4.2.10.1.6.	SO 04
3149	In addition, this section focuses only on harvest activities regulated and reported by the 1854 Treaty Authority, and does not include the exercise of treaty rights by the Fond du Lac Band.	Text has been added to clarify the definition of "1854 Treaty Authority-regulated species" in FEIS Section 5.2.9.2.2. As discussed in this section, Fond du Lac has its own regulations applicable to the 1854 Ceded Territory. The discussion of "1854 Treaty Authority-regulated" species or resources is not inclusive of all species important to the Bands. Instead, the lists serve as the most updated and best available data for the most common game species or tribally harvested resources on the 1854 Ceded Territory.	CR 01
3150	The SDEIS essentially contains no analysis on moose. This issue has been raised by the cooperating agencies a number of times throughout the EIS development process. Given this listing [on August 19, 2013], and the cultural importance to the Bands, the SDEIS should analyze project impacts to moose and also consider it from a cumulative impacts perspective.	The FEIS includes an analysis about cumulative effects on special status wildlife species of cultural importance. The FEIS Section 5.2.9.2.2 explains that a lack of data regarding use of such species in the NorthMet Project area likely indicates limited present day use in that area due to general inaccessibility. The FEIS Section 6.2.3.10.4 discusses general impacts to culturally-important plants and animals. The FEIS wildlife sections (4.2.5, 4.3.5, 5.2.5, and 5.3.5) have been updated to include the new state ETSC status listings from August 19, 2013, as well as any new federal status listing changes. The FEIS includes a more robust analysis on direct and	WI 01

Comment ID	Comment	Response	Theme(s)
		cumulative effects to the moose.	
3151	Stating the economic benefits of the project, while not stating economic costs to resources and related uses, does not allow for a fair comparison or overall view of the project. Environmental economic tools do exist to value resources and the services they provide, and perhaps some would be applicable and beneficial for the SDEIS.	Section 102 of NEPA (42 USC 4321 et seq.) requires all Federal agencies, to the fullest extent possible, to do the following: "identify and develop methods and procedures, in consultation with the Council on Environmental Quality...which would insure that presently unquantified environmental amenities and values may be given appropriate consideration in decision-making along with economic and technical considerations." Neither NEPA nor MEPA require the costs and benefits of a proposed action to be quantified in dollars or any other common metric; moreover, it is not possible to quantify and assign a value to all benefits and costs associated with the NorthMet Project Proposed Action. The FEIS focuses on the benefits and costs of such magnitude or importance that their inclusion in the analysis can inform the decision-making process. The FEIS fulfills NEPA and MEPA requirements in adequately addressing benefits and costs.	SO 04
3152	The document states that there will be a net increase of up to 579.6 acres for the Superior National Forest. Any gains or losses in federal ownership will not be known until the values of all the proposed lands in the exchange have been determined. The proposed exchange loses one large tract of public land for several smaller tracts. The project also results in permanent impacts and changes to the resources regardless of ownership. These issues should be clearly identified in the SDEIS.	The Land Exchange Proposed Action must comply with FLPMA's requirement that the values of the lands exchanged are equal or, if they are not equal, that the values shall be equalized by the payment of money so long as the payment does not exceed 25% of the total value of the lands transferred out of federal ownership. Appraisal reports completed in 2013 indicate that the Land Exchange Proposed Action would meet federal value requirements if all five non-federal land tracts (6,722.5 (GLO) acres) offered by PolyMet would be exchanged for 6,650.2 (GLO) acres of federal land. The appraisal reports indicate that Land Exchange Alternative B would meet the federal value requirements if non-federal Tract 1, Hay Lake (4,651.5 [GLO] acres), would be exchanged for a smaller federal parcel of 4,887.3 (GLO) acres. If the ROD approves the Land Exchange, a current appraisal, approved by the USFS, will be required to verify equal value. Appraisals must conform to Uniform Appraisal Standards for Federal Land Acquisitions and the Uniform Standards of Professional Appraisal Practice of the Appraisal Foundation. The effects to resources are discussed in detailed in Section 5.0.	LAN 03
3153	The SDEIS also puts too much emphasis on the current lack of access to the Forest Service lands (Section 3.1.2.1, page 5-579). This is seemingly done to minimize the impact of losing it.	Access is discussed because it defines the degree to which the lands in question can actually be used—either by the public for recreational purposes, by forestry interests for economic purposes, or for research and conservation purposes.	NEPA 12

Comment ID	Comment	Response	Theme(s)
3154	Access to the specific public waters and wild rice associated with the land exchange (Pike River, Hay Lake, Little Rice Lake) is currently available. Adjacent land ownership is not a direct impact to this access because wild rice is in public waters that are currently accessible. The SDEIS does not paint an accurate picture to say that the land exchange will result in additional wild rice beds, that there is currently no opportunity to harvest wild rice directly on the federal lands, or that the public would have better opportunities for wild rice harvesting (Section 5.3.4.2.1, page 5-609).	Wild rice does not currently grow within the proposed federal land boundaries, and suitable habitat is limited. The Land Exchange Proposed Action would result in the public ownership of additional wild rice beds by the acquisition of Tract 1. Tract 1 contains Little Rice Lake, which supports a continuous population of wild rice. Wild rice also grows along the Pike River south of Little Rice Lake and in isolated populations on Hay Lake. The FEIS vegetation sections clarify the discussion of access to locations of wild rice beds on the non-federal lands. The Land Exchange would result in an increase in wild rice beds within the federal estate. FEIS Section 4.3.4.2.5 provides further discussion of wild rice beds on Tract 1. As a result, the public would have better opportunities for wild rice harvesting on Tract 1, where there is currently no opportunity to harvest wild rice directly on the federal lands (i.e., no known wild rice populations) despite the public water access onto the federal lands. A carry-down boat launching access is located on Tract 1, which may provide private access for wild rice harvesting on the Tract 1 lands. Access to wild rice beds on the federal lands would not be lost as a result of the Land Exchange Proposed Action, but access to wild rice beds on Tract 1 would be gained. Overall, there would be no increase in wild rice harvest opportunities for the public.	VEG 04 VEG 08 WR 155
3155	page 5-591 states that the proposed land exchange would result in a net increase of wild rice beds to the federal estate. Wild rice in these locations are found in public waters (and would not be on federal lands or under federal ownership/management) and are currently accessible through an access on the Pike River. Some resource protection advantages may exist to gaining adjacent federal ownership as it relates to land management.	Wild rice does not currently grow within the proposed federal land boundaries, and suitable habitat is limited. The Land Exchange Proposed Action would result in the public ownership of additional wild rice beds by the acquisition of Tract 1. Tract 1 contains Little Rice Lake, which supports a continuous population of wild rice. Wild rice also grows along the Pike River south of Little Rice Lake and in isolated populations on Hay Lake. The FEIS vegetation sections clarify the discussion of access to locations of wild rice beds on the non-federal lands. The Land Exchange would result in an increase in wild rice beds within the federal estate. FEIS Section 4.3.4.2.5 provides further discussion of wild rice beds on Tract 1. As a result, the public would have better opportunities for wild rice harvesting on Tract 1, where there is currently no opportunity to harvest wild rice directly on the federal lands (i.e., no known wild rice populations) despite the public water access onto the federal lands. A carry-down boat launching access is located on Tract 1, which may provide private access for wild rice harvesting on the Tract 1 lands. Access to wild rice beds on the federal lands would not be lost as a result of the Land Exchange Proposed Action, but access to wild rice beds on Tract 1 would be gained.	VEG 08 WR 155

Comment ID	Comment	Response	Theme(s)
		Overall, there would be no increase in wild rice harvest opportunities for the public.	
3157	We do not agree that the project and proposed land exchange would increase habitat availability because even the with land exchange, the overall result of the project is permanent impacts, loss, and changes to the resources of northeastern Minnesota and the 1854 Ceded Territory (Section 5.3.5, page 625).	FEIS Sections 4.2.5, 4.3.5, 5.2.5, and 5.3.5 (Wildlife) include information about impacts of the NorthMet Project Proposed Action on wildlife habitat types and MBS Sites of Biodiversity Significance. FEIS Section 5.3.4 discusses that the increases in habitat under the Land Exchange Proposed Action would be to the federal estate. However, FEIS Section 5.2.4 discusses that with the Combined Proposed Actions, there would be a decrease in overall habitat. *Minnesota Rules* 6132.2700 does require that a project site be reclaimed once mining has ceased. The goals of such reclamation are to "control erosion, to screen mining areas from non-compatible uses, and to provide for subsequent land uses such as wildlife habitat or timber production." The rules also include requirements about the characteristics and planting schedule for vegetation used in reclamation.	WI 02 WI 03
3158	Regarding habitat availability and impacts from the proposed land exchange, there is no mention of effects on game species such as moose, deer, grouse, waterfowl, furbearers and others in Section 5.3.5.2.5 nor in Section 6.2.3.6 from the cumulative effects analysis.	The FEIS wildlife sections provide an analysis of wildlife species used for subsistence/harvest, as well as those culturally important to the Bands. FEIS Section 4.2.9.3.3 identifies species potentially harvested in the 1854 Ceded Territory, while FEIS Section 5.2.9.2.2 explains that a lack of data regarding use of such species in the NorthMet Project area likely indicates limited present day use in that area due to general inaccessibility. FEIS Section 5.2.5.2.5 discusses the types of potential effects to common and/or game species, which are similar to effects on ETSC species. The FEIS has been revised to include additional detail regarding moose, and this discussion has been moved to the state ETSC species discussion, due to its new state listing status. The response to theme CR 01 also discusses effects to resources important to the Bands.	WI 10
3160	We would suggest that the proposed School Trust Lands Exchange also be a consideration. The project would entail exchange, purchase, or some combination of both for the Forest Service to acquire the school trust lands within the Boundary Waters Canoe Area Wilderness.	FEIS Section 6.1.2 includes an updated list of projects and actions that were considered in the cumulative effects assessment for the Land Exchange Proposed Action, which includes the School Trust Lands project.	CU 08
3161	We believe that limiting the cumulative effects analysis area (CEAA) for water resources (Section 6.2.3.3), wetlands (Section 6.2.3.4) and aquatic species (Sections 6.2.3.7) to the Partridge and Embarrass River watersheds is too small. These	The cumulative effects section in the FEIS (Section 6.1.1.1) describes the rationale for the identification of CEAAs, which for the water resources cumulative effects analysis excludes United Taconite, which lies within the St,. Louis River watersheds. FEIS Section 6.2.2.1.1 provides a rationale for not including the St. Louis River Basin in the cumulative effects analysis.	CU 01

Comment ID	Comment	Response	Theme(s)
	CEAA's should be expanded to include the St. Louis River watershed. Impacts associated with United Taconite's proposal for 1,200 acres of wetland destruction to build a new tailings basin within the St. Louis River watershed should be considered. The PolyMet project would add to the load of pollutants in the St. Louis River and would reduce tributary flows to the river. Impacts that may occur due to the project could be underestimated (due to modeling concerns), and would not stop before reaching the St. Louis River. Further, any added impact from the project to the St. Louis River watershed would in turn impact Lake Superior. We believe that this should be the appropriate scale to analyze cumulative effects for these resources.	The CEAAs for individual resource areas vary based on the potential for cumulative effects, and not on a single overall assessment area. FEIS Table 6.1.1-2 summarizes the spatial areas used for each resource area and FEIS Table 6.1.1.1-1 lists the project considered in the cumulative effects assessment. Please also refer to Section 8.3, MDO 12 for the Co-lead Agencies' rationale for the CEAA identified for water resources.	
3162	We disagree with the conclusion that no cumulative effects to groundwater resources are expected (Section 6.2.3.3, page 6-16)…Cumulative effects at these locations should be assessed with the proposed project along with potential groundwater pollution from the Peter Mitchell Pit, Laskin Energy, Arcelor-Mittal, United Taconite, and US Steel Minntac.	Cumulative effects result when the effects of an action are added to or interact with other effects in a particular place and within a particular time. The modeled groundwater flowpaths of the NorthMet Project Proposed Action do not interact with other groundwater flowpaths. There may be other plumes from other projects in the vicinity of the NorthMet Project Proposed Action, but the effects of these plumes would only interact with NorthMet Project Proposed Action impacts within surface waters. This has been evaluated. The only exception is the seepage effects from existing LTVSMC Tailings Basin that the NorthMet Project Proposed Action would supplant. This combined effect has been considered.	WR 024
3163	A future action that should be considered in the cumulative effects analysis is any potential future backfill of Virginia Formation waste rock for in-pit disposal at the Cliffs Peter Mitchell Pit. Potential dewatering-related interaction effects between the proposed PolyMet Project and the Peter Mitchell Pit should also be evaluated for cumulative effects.	The Northshore Mining Company Progression of the Ultimate Pit Limit project which includes the in-pit stockpiling of Virginia Formation waste rock in the Northshore Mine Pit would have no impact on the Partridge River, as all operations discharges would be primarily to Langley Creek.	WR 024
3164	In Section 6.2.3.4.4 (Future Wetlands and Water Resources) wetlands that would be indirectly impacted from the PolyMet project (and other projects) should be considered for inclusion in the	It is difficult to predict potential indirect wetland effects within the CEAA, and difficult to know what the potential indirect wetland effects would be for the projects assessed other than the NorthMet Project Proposed Action. However, based on the amount of potential indirect wetland effects that	WET 18

Comment ID	Comment	Response	Theme(s)
	number of wetland acres lost.	could occur from the NorthMet Project Proposed Action, there could be 0.1 to 12.0% cumulatively lost, in addition to the direct wetland impacts assessed, within the Partridge and Embarrass River watersheds as a result of the NorthMet Project Proposed Action. FEIS Section 6.2.3 has been revised to include more information.	
3165	In Section 6.2.3.10.4 (page 6-95), it should be clarified that the project would result in permanent impacts, changes, and loss within the 1854 Ceded Territory… No matter how the proposed project is viewed, it would result in a permanent loss or change to treaty guaranteed resources and the exercise of treaty rights….Further consultation required by federal agencies is needed to better understand effects to cultural resources, and to properly plan for avoidance or mitigation.	The Cultural Resources section of the Final EIS Chapters 4 and 5 addresses the federal Co-lead Agencies' federal tribal trust responsibilities under the 1854 Treaty. These sections, along with other relevant natural resources sections of Chapters 4, 5, and 6, also address effects on, and any proposed mitigation for effects on cultural resources and culturally significant natural resources. Mitigation for effects on cultural resources and culturally significant natural resources is considered to the extent possible within the parameters of the statutes and regulations providing the federal authorities for the NorthMet project review.	
3166	it is anticipated that Minnesota Biological Survey sites of High Biodiversity Significance would be decreased by 6056.4 acres on Superior National Forest lands.	The FEIS vegetation sections include information about the decrease of Minnesota Biological Survey (MBS) sites due to the Land Exchange Proposed Action in Sections 5.2.4 and 5.3.4. There would be a decrease of 6,142.7 acres of MBS Sites of High Biodiversity Significance within the Laurentian Uplands subsection, and an increase of 116.9 acres of MBS Sites of High Biodiversity Significance in the North Shore Highlands subsection. The Land Exchange Proposed Action would also result in an increase to the federal estate of 767.6 acres of MBS Sites of Moderate Biodiversity Significance in the Laurentian Uplands subsection. The WCA rules (including those parts applicable to mining projects under *Minnesota Rules* 8420.0930) include a special consideration for wetlands that are rare natural communities (*Minnesota Rules* 8420.0515, Subpart 3). *Minnesota Rules* 6132.2700 require that a project site be reclaimed once mining has ceased. The goals of such reclamation are to "control erosion, to screen mining areas from non-compatible uses, and to provide for subsequent land uses such as wildlife habitat or timber production." The rules also include requirements about the characteristics and planting schedule for vegetation used in reclamation. The Permit to Mine would address special consideration of wetlands that include rare natural communities. Additional information on rare natural communities would be included in the wetland permit application as part of the Permit to Mine process for further refinement of site-specific conditions.	VEG 02

Comment ID	Comment	Response	Theme(s)
3167	The SDEIS states that financial assurance requirements for the project are not included in the document, but will instead be determined during the permitting phase. We are concerned about this approach given the potential for long-term/perpetual treatment, maintenance, and monitoring that may be needed from the proposed project.	It is acknowledged that operation, maintenance and periodic replacement of environmental controls would be required during closure. Financial Assurance would be required under the State's Permit to Mine to perform these activities on a continuous and/or periodic basis for as long as these activities are needed. FEIS Section 3.2.2.4 provides available details regarding financial assurance, including for reclamation of all disturbed areas and ongoing long-term monitoring and maintenance. Additional details on the financial assurance required for the project effects, monitoring, and mitigation would be addressed during permitting. To the extent the reclamation plan includes maintenance and mitigation, those items would be covered by financial assurance. Neither NEPA nor MEPA rules require that all financial assurance mechanisms be in place before the EIS is finalized. In addition, see the response to theme WR 035.	FIN 12 WR 037
3168	The SDEIS states that contingency mitigation will not be included initially in the financial assurance package. Financial assurance must be monitored and updated as the project proceeds to properly cover site cleanup and closure.	FEIS Section 3.2.2.4 provides available details regarding financial assurance. Additional details on the cost estimates, time frames, contingency plan amounts for unforeseen challenges, and calculations that would be required for the project would be addressed during permitting. Table 3.2-15 provides financial assurance cost estimates for various years of closure, as well as monitoring and mitigation costs. Section 3.2.2.4.1 discusses what activities would be considered in cost estimates, and that cost estimates would be updated annually under the Permit to Mine to account for the proceeding year's activities. *Minnesota Rules* 6132.1200, Subpart 3 states that cost estimates shall be annually adjusted, using current dollar value at the time of the estimate. This requires estimating the contingency funds required for closure and post-closure activities in the event of unplanned closure during the course of the year.	FIN 11

A.5 THEME STATEMENTS AND RESPONSES

A.5.1 Issue: Air Quality (AIR)

Theme AIR 01

Theme Statement

The project fails to adequately account for greenhouse gas emissions and their contribution to global climate change, as well as the effects of climate change on general air quality and local resources over the life of the project.

Thematic Response

The information contained in FEIS Tables 5.2.7-8 and 5.2.7-9 quantifies the direct and indirect emissions of greenhouse gases (GHGs) from the NorthMet Project Proposed Action. In addition, information in FEIS Section 5.2.7.2.4 addresses the potential for climate change impacts in the area, including the frequency and duration of severe weather events. GHG issues have been assessed in a manner consistent with USEPA and MPCA guidance, as well as CEQ's Draft NEPA Guidance on Consideration of the Effects of Climate Change and Greenhouse Gas Emissions, dated February 18, 2010 (CEQ 2010, as cited in the FEIS).

Theme AIR 02

Theme Statement

The project fails to adequately account for the impact of emissions from increased energy use/generation due to the project.

Thematic Response

The information contained FEIS Tables 5.2.7-8 and 5.2.7-9 quantifies the direct and indirect emissions of GHGs from the NorthMet Project Proposed Action. The FEIS does not quantify the emissions of non-GHG emissions from indirect sources. Electrical generating units (EGUs) are subject to their own permitting requirements and emission and capacity limitations. If additional electrical capacity is required, then any new EGUs would be subject to environmental permitting and regulation. FEIS Section 5.2.7.1.3 has been revised to address indirect emission of criteria pollutants.

Theme AIR 03

Theme Statement

The project fails to quantify the amount and assess the impact of amphibole mineral fibers resulting from mining activities.

Thematic Response

FEIS Section 5.2.7.5.3 contains information on amphibole mineral fibers resulting from mining activities. The exact human health risk of amphibole mineral fiber exposure is not known, and it is not possible to quantify amphibole mineral fiber emissions. Section 5.2.7.5.3 includes information on activities that can minimize fiber emissions, ongoing ambient monitoring to collect baseline mineral fiber data, and the commitment to continue fiber emission monitoring after start-up of the NorthMet Project Proposed Action, for comparison to the baseline. Amphibole mineral fiber emissions would also be addressed during air permitting.

Theme AIR 04

Theme Statement

The project does not account for the impacts of planned air pollution control measures/equipment on other resources, such as plants and surface water, in the area around the plant.

Thematic Response

The modeling completed for the FEIS includes all facility emissions, taking into account air pollution control mechanisms, where appropriate. I

Theme AIR 05

Theme Statement

The project does not accurately quantify or account for the impacts (e.g., reactivity) of fugitive dust emissions on human health and the environment, including plants and surface water, in the area around the plant.

Thematic Response

The NorthMet project would have fugitive dust emissions. To evaluate the impact of those fugitive dust emissions, air quality modeling was conducted to assess impacts from those emissions. The FEIS quantifies fugitive dust emissions. Language has been added to FEIS Section 5.2.7.1.1 that describes the purpose of the Secondary NAAQS, including as they relate to fugitive dust emissions. The modeled results determined impacts to be below applicable air quality standards. The FEIS used the evaluation criteria available to determine impacts. Secondary ambient air quality standards are used to provide public welfare protection, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings.

Significant impact on water resources or historic properties from dust is not expected because areas with the potential to generate dust would be controlled by a Fugitive Dust Control Plan and any dust leaving the site would most likely come from sources that would be characterized as having low sulfide/low metal content,

All active areas at the Mine Site and Plant Site would be subject to a Fugitive Dust Control Plan approved by the MPCA, which describes management of fugitive dust generated from unpaved roads across the NorthMet Project Proposed Action area, rock dumping and loading locations on the Mine Site, and areas potentially subject to wind erosion on the Plant Site (see Sections 4.1.6 and 4.3.9 of PolyMet 2015a, as cited in the FEIS).

FEIS Sections 5.2.3.2.2 and 5.2.3.2.4 includes a discussion on the potential indirect deposition effects on wetlands from particulate emissions from the Mine Site, Transportation and Utility

Corridor, and the Plant Site. The deposition modeling results for dust, metals, and sulfur would likely not have an adverse effect on wetlands; however, the modeling only indicated those areas that had deposition rates greater than 100 percent of background deposition. These specific wetlands areas would be identified for consideration in any future monitoring to be conducted for the NorthMet Project Proposed Action. Please refer to theme WET 11 for more information.

Theme AIR 06

Theme Statement

The project does not adequately estimate mercury emissions from all sources, or the impacts of mercury on resources and human health.

Thematic Response

The FEIS estimates the mercury emissions from the NorthMet Project Proposed Action and other nearby sources, including their impact on mercury in fish tissue levels. The NorthMet Project Proposed Action does not jeopardize the State's mercury emission reduction goals, as discussed in FEIS Section 6.2.6.3. In addition, please see the responses to themes HU 02, HU 03, as well as the themes associated with Mercury (MERC 01 through 24).

Theme AIR 07

Theme Statement

The emission estimates for the project fail to adequately quantify or speciate the components of the emissions including those that cause odor.

Thematic Response

Emissions from the NorthMet Project Proposed Action are quantified and presented in FEIS Table 5.2.7-4. No odor-causing compounds are anticipated to result from the NorthMet Project Proposed Action. FEIS Section 5.2.7.1.3 has been revised to more clearly address comments associated with this theme.

Theme AIR 08

Theme Statement

The SDEIS does not adequately assess the air pollution caused by existing taconite ore processing facilities or further offsite processing of the project's final product.

Thematic Response

FEIS Table 6.2-20 includes nearby source emissions, including existing (permitted allowed) and reasonable foreseeable sources. Ambient air modeling includes these sources, as well as background concentrations, which include regional emissions generated from vehicles, as well as both far-field and localized smaller sources. If further off-site processing is proposed in the future, it would be subject to all applicable permitting requirements. FEIS Section 6.2.0037.4 has been revised to state that other sources and reasonable future activity are already included in the analysis.

Theme AIR 09

Theme Statement

The project fails to adequately assess the downwind interstate transport of mercury emissions.

Thematic Response

The introduction of FEIS Section 5.2.7.2.5 has been revised to clarification the discussion of mercury transport. FEIS Section 5.2.7.2.5 contains information on the mercury impacts of the NorthMet Project Proposed Action relative to the Minnesota statewide mercury TMDL.

Theme AIR 10

Theme Statement

The air dispersion modeling is not adequate for assessing the effects on plant life due to deposition.

Thematic Response

Title 42, Chapter 85, Subchapter I, Part A, Section 7408 (a)(2) of the Clean Air Act directs the USEPA to develop air quality criteria for air pollutants that have identifiable effects on public health or “welfare.” The term “welfare” in the context of the CAA includes the protection of vegetation. As a result, the Secondary NAAQS are designed to be protective of plant life, including the effects of both concentration and deposition of material.

FEIS Section 5.2.7.1.1 has been revised to include the above language regarding plant life, the Secondary NAAQS, and the use of information gathered through the Integrated Science Assessment and Ecological Risk Assessment process. In addition, FEIS Section 5.2.7.1.4 includes the results of a deposition modeling assessment that assesses depositional impacts on nearby Class I areas.

Theme AIR 11

Theme Statement

The project does not adequately assess the contribution of the project to regional haze in Class I areas.

Thematic Response

FEIS Section 5.2.7.1.4 contains a Class I visibility impact analysis. The FEIS concludes that the NorthMet Project Proposed Action does not jeopardize the Minnesota’s Regional Haze State Implementation Plan (MPCA 2009b, as cited in the FEIS). The full discussion of visibility impacts and Regional Haze is included in FEIS Section 6.2.7.6.

Theme AIR 12

Theme Statement

The SDEIS requires clarification of air quality terms, values, and concepts.

Thematic Response

The FEIS has been revised to better describe and provide updated values for air pollution control terms, values, and concepts, including:

- The Annual $PM_{2.5}$ Standard in FEIS Table 4.2.7-1 changed from 15 to 12 (footnote added to reflect December 2012 updated standard).
- The Sulfur Dioxide 3-hour Primary Standard value in FEIS Table 4.2.7-1 is aligned with "Primary" in the "Standard Type" column.
- The Sulfur Dioxide 1-hour Standard listed as 0.075 ppm identified as the state standard has been corrected to 0.5 ppm by volume. The federal standard remains 0.075 ppm.
- In FEIS Section 5.2.7.1.3, the last sentence of the third paragraph has been revised from "ambient air quality monitors" to "PM10 monitors."
- The column headings in FEIS Table 5.2.7-4 have been revised to include "controlled potential" parenthetically under the existing headings (which are acknowledged to be non-standard air permitting nomenclature).
- The title of FEIS Table 5.2.7-6 has been changed from "Annual Hazardous Air Pollutant Emissions for Prevention of Significant Deterioration-regulated Stationary Sources" to read "Annual Hazardous Air Pollutant Emissions"
- An explanation of the use of short tons has been added in FEIS Table 5.2.7-7 and metric tons in FEIS Table 5.2.7-8.
- A footnote has been added to FEIS Table 5.2.7-7, indicating that the emission estimates in the table are not proposed permit limitations.
- FEIS Section 5.2.7.1.4 has been revised to indicate that the North Shore Mine was determined to be permitted before the Prevention of Significant Deterioration (PSD) baseline date, and is not an increment-consuming source; therefore, it was not included in the increment modeling.
- The sentence reading "NOx and SO2 would be primarily emitted by mobile sources" was removed from FEIS Section 5.2.7.2.1.
- In FEIS Section 5.2.7.2.3, the sentence that reads, "The risk driver for acute inhalation was NO_2 from the natural gas combustion" has been revised to read, "The risk driver for acute inhalation was NO2 from the diesel fuel combustion."
- H2H PM_{10} concentration of 29 $\mu g/m^3$ for the year 13 operating scenario is shown in FEIS Table 5.2.7.11.
- In FEIS Section 5.2.7.5.1, the statement, "The State of Minnesota's definition of amphibole mineral fibers incorporates..." has been revised to read, "The State of Minnesota's definition of fibers incorporates...."

- In FEIS Section 5.2.7.1.1, the statement, "The NorthMet Project area has been designated by the USEPA as attainment for all air quality pollutants" has been revised to read, "The NorthMet Project area has been designated by the USEPA as attainment or unclassified for all air quality pollutants."
- As stated in the FEIS, all of the receptor nodes with the highest model-estimated deposition rates were located within the ambient air boundary.
- The distinction between metallic dust and sulfide dust has been clarified in the text.

Theme AIR 13

Theme Statement

Comments related to issues that will be determined in the air quality permitting process.

Thematic Response

Comments identified as permitting-related are outside of the scope of the FEIS, and would be resolved during air quality permitting. These are issues that would be negotiated by the applicant and MPCA; the public would be involved through the permit review process. The role of the air permitting process is described in FEIS Section 5.2.7. In addition, the permitting authority of the MPCA is described in FEIS Section 4.2.7. Issues identified by comments in this theme that would be part of the air permitting process include:

- Ambient air quality monitoring;
- Air emissions monitoring;
- Air emissions reporting;
- Emission limits and averaging times;
- Permit limit compliance demonstration;
- Additional air emission mitigation measures; and
- Permitting applicability.

Theme AIR 14

Theme Statement

General statements of support for the Project based on perceived compliance with air quality regulations.

Thematic Response

These comments have been received and acknowledged by the Co-lead agencies. No specific information related to the environmental effects of the NorthMet Project Proposed Action was provided. No changes were made to the FEIS in response to these comments.

A.5.2 Issue: Alternatives (ALT)

Theme ALT 01

Theme Statement

The FEIS should evaluate an underground mining alternative. Such an alternative would cost more, but would have environmental benefits, such as greatly reducing forest, rare habitat, and wetland losses. The company's economic analysis of the underground mining alternative lacks support, and the assumed costs for water treatment for that alternative should be updated, especially considering that perpetual water treatment might not be necessary. Economics alone should not eliminate an alternative from consideration in the FEIS. A cost/benefit analysis should be done for this alternative. Tribal Cooperating Agencies identified this deficiency in the DEIS, consistently brought it forward for discussions throughout the SDEIS process, and USEPA cited the lack of alternatives as a factor when issuing an EU-3 rating for the DEIS.

Thematic Response

The Underground Mine alternative was first considered but eliminated during the Final Scoping Decision Document (FSDD) process. FEIS Section 3.2.3.4.1 describes how it was re-considered during the DEIS process as alternative E7 in response to Cooperating Agency and stakeholder comments, but eliminated from further consideration. The economic feasibility of the Underground Mine alternative was re-considered during development of the SDEIS. In response to a request from the Co-lead Agencies, PolyMet's consultants prepared an updated economic assessment of underground mining, which the Co-lead Agencies independently evaluated (see FEIS Appendix B). The Co-lead Agencies concluded that an underground mine would not be economically feasible, regardless of the tonnage extracted. In addition, the lower rate of ore production would not meet the Purpose and Need of the project. Although the Underground Mine alternative would offer environmental benefits over the NorthMet Project Proposed Action, it would result in reduced socioeconomic benefits. A position paper (FEIS Appendix B) was prepared to document the Co-lead Agencies' rationale for eliminating the Underground Mine alternative from further consideration.

FEIS Section 5.2.10.1.4 states, "neither NEPA nor CEQ requires the cost and benefits of a proposed action to be quantified in dollars or any other common metric. However, this EIS acknowledges that economic costs and loss of non-market value may result from environmental and social effects. Also acknowledged is that the agreement on the value (i.e., the "cost") of environmental effects is often difficult to achieve. Therefore, the approach of this EIS is to evaluate environmental and social impacts directly, in the appropriate resource-specific section." The Council on Environmental Quality (CEQ) regulations for implementing the National Environmental Policy Act (NEPA) (40 CFR 1502.23) state that, "for purposes of complying with the Act, the weighing of the merits and drawbacks of the various alternatives need not be displayed in a monetary cost-benefit analysis and should not be when there are important qualitative considerations."

Theme ALT 02

Theme Statement

An underground mining alternative does not require a land exchange.

Thematic Response

FEIS Section 3.3.3.3.6 states that a land exchange would not be needed if underground mining was proposed for the NorthMet Deposit.

See the response to Theme ALT 01 which discusses why the Underground Mine alternative is not reasonable.

Theme ALT 03

Theme Statement

The FEIS should evaluate a West Pit backfill alternative. This alternative would cost more but would have greater environmental benefits, such as reduced wetlands and water quality effects. The company's economic analysis for the West Pit backfill alternative lacks support. Economics alone should not eliminate an alternative from consideration in the FEIS. A cost/benefit analysis should be done for this alternative.

Thematic Response

The West Pit Backfill alternative (E20) was considered but eliminated during the development of the DEIS. It was eliminated from further consideration because it was determined that it would not offer significant environmental or socioeconomic benefits compared to the NorthMet Project Proposed Action and because backfilling the West Pit would prevent recovery of additional mineral resources. These factors are sufficient to qualify the West Pit Backfill alternative as unreasonable under NEPA, and justify its exclusion under *Minnesota Rules* 4410.2300, subpart G. It was re-considered in the SDEIS in response to DEIS comments from the Cooperating Agencies. A Co-lead Agencies memorandum (MDNR et al. 2013b, as cited in the FEIS) was prepared to summarize the decision-making process, which is referenced in FEIS Section 3.2.3.4.2. The Co-lead Agencies screened the alternative against criteria used for other alternatives, including Purpose and Need, Technical and Economic Feasibility, Availability, and Environmental or Socioeconomic Benefit. The opportunity to reclaim wetlands and vegetation at the Category 1 Waste Rock Stockpile footprint area would be a measurable environmental benefit offered by backfilling the Category 1 Stockpile into the West Pit. However, some degree of these vegetation and wetland impacts would occur and would require mitigation regardless of future backfilling or not, because of the need to "temporarily" store these materials until mining operations cease.

FEIS Section 5.2.10.1.4 states, "Neither NEPA nor CEQ requires the cost and benefits of a proposed action to be quantified in dollars or any other common metric; however, this EIS acknowledges that economic costs and loss of non-market value may result from environmental and social effects. Also acknowledged is that the agreement on the value (i.e., the "cost") of environmental effects is often difficult to achieve. Therefore, the approach of this EIS is to evaluate environmental and social impacts directly, in the appropriate resource-specific section." CEQ regulations for implementing NEPA (40 CFR 1502.23) state that, "for purposes of complying with the Act, the weighing of the merits and drawbacks of the various alternatives need not be displayed in a monetary cost-benefit analysis and should not be when there are important qualitative considerations."

Theme ALT 04

Theme Statement

A perpetual pumping alternative for the West Pit could mitigate or prevent long-term environmental damage. It would prevent a pit lake from forming, thus protecting surface and groundwater.

Thematic Response

An interagency memorandum was prepared regarding the West Pit Water Elevation Alternative (MDNR et al. 2014, as cited in the FEIS). This alternative includes both the option to maintain a dry West Pit through perpetual pumping and maintaining pit water levels below the elevation of the Partridge River. The alternative was screened against criteria used for other alternatives, including Purpose and Need, Technical and Economic Feasibility, Availability, and Environmental or Socioeconomic Benefit. The screening level assessment concluded that the alternative would meet all criteria except for the environmental or socioeconomic benefit criterion. Continuous dewatering of the West Pit would keep the pit walls exposed instead of covered by a pit lake as in the NorthMet Project Proposed Action. This exposure would potentially result in increased solute loading to a smaller pit lake volume, and thus higher concentrations of pollutants than under the NorthMet Project Proposed Action. Consequently, treatment would be required for a longer period of time. The Co-lead Agencies recommend that the Alternative be considered as an adaptive mitigation measure in the event that monitoring during operations and reclamation indicate that implementing this action is better able to meet future environmental objectives, compared to the NorthMet Project Proposed Action.

Theme ALT 05

Theme Statement

The SDEIS fails to evaluate an alternative that would allow the West Pit to refill naturally without pumping, thereby avoiding effects on Yelp Creek.

Thematic Response

Allowing the West Pit to refill naturally without pumping water into the pit would keep the pit walls exposed for a longer time period, which would potentially result in increased solute loading to a smaller pit lake volume and higher concentrations of pollutants than under the NorthMet Project Proposed Action. Consequently, treatment would be required for a longer period of time.

In addition, groundwater from the West Pit is projected to flow towards the Partridge River rather than Yelp Creek under the NorthMet Project Proposed Action. The NorthMet Project Proposed Action would not be anticipated to have any different impact on Yelp Creek than would be expected with natural flooding. Allowing the West Pit to refill naturally without pumping water into the pit does not offer significant environmental benefits when compared to the NorthMet Project Proposed Action.

Theme ALT 06

Theme Statement

The FEIS should address other alternatives, such as mine design alternatives, a reduced scale of operations, paste tailings, more waste rock backfilling for wetland benefits, and limestone addition to reduce sulfate levels.

Thematic Response

An off-site disposal of waste rock alternative (E1) and off-site subaqueous in-pit disposal of waste rock in the LTVSMC Area 3 pit or other Dunka pits alternatives (E2, E6) were considered but eliminated in the DEIS. The Co-lead Agencies determined after independent review that off-site subaqueous disposal of waste rock would not have environmental benefits greater than on-site subaqueous disposal. In addition, the alternatives were eliminated because of the added potential impacts associated with transporting waste rock off site, or because off-site locations were insufficient in storage capacity or unavailable due to access rights.

The Co-lead Agencies considered several different reduced scales of operation (e.g., E21), but each was deemed unreasonable and eliminated because they were not economically feasible and/or they did not significantly reduce environmental impacts.

A thickened tailings (paste tailings) alternative (A1) was considered but eliminated in the DEIS and post-DEIS, as it was found not to offer significant environmental benefits when compared to the NorthMet Project Proposed Action.

FEIS Section 3.2.2.1.10 states that waste rock would be backfilled into the East Pit starting at year 11 and in the combined East Central Pit starting in year 16. After backfilling is complete, a wetland would be constructed over the combined East Central Pit.

FEIS Section 3.2.2.1.10 also discusses the possibility of adding lime to the East Pit during waste rock backfilling in order to maintain circumneutral pH in the pit pore water. The volume of lime required would be determined through monitoring during operations. During reclamation, water from the West Pit would be treated at the Wastewater Treatment Facility (WWTF), which would be upgraded to include a Reverse Osmosis (RO) treatment unit to meet applicable water quality standards.

Theme ALT 07

Theme Statement

The SDEIS does not adequately analyze major design alternatives, such as the use of liners for the Overburden Storage and Laydown Area or Category 1 Stockpile.

Thematic Response

As described in the FEIS, liners would be installed for stockpiles or areas where there is a potential to generate acid and/or metal leachate from potentially reactive waste. Temporary stockpiles (Category 2/3 and Category 4) and the Ore Surge Pile would contain a liner. The Category 1 Stockpile would have a containment system to collect seepage, which would be pumped to the WWTF. The Overburden Storage and Laydown Area would hold peat soils and unsaturated overburden, which are not considered to be reactive.

The EIS scoping process, as documented in the FSDD, examined several modified design alternatives, as well as multiple mitigation and monitoring measures. The 2009 DEIS also discussed a liner system as part of its consideration of a modified design or layout at the Mine Site. Key aspects of this alternative from the 2009 DEIS were incorporated into the NorthMet Project Proposed Action and assessed in the SDEIS.

Theme ALT 08

Theme Statement

The FEIS should consider an alternative that employs fly ash as a solution to potential acid mine drainage. For example, fly ash could be used as a mine cap and/or a neutralizing agent in the mine pit.

Thematic Response

The analysis in the FEIS shows that the treatment and mitigation measures employed as part of the NorthMet Project Proposed action would prevent acid mine drainage.

During operations, water from the mine pits would be treated at the WWTF. During reclamation, water from the West Pit would be treated at the WWTF, which would be upgraded to include a RO treatment unit. Treatment at this unit would result in an effluent that meets all applicable water quality standards.

FEIS Section 3.2.2.1.10 discusses the possibility of adding lime to the East Pit during waste rock backfilling in order to maintain circumneutral pH in the pit pore water. The necessity of this mitigation measure and the volume of lime required would be determined through monitoring.

Fly ash is regulated by the Minnesota Pollution Control Agency (MPCA) under their Industrial Solid Waste Rules and is proposed to be regulated by the U.S. Environmental Protection Agency (USEPA) under their draft amendment to the Resource Conservation and Recovery Act (RCRA) Subtitle D. In general, fly ash must be disposed of within a lined facility or be used in a manner approved by appropriate regulation. With the exception of beneficial use as a cement replacement, studies, permits, and approvals are required for both fly ash disposal and beneficial use. The potential use of fly ash could be assessed during the permitting process.

Theme ALT 09

Theme Statement

The FEIS should consider alternative means of storage, recycling, transport, and disposal of mining operation by-products, such as hydrometallurgical residue or reject concentrate.

Thematic Response

The FEIS discusses the storage, recycling, transport, and disposal of mining operation byproducts. For example, FEIS Section 3.2.2.3.7 describes the management of hydrometallurgical residue, which would be disposed of in the Hydrometallurgical Residue Facility. The facility would be located at the existing LTVSMC Emergency Basin. This facility would include a double-lined cell that could be expanded vertically and horizontally, as needed. The water ponded at the Hydrometallurgical Residue Facility would be returned/recycled to the

Hydrometallurgical Plant as much as possible. Because solids from the Mine Site WWTF would be similar to hydrometallurgical residue, they would be recycled directly into the Hydrometallurgical Plant and disposed of in the Hydrometallurgical Residue Facility. Transporting these materials to an off-site location was found not to offer significant environmental benefits when compared to the NorthMet Project Proposed Action.

FEIS Section 3.2.2.3 also explains that reject concentrate from the Plant Site WWTP would be treated at the Mine Site WWTF. In the long term, reject concentrate from the WWTP and the WWTF would be evaporated, and the residual solids disposed of at appropriate off-site facilities (see FEIS Sections 3.2.2.1.10, 3.2.2.3.12).

Theme ALT 10

Theme Statement

The FEIS should evaluate different Tailings Basin design alternatives, such as a lined facility or a different location. Specifically, the FEIS should evaluate paste tailings placed on a lined and covered facility.

Thematic Response

FEIS Table 3.2-17 compares the previous alternatives that were screened for the SDEIS. An off-site subaqueous in-pit disposal of tailings alternative (E5) was considered but eliminated in the DEIS. The Co-lead Agencies determined after independent review that off-site subaqueous disposal of waste rock would not have environmental benefits greater than on-site subaqueous disposal. In addition, the alternatives were eliminated because of the added potential impacts associated with transporting waste rock off-site or because off-site locations were insufficient in storage capacity or unavailable due to access rights.

A thickened tailings (paste tailings) alternative TB-1 was considered but eliminated in the DEIS, and post-DEIS it was reconsidered and determined not to offer significant environmental benefits when compared to the NorthMet Project Proposed Action.

A co-disposal of waste rock and tailings on a lined tailings basin alternative (E14) was considered but eliminated in the DEIS because it was not technically feasible and its economic feasibility was uncertain. Several different Tailings Basin alternatives (TB2-TB6) were reconsidered but eliminated during the SDEIS process. These Tailings Basin alternatives did not afford significant environmental benefits when compared to the enhanced engineering controls (seepage collection and RO mechanical water treatment) built into the NorthMet Project Proposed Action. A dry cap alternative was considered; however, seepage was predicted to result in substantially higher constituent concentrations.

After the close of the comment period on the SDEIS, but prior to publication of the FEIS, an Independent Expert Engineering Investigation and Review panel issued a *Report on Mount Polley Tailings Storage Facility Breach* (January 2015). This report was reviewed by Co-lead Agency geotechnical staff as part of developing this response. The report contained general recommendations that can be considered to reduce the risk of tailings dam failures. Environmental review of the NorthMet Project considered design and siting features similar to the recommendations in the report. The specific use of dry stacking technology would increase tailings basin stability, but when other site specific and environmental factors are considered, this alternative technology does not have significant environmental benefit over the proposed Project. Other factors considered included:

- Industry standard for dry stacking includes the use of a basin liner. Construction of a basin liner on the existing LTVSMC tailings basin has been evaluated and determined not to be feasible.
- Use of dry stack technology would require a new tailings basin to be constructed in a different location as a lined dry stack basin. A separate dry stack tailings basin would increase footprint effects of the project.
- The proposed Project addresses legacy water quality issues of the LTVSMC tailings basin while making use of the brownfield site for tailings disposal. A separate dry stack tailings basin would not address LTVSMC tailings basin legacy issues.

Theme ALT 11

Theme Statement

The FEIS should address Tailings Basin emergency overflow channel alternatives.

Thematic Response

According to *Minnesota Rules* 6132.2500, Tailings Basin designs must ensure that probable maximum precipitation (PMP) rainfall events do not result in overtopping the basin. The emergency overflow channel is a design feature required to prevent Tailings Basin failure in such a situation. The emergency overflow for the Tailings Basin is discussed in the FEIS Section 3.2.2.3.10.

FEIS Table 3.2-17 compares the previous alternatives that were screened for the SDEIS. Various modified designs of the Tailings Basin and tailings management technologies were considered as an alternative (A1) during the DEIS process, but were found not to offer significant environmental benefits when compared to the NorthMet Project Proposed Action.

Theme ALT 12

Theme Statement

Water from Colby Lake for ore processing may not always be available. The FEIS should evaluate alternative sources, such as spring snow-melt.

Thematic Response

FEIS Table 3.2-17 describes an alternative that was considered in the DEIS (E19) that would have used non-contact stormwater from the Mine Site detention pond as process water at the Plant Site, to reduce withdrawals from Colby Lake. The Co-lead Agencies eliminated this alternative because it was found not to offer significant environmental benefits when compared to the NorthMet Project Proposed Action, as it would reduce the flow in the Partridge River. The water needed for ore processing would primarily be from the Tailings Basin pond and collected seepage. Colby Lake make-up water would only be drawn on an as-needed basis. Water management of the NorthMet Project Proposed Action changed since the publication of the

SDEIS. Predicted average annual demand for Colby Lake water decreased from 1,170 gpm to 760 gpm.

Theme ALT 13

Theme Statement

The FEIS should specifically consider (or consider in greater detail) alternative designs and operational approaches that reduce air emissions and water contamination, while mitigating effects on aquatic ecosystems, wetlands, or important habitat types. Examples include earlier use of the reverse osmosis (RO) system beginning in year one, a Category 1 Stockpile liner, and other efforts to reduce or foreshorten the reactivity of waste rock and tailings.

Thematic Response

The WWTP would include a RO unit or equivalent technology throughout operations, while the WWTF would be upgraded to include a RO unit or equivalent technology during closure. The Category 1 Stockpile would have a containment system to collect seepage that would be pumped to the WWTF.

Alternatives to the NorthMet Project Proposed Action were identified in accordance with the requirements of NEPA and the Minnesota Environmental Policy Act (MEPA). Engineering controls and mitigation measures have been incorporated into the NorthMet Project Proposed Action to minimize effects, including air emissions and water contamination, to subsequently minimize potential effects to aquatic ecosystems, wetlands, or other important habitat types. Refer to FEIS Section 3.2.3.3 for more information on the development of the NorthMet Project Proposed Action and alternatives. Refer to FEIS Table 3.2-16 for the engineering controls adopted into the NorthMet Project Proposed Action since the DEIS in order to reduce emissions and mitigate impacts. During operations, extensive monitoring would be required, and adaptive management would be used to ensure minimization of effects and compliance into the future.

FEIS Table 3.2-17 compares the previous alternatives that were screened for the SDEIS. Alternatives were considered in the SDEIS (E2, E6) that would transport the Category 2/3 and Category 4 waste rock and/or tailings to an off-site pit for subaqueous disposal. These alternatives were eliminated because the added impacts associated with transport were found not to offer significant environmental benefits when compared to the NorthMet Project Proposed Action.

Theme ALT 14

Theme Statement

The SDEIS does not provide an adequate analysis of the No Action Alternative. In particular, there is no detailed discussion of the No Action Alternative, and the analysis provided does not accurately characterize changes that would occur under the Cliffs Erie Consent Decree, in the absence of the Project. In particular, the SDEIS does not recognize the direct and indirect effects on wetlands from the No Action Alternative.

Thematic Response

FEIS Section 3.2.3.2 discusses how the Consent Decree under the NorthMet Project No Action Alternative would require Cliffs Erie to complete closure and reclamation activities at the Plant Site. This would include completing activities for the localized affected areas under the Minnesota Voluntary Investigation and Cleanup (VIC) Program, removal of the former Plant Site building, and management of seepage at the Tailings Basin embankment. FEIS Table 3.2-1 shows that under the NorthMet Project No Action Alternative, there would be no mining activities, and that existing management and land use of the federal lands would continue. The NorthMet Project No Action Alternative is also analyzed under each resource area in FEIS Chapter 5, and summarized in FEIS Table 7.2-1. FEIS Section 5.2.3.4 identifies that under the NorthMet Project No Action Alternative, there would be no direct or indirect effects on wetlands.

Theme ALT 15

Theme Statement

The FEIS should analyze an alternative that achieves no active treatment (zero discharge) at closure.

Thematic Response

The DEIS considered two potential options that could be considered as no active treatment, or zero discharge, scenarios. They involved pre-treatment of reactive runoff from the Mine Site and process water from the Plant Site Tailings Basin, and discharge this water to the Cities of Hoyt Lakes' or Babbitt's Publically Owned Treatment Works (POTWs). See FEIS Table 3.2-17 for alternatives E16 and E17, respectively. These alternatives were eliminated because the nearby POTW facilities would not have enough capacity to handle the projected volume of water, and were found not to offer significant environmental benefits when compared to the NorthMet Project Proposed Action. FEIS Sections 3.1.1.7 and 3.2.1 indicate that a goal for long-term water treatment in the NorthMet Project Proposed Action is to provide mechanical or non-mechanical treatment for as long as necessary to meet regulatory standards at applicable groundwater and surface water compliance points.

Minnesota Rules 6132.3200, Subpart 2.E.6 allow for closure and post-closure maintenance, and state that post-closure maintenance includes those techniques or activities that are required to meet closure objectives. PolyMet plans to do pilot-scale testing of non-mechanical water treatment technologies (e.g., Permeable Reactive Barriers [PRBs], Sulfate Reducing Bacteria [SRB] cubes, etc.) during mine operations and following closure until an acceptable treatment performance could be achieved for full scale implementation.

Theme ALT 16

Theme Statement

The FEIS should identify and analyze alternatives that use more modern, less environmentally damaging mineral extraction techniques, including underground mining.

Thematic Response

As discussed in the response to Theme ALT01, the Co-lead Agencies considered an Underground Mine alternative that could have offered environmental benefits when compared to the NorthMet Project Proposed Action. A position paper (FEIS Appendix B) documents the Co-lead Agencies' rationale to eliminate the Underground Mine alternative from further consideration, because it would not meet the Purpose and Need and would not be economically feasible.

FEIS Table 3.2-17 states that other hydrometallurgical technologies were considered in an alternative (E8), but eliminated in the FSDD. The Co-lead Agencies concluded that these hydrometallurgical technologies were found not to offer significant environmental benefits when compared to the NorthMet Project Proposed Action.

Theme ALT 17

Theme Statement

The FEIS should address other alternatives, such as solar hydrogen or fumarole biotics to reduce sulfate levels. Use of slowly biodegradable electron donor materials should be considered.

Thematic Response

The Co-lead Agencies considered a reasonable range of alternatives during screening. FEIS Sections 3.1.1.7 and 3.2.1 indicate that a goal for long-term water treatment in the NorthMet Project Proposed Action is to provide mechanical or non-mechanical treatment for as long as necessary to meet regulatory standards at applicable groundwater and surface water compliance points. After closure, water from the West Pit would be treated at the WWTF, which would be upgraded to include a RO treatment unit. Treatment at this unit would result in an effluent that meets all applicable water quality standards, eliminating the need for alternative technologies in the mine pits. Similarly, water that could not be stored in the Tailings Basin would be treated at the WWTP, which would include a RO treatment unit.

Theme ALT 18

Theme Statement

Adaptive management is itself an alternative that must be analyzed in the FEIS.

Thematic Response

CEQ regulations (40 CFR 1502.14(f)) do not require adaptive management to be analyzed as its own alternative. Further, USEPA guidance on utilization of adaptive management defines it as a decision making process that can be adjusted in the face of uncertainties as outcomes from management actions and other events become better understood - not as a separate alternative for NEPA purposes. The FEIS discusses adaptive management in Section 5.2.2.3.5.

Theme ALT 19

Theme Statement

The FEIS should evaluate alternatives to open-pit mining such as hydrometallurgy, where a leach liquor solution is used to extract the precious metal.

Thematic Response

The Co-lead Agencies considered a reasonable range of alternatives during screening. As discussed in response to ALT 16, other hydrometallurgical technologies were considered in an alternative (E8) but eliminated in the FSDD (see FEIS Table 3.2-17). The Co-lead Agencies concluded that these hydrometallurgical technologies would have no significant environmental benefit when compared to the NorthMet Project Proposed Action.

Theme ALT 20

Theme Statement

The SDEIS fails to identify an Agency Preferred Alternative and/or a Least Environmentally Damaging Practicable Alternative (LEDPA).

Thematic Response

CEQ regulations (40 CFR 1502.14) states that based on the information and analysis presented in the affected environment and environmental consequences sections of an EIS, the EIS should present the environmental impacts of the proposal and the alternatives in comparative form to provide a clear basis for choice among the alternative options by the decision makers and the public. The regulations further state under 1502.14(e) that federal agencies shall identify the agency's preferred alternative or alternatives, if one or more exists, in the draft statement and identify such alternative in the final statement unless another law prohibits the expression of such a preference; however, the regulations do not require a rationale for the choice. No similar requirement to identify a preferred alternative exists for the MDNR under state law.

For the USFS, the Agency-Preferred Alternative is the Land Exchange Proposed Action described in Section 3.3.2. Potential effects specifically relating to the Land Exchange Proposed Action are identified in Sections 5.3 and 6.3. Table 7.3.5-1 summarizes potential effects relating to public interest factors considered for the Land Exchange Proposed Action and its alternatives. The FEIS Sections 3.2.3.4, 7.4, and 7.5 further detail this process.

Theme ALT 21

Theme Statement

Alternatives screening in Section 3.2.3 was flawed because it either eliminated alternatives or incorporated them into the project, rather than subjecting them to detailed review in the body of the SDEIS. This is not consistent with the purpose of an EIS, and is therefore a violation of the National Environmental Policy Act (NEPA).

Thematic Response

FEIS Section 3.2.3 describes how the alternatives were developed from initial project scoping through the SDEIS. Minnesota Rules and CEQ rules (40 CFR 1502.14) require a comparison of the effects of the proposed action and alternatives. The FEIS compares the effects of the

NorthMet Project Proposed Action, NorthMet Project No Action Alternative, Land Exchange Proposed Action, Land Exchange Alternative B, and Land Exchange No Action Alternative.

The original project proposal and alternatives were developed during project scoping in 2005. The project was refined at various points in response to public and agency input. As a result, the NorthMet Project Proposed Action studied in the SDEIS incorporates additional engineering controls that were not part of the proposed action in the 2009 DEIS. The alternatives to the NorthMet Project Proposed Action that were eliminated during the scoping and DEIS phases of the project were re-assessed during development of the SDEIS.

Alternatives were eliminated from detailed evaluation if they did not offer substantial environmental or socioeconomic benefits, were not reasonable (were not technically or economically feasible), were not available, or would not meet the Purpose and Need. This review—beginning during the scoping process and concluding with the FEIS—is consistent with the alternatives review required by NEPA and MEPA, and with the CEQ rules for analyzing alternatives.

Theme ALT 22

Theme Statement

Section 3.2.3 of the SDEIS would be improved if it better reflected the thoroughness of the Co-lead Agencies' alternatives review, including review that occurred during scoping and the 2009 DEIS.

Thematic Response

Additional clarifying information has been included in the FEIS. The FEIS incorporates available and relevant details about the Co-lead Agencies' alternatives review, specifically in section 3.2.3. This section describes how the alternatives were developed from initial project scoping through the SDEIS. FEIS Table 3.2-17 identifies alternatives that were screened for the SDEIS.

Theme ALT 23

Theme Statement

The SDEIS analyzes an insufficient range of Land Exchange alternatives.

Thematic Response

Following the publication of the 2009 DEIS, several land exchange alternatives were identified, screened, and made a part of the SDEIS scoping process. Some of the land exchange alternatives were ultimately eliminated from detailed analysis. The FEIS separately compares the Land Exchange Proposed Action, Land Exchange Alternative B, and Land Exchange No Action Alternative. FEIS Section 3.3.3 discusses the process by which land exchange alternatives were analyzed.

Theme ALT 24

Theme Statement

The SDEIS and associated documents provide sufficient alternatives analysis. However, additional detail is available and should be included in the FEIS.

Thematic Response

Additional clarifying information has been included in the FEIS. The FEIS incorporates available and relevant details about the Co-lead Agencies' alternatives review, specifically in Section 3.2.3. FEIS Table 3.2-17 identifies alternatives that were screened for the SDEIS, and FEIS Section 3.2.3 describes how alternatives were developed through a process from initial project scoping through the SDEIS (which includes the FSDD, DEIS, SDEIS, and FEIS—along with supporting attachments, appendices, and addenda).

A.5.3 Issue: Aquatic Species (AQ)

Theme AQ 01

Theme Statement

The SDEIS does not include adequate information and data on fisheries and aquatic organisms (e.g., microbiota; mollusks). The FEIS should include additional baseline data on the aquatic biota as well as habitat identification and monitoring, particularly of aquatic indicator species, in order to determine potential effects from the NorthMet Project. In addition, the assessment area defined by the Co-lead Agencies for effects on aquatic species from the Project is overly limited.

Thematic Response

Additional relevant aquatic species baseline data has been added to FEIS Tables 4.2.6-4, 4.2.6-5, and 4.2.6-6 in Section 4.2.6.1.3. Aquatic Monitoring would be finalized during permitting; however, overviews of water monitoring plans at the Mine Site and Plant Site are presented in FEIS Section 5.2.2.3.6. The NorthMet Project Proposed Action is not considered to have the potential for effects on hydrology and water quality in the St. Louis River Watershed. As a result, the assessment area for aquatic species is defined by the Partridge River and Embarrass River watersheds.

Theme AQ 02

Theme Statement

The SDEIS contains outdated information regarding tribal lake sturgeon (*Acipenser fulvescens*) reintroduction efforts. Uncontrolled contaminant loading from existing mine facilities, along with elevated constituents from the Proposed Project, have the potential to affect the successful establishment of a sustainable lake sturgeon fishery throughout the St. Louis River Watershed. Updated data on these efforts along with additional baseline data on the existing aquatic ecology is needed in order to determine potential effects on lake sturgeon from the Proposed Project.

Thematic Response

Existing data review from the Minnesota Department of Natural Resources (MDNR) and Fond du Lac Band of Lake Superior Chippewa (FDL) since publication of the SDEIS indicates recruitment and a viable population of lake sturgeon do exist in the St. Louis River Watershed (see FEIS Section 4.2.6). The NorthMet Project Proposed Action is not considered to have the potential for cumulative effects on hydrology and water quality in the St. Louis River Watershed (see FEIS Section 5.2.6). As a result, no effects to lake sturgeon population within the St. Louis Watershed would occur.

Theme AQ 03

Theme Statement

The SDEIS states that the current fish tissue concentration in five local lakes results in Hazard Quotients that exceed 1, but gives no further information. The actual values of the Hazard Quotients and their meaning should be included in the FEIS.

Thematic Response

Information pertaining to the specific Hazard Quotients summarized in the report *Cumulative Impacts Analysis, Local Deposition and Bioaccumulation in Fish* (Table 5 of Barr 2012b, as cited in the FEIS) and their significance have been included in the FEIS Section 6.2.6.3.3, which summarizes the cumulative effects assessment for mercury deposition.

Theme AQ 04

Theme Statement

The Index of Biotic Integrity scores in the SDEIS (Table 4.2.6-4) do not indicate good fish assemblage conditions.

Thematic Response

Index of Biological Integrity (IBI) scores were derived from two MPCA fish surveys conducted at sites MCA_97LS077 and MCA_09LS105. The scores of 61 and 87, respectively, represent average to good habitat quality. FEIS Table 4.2.6-4 has been edited to include data for 09LS105 and USFS_SBPR (see revised FEIS Figure 4.2.6-1). The IBI was not available for many of the Partridge River sites closest to the NorthMet Project area; however, the presence of one or more intolerant or intermediate species in each of these monitoring locations is one indication that quality habitat is present at these sites, and that chemical and physical stream deterioration is likely negligible.

Theme AQ 05

Theme Statement

Sulfates and toxic metals such as mercury, arsenic, copper, and nickel from the Project that are not captured for treatment would affect aquatic organisms—including their population size, community composition, and habitats. This may impact fish, mollusk, and wild rice resources and in turn affect people, birds, and wildlife that depend on fish and other aquatic organisms for food.

Thematic Response

The NorthMet Project Proposed Action is designed to capture sulfates and metals with engineering controls and adaptive management. FEIS Section 4.2 describes existing conditions that may be directly or indirectly affected by the NorthMet Project Proposed Action. Potential impacts to water resources and aquatic species from the NorthMet Project Proposed Action are discussed in detail in FEIS Section 5.2.2 and Section 5.2.6, respectively. The discussion in FEIS Section 5.2.6 now provides additional information on potential impacts to aquatic species from metals, specifically aluminum and lead. Water monitoring would ensure that water quality standards would be met with engineering controls. In addition, spill prevention plans would be implemented. These measures would minimize any potential impacts to aquatic species. See also the responses to themes AQ 06 and AQ 22.

Theme AQ 06

Theme Statement

The SDEIS does not address aquatic toxicity or effects on aquatic life from chemicals or other constituents in the Tailings Basin leachate or water leaving the Mine Site. Toxicity testing of mine waste, Tailings Basin and Hydrometallurgical Residue Facility leachates prior to issuing the FEIS would identify risks to aquatic life from inorganic ions as well as from metals solutes. The FEIS should be revised to evaluate the significance of the potential effects on aquatic life from increased metal solutes under the Proposed Action, including solutes not predicted to exceed water quality standards.

Thematic Response

Potential impacts to aquatic species from the NorthMet Project Proposed Action are discussed in detail in FEIS Section 5.2.6. The discussion in FEIS Section 5.2.6 now provides additional information on potential impacts to aquatic species from metals, specifically aluminum and lead. Toxicity testing of mine waste, Tailings Basin and Hydrometallurgical Residue Facility leachates themselves is not planned and are not necessary, because these are within the engineering controls; however, water monitoring, including Whole Effluent Toxicity (WET) testing, as appropriate, would ensure that water quality standards would be met with engineering controls. Specific monitoring details would be addressed in permitting. In addition, spill prevention plans would be implemented. See also the responses to themes AQ 05 and AQ 22.

Theme AQ 07

Theme Statement

To comply with NEPA and MEPA, the FEIS should provide substantially more information on the likely effects of aluminum and lead exceedances on the aquatic community.

Thematic Response

The discussion in FEIS Section 5.2.6 now provides additional information on potential impacts to aquatic species from metals, specifically aluminum and lead. An exceedance of aluminum could potentially affect aquatic species by causing pulmonary problems, developmental issues, and osmoregulatroy disturbances (Soucek 2006, as cited in the FEIS). However, given the similarity between the Continuation of Existing Condition Scenario and the NorthMet Project Proposed Action, aluminum values at Embarrass River and Partridge River evaluation locations, impacts from aluminum to aquatic species due to the NorthMet Project Proposed Action are not anticipated. Lead does not bioaccumulate, and tends to decrease with increasing trophic levels in freshwater habitats. Exposure to high levels of lead could result in muscular and neurological degeneration and destruction, growth inhibition, reproductive problems, paralysis, and mortality in fish. It could also negatively affect invertebrate reproduction as well as reduce growth, photosynthesis, mitosis, and water absorption in aquatic plants (Eisler 1988b, as cited in the FEIS). The NorthMet Project Proposed Action is designed to capture metals with engineering controls and adaptive management. Water monitoring would ensure that water quality standards would be met with engineering controls. In addition, spill prevention plans would be implemented. These measures would minimize any potential impacts to aquatic species.

Theme AQ 08

Theme Statement

Acid mine drainage would pollute surrounding water and lower the pH of the water. Sulfuric acid runoff can kill many important fish species and can indirectly alter the food chain by reducing food availability for birds and other mammals. These consequences could impact the fishing industry and the health of those who consume fish (i.e., humans, birds, other wildlife) from areas exposed to acid mine drainage.

Thematic Response

The FEIS considers the release of acidity from proposed NorthMet facilities in that leachate from all acid-generating material (Waste Rock and pit wall rock composed of Category 2/3 and Category 4 material) would be captured and treated prior to discharge. The permanent surficial waste facilities (Category 1 Stockpile and Tailings Basin) would contain material that is not expected to produce acidic leachate. The non-acid generating waste was identified using multi-year kinetic tests (humidity cells) on NorthMet rock samples. Waste rock with 0.12 percent sulfide S or less is the threshold for selecting non-acid generation mine waste and, is supported by long-term humidity cell tests on NorthMet waste (i.e., 42 samples of Category 1 waste rock, with tests now run for over 450 weeks; and 33 humidity cell tests run between 84 and 304 weeks [see Section 4.3 and Attachment E, respectively, of PolyMet 2015q, as cited in the FEIS]). These tests demonstrate that tailings and Category 1 waste rock materials do not generate acidic leachate, and acid generation rates decreases over time as sulfide S minerals are depleted. The NorthMet Project Proposed Action design thus prevents the introduction of acidic leachate to surface water that could affect fisheries.

Theme AQ 09

Theme Statement

The SDEIS ignores the broad effects of underwater disposal on metal and other constituent concentrations. As the pits fill, the high concentrations of these parameters will seep or flow out of the pits, and will impact the adjacent wetlands and the Partridge River Watershed, as well as the aquatic life in them.

Thematic Response

The rate of oxidation and associated release of acidity and metals from waste rock and wall rock after it is submerged under water was considered by the Impact Assessment Process (see Table 1 of MPCA 2011d, as cited in the FEIS). Analysis found that after the rock was submerged by a layer of oxygenated water, the rate of oxidation in the rock would decrease by at least a factor of approximately 800 relative to the oxidation rate when it was exposed to atmospheric oxygen (Day 2008, as cited in the FEIS). Based on this analysis, which is consistent with general results of studies on subaqueous disposal of sulfide-bearing mine waste, the GoldSim model assumed that oxidation in submerged wall rock and waste rock was negligible. Therefore, modeling has indicated that the NorthMet Project Proposed Action would not impact the adjacent wetlands and the Partridge River Watershed, as well as the aquatic life in them. FEIS Section 5.2.5.2.3 discusses potential impacts to wildlife from incidental contact with the tailings basin pond and pit lakes. FEIS Section 5.2.2.3.6 discusses on-site monitoring.

Theme AQ 10

Theme Statement

Many Trust Resources will continue to have direct access to open water sources at the Mine Site (mainly migratory birds and northern long-eared bat). The FEIS should clearly state the anticipated water quality of the West Pit and East-Central Pit lakes and the potential for bioaccumulation of methylmercury from aquatic invertebrates and other food chain pathways, and should propose measures to minimize or mitigate for any effects on Trust Resources throughout the life of the mine and into reclamation phase.

Thematic Response

The Cultural Resources section of the FEIS Chapters 4 and 5 addresses the federal Co-lead Agencies' federal tribal trust responsibilities as part of the 1854 Treaty. These sections, along with other relevant natural resources sections of Chapters 4, 5, and 6, also address effects, and any proposed mitigation for effects, on cultural resources and culturally significant natural resources that do not qualify for listing on the National Register of Historic Places (NRHP).

Based on the results of water quality modeling, the water quality of the West Pit Lake, East Pit wetland and Tailings Basin pond is predicted to be at concentrations not injurious to wildlife. On-site monitoring of water bodies within facility boundaries would likely be a part of a monitoring program. Monitoring details would be finalized in the permitting process. FEIS Section 5.2.5.2.3 discusses potential impacts to wildlife from incidental contact with the tailings basin pond and pit lakes. FEIS Section 7.3.4 discusses potential human health impacts. FEIS Section 5.2.2.3.6 discusses on-site monitoring. FEIS Section 5.2.2.3.4 discusses bioaccumulation of methylmercury.

Theme AQ 11

Theme Statement

Several waterbodies within the Project area are impaired (as defined by the Clean Water Act) for Fishes Bioassessments, Mercury in Fish Tissue, and Aquatic Macroinvertebrates Bioassessments. Any additional releases of constituents, including metals such as mercury and copper, to the environment will exacerbate these already existing impairments.

Thematic Response

FEIS Section 4.2.2.1.2 and Table 4.2.2-2 identify the existing impairments of waters downstream of the NorthMet Project area. In particular, the Embarrass River is listed on the final 2012 "TMDL List" as impaired for Fishes Bioassessments, and the St. Louis River and several lakes in the Embarrass Chain of Lakes are listed as impaired for Mercury in Fish Tissue.

With respect to the Fishes Bioassessment impairment in the Embarrass River, the specific stressor (or pollutant) causing the impairment has not yet been identified – stressor identification studies are currently in progress by the MPCA to identify the cause of the impairment. Without that identification, it is speculative to attempt to describe potential impacts on the impairment as a result of the proposed project. However, that said, the discharge from the Plant Site Wastewater Treatment Plant (WWTP) to the tributaries of the Embarrass River would be required to meet all applicable Water Quality Based Effluent Limits.

For the Mercury in Fish Tissue impairments, atmospheric deposition of mercury has been identified as the dominant source of mercury for these waters – this is summarized in FEIS Section 5.2.7.2.5. MPCA has conducted a review of potential mercury emissions from the proposed project and has determined that they would not impede the state's reduction goals (MPCA 2013b, as cited in the FEIS). Furthermore, discharges to surface water from the Plant Site WWTP and from the Mine Site Wastewater Treatment Facility (WWTF) are both expected to meet the 1.3 ng/L water quality standard for mercury at the point of discharge. Overall, the NorthMet Project Proposed Action is predicted to result in no increase in mercury loading and a net decrease in sulfate loading to downstream impaired waters (mercury and sulfate being contributory to methylation of mercury and accumulation of mercury in fish tissue) as compared to the Continuation of Existing Conditions Scenario. Potential impacts to water resources and aquatic species from the NorthMet Project Proposed Action are discussed in detail in FEIS Section 5.2.2 and FEIS Section 5.2.6, respectively. Water monitoring would ensure that water quality standards would be met with engineering controls. In addition, spill prevention plans would be implemented. These measures would minimize any potential impacts to aquatic species and ensure already existing impairments are not exacerbated.

Theme AQ 12

Theme Statement

The SDEIS completely ignores the potential for effects on aquatic fauna due to the reduction of sulfate to sulfide within the wetland environment. Considering that several streams within the Plant Site are on the impaired waters list for Fishes Bioassessments, PolyMet and the Co-lead Agencies need to investigate the role of sulfate in the degradation of aquatic wildlife before permitting any additional releases.

Thematic Response

Sulfur is one six macronutrients essential for plant growth, and low levels of available sulfur have the potential to limit plant primary production (Marschner 1995, Leustek and Saito 1999). Sulfate is commonly found in the sufficiently saturated soils of wetland environments, and reduced sulfur compounds (i.e., sulfides) are known to be potent inhibitors of plant growth, as well as particular microbial processes (Wiessner et al. 2005). The reduction of sulfate forms insoluble sulfide precipitates, most commonly with metals such as cadmium, copper, iron, lead, and zinc; however, if the wetland becomes inundated as a result of flooding or other changes in hydrology, and anaerobic conditions return, the reaction would reverse and sulfates (along with their reactive metal counterparts) would once again become available (Schrauf and Smith 2005). The apex of the reduction of sulfate typically appears after aerobic conditions have been eliminated (i.e., flooding, sufficient saturation, etc.) and microbial respiration is entirely dependent on biochemical processes rather than on oxygen alone. Following the depletion of oxygen, microbial respiration favors nitrate (NO_3), manganese (Mn), iron (Fe), and finally sulfate (SO_4) (Inglett et al. 2005). As such, sulfate is the last compound to reduce in a wetland environment and results in the production of hydrogen sulfide (H_2S), carbon dioxide (CO_2), and water (H_20). Hydrogen sulfide can be highly toxic to aerobic organisms due to its ability to react with available metals, often resulting in the precipitation of metal sulfides.

However, toxic levels of sulfide can only accumulate in anaerobic conditions. If oxidation of the wetland soil occurs, the concentrations of sulfide would decrease, as would toxic accumulations. Oxidation typically occurs through atmospheric introduction, and can occur any time there is sufficient exposure to air through numerous pathways. The difficulty in proving sulfide toxicity centers on other changes in the biochemical characteristics of the ecosystem, which typically occur concurrently with the accumulation of sulfide, such as changes in salinity, substrate organic matter or composition, and the availability of oxygen and other macronutrients. Studies have also shown the even increased rates of sulfide accumulation via sulfate reduction can have only moderate or even limited phytotoxic effects as a result of metal sequestration, mainly by iron which produces iron sulfide (FeS) and iron pyrite (FeS2), which essentially detoxifies sulfide (Smolders et al. 1995, Lamers et al. 2002, Van der Welle et al. 2006 and 2007, Marba et al. 2007). Numerous prokaryote (i.e., single-celled organisms) and eukaryote (i.e., multi-celled organisms) animals have both been shown to be able to oxidize sulfide via mitochondria processes (Gray et al. 1999, Emelyanov 2003, Olsen 2012, Bagarinao 1992, Ghosh and Dam 2009).

As such, it is difficult to determine what effect sulfide may have on any one particular ecosystem, because the end result of increased sulfur inputs is highly dependent on a multitude of variables. It is impractical to attempt to identify what effect any increase in sulfur contribution to the on-Site wetlands may be. The degree to which the NorthMet Project Proposed Action might result in an increase in a negative impact on wetlands, watercourses, or aquatic fauna resultant from an increase in sulfide production cannot be determined.

Theme AQ 13

Theme Statement

Project-related sulfate reduction would impact all types of aquatic flora in addition to wild rice.

Thematic Response

The reduction of sulfate results in the production of sulfide, including insoluble metal sulfides; however, in some instances, increased rates of sulfate inputs into a wetland system may result in the formation of free sulfide, which can function as a potent phytotoxin (Wiessner et al. 2005). The accumulation of toxic levels of sulfides is dependent on the maintenance of an anaerobic environment without oxidation of the substrate. The toxicity of sulfides varies greatly from one species to another, and is highly dependent on a species' ability to metabolize the compound (Lemars et al. 2013). Research has shown that early successional plants typically have a lower tolerance of increased sulfide, as compared to that of late successional plants, such as shrubs and trees (Lemars et al. 2013). The response to theme AQ 12 provides more detailed information regarding the toxicity of sulfides and its potential effects on aquatic environments.

Increased levels of sulfate in an aquatic ecosystem may or may not result in impacts to aquatic flora. Potential impacts resultant from increased sulfur inputs into an aquatic system are dependent on a multitude of variables including: the microbial condition of the system, the buffering capacity of the habitat, the amount of existing substrate and organic material, temperature, amount of additional sulfate introduced, the species of flora present within the ecosystem, the seral stage of the habitat, the availability of reactive metals, and other considerations. The degree to which sulfate reduction may or may not impact all types of aquatic flora cannot be determined.

Theme AQ 14

Theme Statement

The SDEIS fails to analyze specific conductivity and total dissolved solids, elements that are both governed by Minnesota water quality standards and are known to be stressors for aquatic life. Even though existing Tailings Basin seeps have exceeded standards for specific conductivity, the SDEIS neither reports existing conditions nor models effects of the Proposed Action on specific conductivity. To evaluate effects of the Proposed Action on aquatic life, the FEIS should analyze both specific conductance in the affected environment and predicted levels of this pollutant resulting from the Proposed Action.

Thematic Response

The SDEIS discussed Total Dissolved Solids (TDS) in Section 4.2.2 and Section 5.2.2. Minnesota does not have specific toxicity standards for TDS or specific conductivity and the water quality evaluation criteria used for TDS at the Tailings Basin are irrigation standards and not applicable to aquatic life. However, under the NorthMet Project Proposed Action, TDS concentrations were predicted to be below the current applicable 4A standards.

Baseline data for TDS and specific conductivity have been added to FEIS Section 4.2.2 and 4.2.6, respectively. Although neither of these parameters is included in the water model, the potential concentrations of TDS under the NorthMet Project Proposed Action and the Continuation of Existing Conditions (CEC) Scenario are calculated in Section 5.2.2.

Studies on the relationship between specific conductivity and aquatic life are ongoing; therefore, the degree to which the NorthMet Project Proposed Action could potentially affect aquatic species due to changes in specific conductivity cannot be determined. Water monitoring, including for TDS and specific conductivity, would ensure that water quality standards would be met with engineering controls and adaptive management. Specific monitoring details would be addressed in permitting. In addition, spill prevention plans would be implemented.

Theme AQ 15

Theme Statement

The FEIS should examine how aquatic and wetland species and communities in the Project area and downstream of the Project may be impacted by changes in water temperature, especially in relation to other parameters, due to the Project. The FEIS should determine whether warmed augmentation water from Colby Lake will kill off colder-water fish.

Thematic Response

The NorthMet Project Description has changed since the SDEIS. The FEIS Project Description indicates that no Colby Lake water would be used for direct surface water augmentation. All water used for stream augmentation would be treated prior to being added to hydrologically affected waters. Wyman Creek is the only designated trout stream in the NorthMet Project area; since no water is expected to be discharged there, temperature impacts to aquatic species are not anticipated. All other streams in the NorthMet Project area are classified as warm water streams; however, some Project area streams could exhibit cooler temperatures due to shading from riparian vegetation cover and the regional setting. Water temperatures for any treated water discharged to these streams would be regulated via the National Pollutant Discharge Elimination System (NPDES) process.

Theme AQ 16

Theme Statement

The FEIS should take into account not just the anticipated effects on aquatic species under the current climate, but the likely effects on aquatic species in the future under probable future climate scenarios.

Thematic Response

Effects of climate change on aquatic species was not identified as a concern during scoping and is beyond the scope of the FEIS analysis, because the effects to aquatic species under future climate scenarios is speculative. A preliminary qualitative assessment of water resources impacts due to climate change is provided in Attachment W of the NorthMet Project Air Data Package, Version 5. January 15, 2015 (PolyMet 2015e, as cited in the FEIS).

Theme AQ 17

Theme Statement

Increased calcium loads from mining discharges would enhance the zebra mussel's ability to colonize the watershed. The FEIS should analyze the consequences of increasing the amount of calcium in waters that could be invaded by zebra mussels.

Thematic Response

The water modeling results, which are discussed in FEIS Section 5.2.2, predict that calcium concentrations in surface water at the Plant Site would be lower under the NorthMet Project Proposed Action (max P90 concentrations in the tributaries range from 26.0 to 36.6 mg/L and in Embarrass River range from 23.4 to 41.5 mg/L) than under the CEC Scenario (tributaries range from 41.4 to 112 mg/L and Embarrass River range from 23.4 to 49.3 mg/L) due to project capture of Tailings Basin seepage. Calcium concentrations in surface water at the Mine Site are predicted to be similar under the NorthMet Project Proposed Action (range from 36.7 to 38.0 mg/L) and the CEC Scenario (range from 36.7 to 38.0 mg/L). Therefore, calcium concentrations in discharges from the NorthMet Project Proposed Action would not enhance the zebra mussel's ability to colonize either watershed as compared to the CEC Scenario.

Theme AQ 18

Theme Statement

The FEIS should address how listed and sensitive aquatic indicator species--including the mussel (Ligumia recta), Zigzag Darner dragonfly (Aeshna sitchensis), and the Lake Emerald dragonfly (Somatochlora cingulata)--will be impacted by the NorthMet Project. Two poorly chosen sampling sites missed an important indicator species—the mussel. Mussels are sensitive to sulfate, copper sulfate, and calcium arsenate levels and could be threatened by the Project or the alternative.

Thematic Response

There should be no direct effects to creek heelsplitter and black sandshell mussels from the NorthMet Project Proposed Action, because they have not been reported within the NorthMet Project area. Mussels were sampled in the NorthMet Project area at the Partridge River, Embarrass River, and Trimble Creek in 2004, and at two locations of the Partridge River in 2009 (Heath 2011, as cited in the FEIS; see FEIS Section 4.2.6.1.3 and FEIS Figure 4.2.6-3). Because the NorthMet Project Proposed Action would not result in any significant changes in habitat quality, flow regimes, or water quality (i.e., no project-caused exceedances of Class 2B water quality standards) in the NorthMet Project area, no effects to the habitat for these species are expected within the Partridge River or Embarrass River watersheds. FEIS Section 5.2.2 and FEIS Section 5.2.6 provide additional information on anticipated changes to flow regimes.

Theme AQ 19

Theme Statement

Amphibians are experiencing high rates of species extinction and seem to be very sensitive to environmental pollution. The FEIS should address how amphibians will be impacted by the NorthMet Project.

Thematic Response

The FEIS Section 5.2.5 (Wildlife) includes an analysis of hydrologic changes and impacts to amphibians or other sensitive species by cross-referencing Section 5.2.2 (Water Resources). The Wetland Data Package (PolyMet 2015b, as cited in the FEIS) XP-SWMM model estimates that changes in the average annual flow of the Partridge River and Embarrass River would be within naturally occurring annual variation; thus, there would be limited hydrologic changes. As a result, effects to amphibians and other sensitive wildlife species due to hydrologic changes would be limited. The NorthMet Project Reclamation Plan (PolyMet 2015g, as cited in the FEIS) explains that when roads or railroads are abandoned, culverts would be removed to prevent damming and access impediments for aquatic life. These locations would also be graded and vegetated to provide a stable stream bank. The Reclamation Plan states that during reclamation monitoring and maintenance, areas that have been damaged by erosion, animal activity (e.g., beaver dams), or that have lost vegetation would be identified and repaired.

Theme AQ 20

Theme Statement

The Embarrass River and Partridge River watersheds have some of the highest condition and watershed integrity scores in the St. Louis Watershed. Biological monitoring of the NorthMet Project site indicates the waters are capable of supporting many important fish and macrobiotic species. Specialists should be used to move/relocate aquatic species, including micro and macroinvertebrates in base sediments that would be harmed by Project activities. Failure to do so will result in loss of wildlife and destruction of food chains.

Thematic Response

Both the Embarrass River and Partridge River watersheds are listed for "Mercury in fish tissue" and "Fishes Bioassessments" impairments. Portions of the Embarrass River are also listed for "Macroinvertebrate Bioassessments" impairment. These impairments are discussed in FEIS Section 4.2.2.1.2.

Water monitoring (see FEIS Section 5.2.2.3.6) would ensure that water quality standards would be met with engineering controls. In addition, spill prevention plans would be implemented. These measures would minimize potential impacts to aquatic species. The need for biological monitoring would be determined in permitting.

Aquatic species would not be moved or relocated, because there is high mortality associated with relocation of wildlife. Relocation is often not successful, because it is stressful to the organisms, which makes them more vulnerable to disease and predation. Relocation also forces the relocated organisms to compete with established species for food and shelter, and increases the risk of the spread of diseases to new areas.

Theme AQ 21

Theme Statement

Because waterbodies in northern Minnesota are oligotrophic and often have long water residency times, the influences of mining contaminants can be long lasting. Decomposition and growth is slow in these systems, which can equate to more accumulation of toxins in sediments and increased bioaccumulation of toxins in the tissues of animals such as fish.

Thematic Response

Potential impacts to water quality from the NorthMet Project Proposed Action are discussed in FEIS Section 5.2.2. Most Minnesota Class 2 water quality standards (upon which project evaluation criteria were based) apply to all waters of the state in the NorthMet Project area, regardless of the trophic status of the water. Lakes downstream of the NorthMet Project area (Colby and Whitewater Lakes in the Partridge River Watershed and Wynne, Sabin, and the Embarrass chain of lakes in the Embarrass River Watershed) are riverine lakes, and do not have particularly long residence times. Water monitoring would ensure that water quality standards would be met with engineering controls. In addition, spill prevention plans would be implemented. These measures would minimize potential impacts to aquatic species. Moreover, water flow alterations would not cause measurable changes in ecosystem function if maintained under twenty percent of baseline flows.

Theme AQ 22

Theme Statement

The FEIS should address the probability, impact potential, and aquatic toxicity potential of an accidental release of chemicals and untreated water at the Mine Site and Plant Site.

Thematic Response

Stability modeling and the rationale for the design are discussed in FEIS Section 5.2.14. Final design is subject to permitting under the requirements of the MDNR Dam Safety Permit and Permit to Mine. The potential effects of hypothetical failure scenarios have not been assessed in this FEIS, as the risk of failure is mitigated through application of design and safety requirements including adaptive management procedures.

Potential impacts to aquatic species from the NorthMet Project Proposed Action are discussed in detail in FEIS Section 5.2.6. Testing for aquatic toxicity of the seepage or leachate from the various mine wastes (i.e., waste rock, tailings or Hydrometallurgical Residue Facility residues) prior to their treatment at the WWTF and/or WWTP is not expected, since these are internal waste streams that are not discharged untreated to the environment. Toxicity testing (Whole Effluent Testing or WET testing) of the treated discharges from the WWTP and WWTF to the environment, is anticipated to be included as a requirement of the water quality permit. Specific monitoring details would be addressed in permitting. In addition, spill prevention plans would be implemented. See also the responses to themes AQ 05 and AQ 06.

Theme AQ 23

Theme Statement

The SDEIS did not evaluate impacts to aquatic ecosystems from the volume as well as chemical composition of Wastewater Treatment Facility (WWTF) effluent that would be discharged to the Partridge River.

Thematic Response

By comparing modeled project water quality against evaluation criteria based, in part, on Class 2B water quality standards (protection of aquatic life and recreation), the SDEIS did indirectly evaluate impacts to aquatic ecosystems. Evaluation criteria can be found in Section 5.2.2. Water quality monitoring to be conducted pursuant to NPDES/State Disposal System (SDS) permitting would ensure that water quality standards would be met with engineering controls. In addition, spill prevention plans would be implemented. These measures would minimize potential impacts to aquatic species. Water flow alterations would not cause measurable changes in ecosystem function if maintained under twenty percent of baseline flows.

Varying degrees of hydrologic alteration can be tied to ecological condition using the Limits of Hydrologic Alteration (LOHA) Method, which is intended to provide a better articulation of the aspects of flow rate and timing thought to be most important to ecological condition, and provide more elaboration on the ecological changes that are associated with increasing degrees of hydrologic alteration. Research in review lists 10%, 20%, and greater than 20% flow alteration as setting the ecological condition of 'natural', 'minimally altered', and 'moderately altered', respectively. A review of case studies (Richter et al. 2011, as cited in the FEIS) found that recommendations for flow protection are quite consistent, typically resulting in a range of allowable cumulative depletion of 6% to 20% of normal to low flows, but with occasional allowance for greater depletion in seasons or flow levels during which aquatic species are thought to be less sensitive.

Based on the professional application of accumulated science, the MDNR has determined that monitoring should be conducted at a minimum of 3 sites for each impacted stream whenever there is a 20% change in watershed area or an extraction or addition of flow that exceeds 20% of the mean annual flow (MAF). Monitoring sites should be located:

1) within 2000 feet of the (each) outflow;

2) at the endpoint of impact; and,

3) midway between the two.

The only surface water discharge from the Mine Site to the Partridge River is the discharge of treated Category 1 Stockpile drainage and West Pit water via the WWTF in long-term closure. This discharge is included in the GoldSim model at location SW004a. The XP-SWMM model estimates an average annual flow of 1.2 cfs at the approximate location of the WWTF discharge under existing conditions. The estimated average annual flow at this location in long-term closure is increased to 1.4 cfs (due to changes in upstream watershed areas and the addition of the WWTF discharge). However, as a whole, the NorthMet Project Proposed Action would reduce flow within the Partridge River by a maximum of eight percent, respectively. Therefore, flow changes due to the NorthMet Project Proposed Action are anticipated to be within the natural ecological condition and have minimal impacts to ecosystem function.

Theme AQ 24

Theme Statement

Aquatic organisms that live in the streams, rivers, and wetlands in the Project area would likely be adversely affected by changes in streamflow and loss of connectivity of the streams. The conclusion in the SDEIS that allowing up to a 20 percent change in streamflow volumes is protective of aquatic life is unsubstantiated. For example, the SDEIS lacks details on potential effects on aquatic ecosystems from hydrologic changes resulting from the NorthMet Project in the Partridge River Watershed, including Yelp, Wetlegs, Wyman, Longnose, and Unnamed creeks as well as the Partridge River.

Thematic Response

Flow within both the Embarrass River and Partridge River would be reduced by a maximum of two percent and eight percent, respectively. Varying degrees of hydrologic alteration can be tied to ecological conditions using the LOHA Method, which is intended to provide a better articulation of the aspects of flow rate and timing thought to be most important to ecological condition, and provide more elaboration on the ecological changes that are associated with increasing degrees of hydrologic alteration. Research in review lists 10%, 20%, and greater than 20% flow alteration as setting the ecological condition of 'natural', 'minimally altered', and 'moderately altered', respectively. A review of case studies (Richter et al. 2011, as cited in the FEIS) found that recommendations for flow protection are quite consistent, typically resulting in a range of allowable cumulative depletion of 6% to 20% of normal to low flows, but with occasional allowance for greater depletion in seasons or flow levels during which aquatic species are thought to be less sensitive.

Based on the professional application of accumulated science, the MDNR has determined that monitoring should be conducted at a minimum of 3 sites for each impacted stream whenever there is a 20% change in watershed area or an extraction or addition of flow that exceeds 20% of the mean annual flow (MAF). Monitoring sites should be located:

1) within 2000 feet of the (each) outflow;

2) at the endpoint of impact; and,

3) midway between the two.

Flow reductions due to the NorthMet Project Proposed Action are anticipated to be within the natural ecological condition and have minimal impacts to ecosystem function. Moreover, geomorphic surveys of the Partridge River and the unnamed creek south of Dunka Road indicate that the upper reaches of these systems are near 100 percent vegetated, and that the influence of riparian vegetation is very high. Moderate changes to flow within these systems are expected to be protected by the riparian vegetation, and these reaches are expected to be stable under moderate changes to stream flow and sediment supply (Barr 2013a, as cited in the FEIS). This characteristic is evident within these reaches as hydrologic changes are often caused by the influence of beaver dams.

Theme AQ 25

Theme Statement

The FEIS should include quantitative modeling in addition to the existing qualitative discussion for effects on fish. Specific analysis should include: mercury, methylmercury, specific conductance, and discharge and hydrologic changes.

Thematic Response

Hydrologic changes to the Partridge River were modeled and are discussed in FEIS Section 5.2.2. In addition, PolyMet performed geomorphology studies on the channel downstream of the proposed West Pit/WWTF discharge (Rosgen Classification: Unnamed Creek South of Dunka

Road, Barr 2013o, as cited in the FEIS). The analysis determined that the planned pumping rate was less than the estimated bankfull flow. Note that due to project description changes since the SDEIS, the currently-planned WWTF discharge is well below the previously planned pumping rate (i.e., is well below bankfull flow). See also the response to theme AQ 24.

Studies on the relationship between specific conductivity and aquatic life are ongoing. Therefore, the degree to which the NorthMet Project Proposed Action could potentially affect aquatic species due to changes in specific conductivity cannot be determined. Water monitoring, including for specific conductivity, would ensure that water quality standards would be met with engineering controls and adaptive management. Specific monitoring details would be addressed in permitting. In addition, spill prevention plans would be implemented. See also the response to theme AQ 14.

The FEIS assesses project-related mercury contributions using a mass-balance methodology. This approach was identified as the appropriate analytic tool for predicting mercury concentrations during scoping of this EIS and it is a common, reliable, analytical tool used by agencies to assess mercury impacts in EISs. This estimation method is preferred over a detailed mechanistic model, because it incorporates the important input and removal processes for mercury, it is very transparent with regard to data inputs, it typically provides conservative estimates of aqueous mercury concentrations, and it allows for easy assessment of the effect of changing parameter values on mercury concentrations. The Reverse Osmosis (RO) treatment is expected to discharge mercury at or below the mercury standard of 1.3 ng/L, which includes all surface water that would be discharged at the Plant Site, including water used for flow augmentation. Mercury loadings from the Mine Site are projected to decrease due to the NorthMet Project Proposed Action, and the combined contributions from the Embarrass River and Partridge River are unchanged when modeled for the St. Louis River at the Fond du Lac reservation boundary. Therefore, the potential effects are expected to be less than significant, and the mass balance approach is appropriate to provide a reasonable estimate of potential contributions for purposes of environmental review given these circumstances.

In regards to mercury concentrations in fish, the scientific community's understanding of the relationship between total mercury, sulfate, methyl mercury, etc., is evolving, and the science is complex. That said, change in mercury concentration in fish is thought to be ultimately proportional to the percent increase in mercury load (MPCA 2006a). Therefore, sophisticated modeling of methylation and bioaccumulation is not likely to lead to more accurate results, but by failing to capture unknown or uncertain relationships and variables, could instead lead to erroneous conclusions.

Theme AQ 26

Theme Statement

The Cumulative Effects Assessment Area (CEAA) defined by the Co-lead Agencies for effects on aquatic species is overly limited. The appropriate spatial scale for considering cumulative effects on aquatic species is the entire St. Louis River Watershed and Lake Superior Basin. Some of the waters in the Project area and downstream of it are already impaired for aquatic life and aquatic consumption.

Thematic Response

The NorthMet Project Proposed Action is not considered to have the potential for cumulative effects on hydrology and water quality in the St. Louis River Watershed. As a result, the Cumulative Effects Assessment Area (CEAA) for aquatic species is defined by the Partridge River and Embarrass River watersheds.

Theme AQ 27

Theme Statement

The aquatic species cumulative effects section of the FEIS should provide a discussion of the significance of the predicted adverse cumulative effects on aquatic resources, as well as the relationship between these effects and legal standards preventing degradation of water quality. This includes solutes not predicted to exceed numeric water quality standards.

Thematic Response

Water quality standards and evaluation criteria are discussed in FEIS Section 5.2.2. As discussed in FEIS Section 6.2.2, the impact assessment water quality modeling for the NorthMet Project Proposed Action already takes into consideration low flow conditions. Even during low flows, the NorthMet Project Proposed Action is not predicted to result in any direct exceedances of water quality evaluation criteria, although achieving this prediction would require long-term water treatment and WWTF/WWTP maintenance. Other reasonably foreseeable actions may also increase metal and other solute loadings downstream, but it is assumed that these other actions would also be required to meet federal and state water quality requirements, including nondegradation. Therefore, the potential for exceedances of water quality evaluation criteria as a result of cumulative effects from the NorthMet Project Proposed Action and other reasonably foreseeable actions is considered unlikely.

Although not expected to result in any direct exceedances of water quality evaluation criteria, the NorthMet Project Proposed Action, in combination with other reasonably foreseeable actions, would increase metal and other solute loadings to the Partridge River and Embarrass River, and further downstream in the St. Louis River Watershed. These loadings would, however, be diluted as the solutes are transported downstream (i.e., average annual flow in the St. Louis River at the confluence with the Embarrass River is approximately four times more than in the Partridge and Embarrass rivers alone). Further, the MPCA would review the NorthMet Project Proposed Action for consistency with the State’s non-degradation requirements prior to any permitting, as it would also do at the time of permitting for any other reasonably foreseeable actions. FEIS Section 6.2.6 states that potential cumulative impacts to aquatic species are anticipated to be minimal. FEIS Section 5.2.6 now provides additional information on potential impacts to aquatic species from metals.

FEIS Section 6.2.6 discusses the predicted adverse cumulative effects on aquatic resources. The methodology and evaluation criteria that was utilized for determining direct and indirect effects to aquatic species is discussed in FEIS Section 5.2.6.1, and the effects that could occur from the proposed Project are discussed in detail in FEIS Section 5.2.6.2. The direct, indirect, and cumulative assessments that were performed for the NorthMet Project Proposed Action were agreed upon during the Scoping Process.

Theme AQ 28

Theme Statement

The SDEIS does not adequately address how the Project, combined with other mines, would affect levels of mercury in fish. Any additional mercury releases to the environment will exacerbate already existing impairments, including fish advisories set for recreational fishing. Increased fish mercury levels will have direct effects on both the cultural and recreational resources of the region. Mercury is also known to bioaccumulate in fish at a faster rate in warmer water. Sulfate discharges and water level fluctuations from the Proposed Project will also contribute to increased mercury levels in fish.

Thematic Response

Based on the evaluations conducted for air emissions and water discharges for the FEIS, the NorthMet Project Proposed Action is not considered to have an appreciable effect on: 1) surface water mercury concentrations, 2) fish mercury concentrations, 3) methylation of mercury, or 4) risk to people consuming fish from lakes near the NorthMet Project Proposed Action site.

MPCA's Cumulative Mercury Risk Estimation Method (MMREM) analysis for the two scenarios showed a 0.5-1.8 percent and 0.3-0.5 percent potential increase (respectively) in fish mercury concentration above background. However, the change is not expected to be significant as compared to background concentrations. The increase would not be expected to have any appreciable effect on the loading estimates from permitted discharges to the Embarrass River, Partridge River, or the lower St. Louis River Watershed. Discharges are expected to meet the 1.3 ng/L standard for mercury, with an overall net decrease in mercury loading predicted for the NorthMet Project Proposed Action Alternative.

The goal of the MPCA is to protect high-quality waters and improve the quality of impaired waters so water quality standards are met and beneficial uses are maintained and restored, where these uses are attainable. As summarized in FEIS Section 5.2.7.2.5, widespread contamination of fish from atmospheric pollution is why Minnesota established a statewide mercury TMDL. The TMDL seeks to reduce atmospheric deposition everywhere in the state in order to make the state's lakes and streams fishable, as required by federal regulations, and is intended to provide the long-term framework to reduce mercury in fish. The MPCA published Guidelines for New and Modified Mercury Air Emission Sources, and revised those guidelines in 2012 (MPCA 2012g, as cited in the FEIS). The guidelines were developed to limit the mercury emissions from new and expanding sources in order to meet the TMDL goal of total statewide mercury emissions. MPCA has conducted a review of the NorthMet Project Proposed Action mercury emissions and has determined that it would not impede the reduction goals (MPCA 2013b, as cited in the FEIS).

Further, the NorthMet Project Proposed Action is not anticipated to be a significant discharger of mercury to the environment. The RO treatment is expected to discharge mercury at or below the mercury standard of 1.3 ng/L, which includes all surface water that would be discharged at the Plant Site, including water used for flow augmentation. Mercury loadings from the Mine Site are projected to decrease due to the NorthMet Project Proposed Action, and the combined contributions from the Embarrass River and Partridge River are unchanged when modeled for the St. Louis River Watershed at the Fond du Lac reservation boundary. Therefore, further degradation of surface water quality, and by extension increased mercury in fish, is not expected.

The NorthMet Project Proposed Action is not anticipated to have any noticeable effect on water temperature, since only water from the Plant Site's WWTP would be used for stream augmentation. When discharged, the temperature of this water is expected to quickly equilibrate to ambient water temperatures such that temperature effects would not be expected in downstream rivers and lakes.

In general, in aquatic systems there is generally a positive correlation between warmer water temperatures and accumulation of heavy metals. However, studies on the relationship between temperature and bioaccumulation of mercury in aquatic life are ongoing. Therefore, the degree to which the NorthMet Project Proposed Action could potentially affect aquatic species due to changes in temperature cannot be determined. Water monitoring would ensure that water quality standards would be met with engineering controls and adaptive management. Specific monitoring details would be addressed in permitting. In addition, spill prevention plans would be implemented.

It is difficult to quantify the extent to which mercury concentrations in the Tailings Basin surficial seepage might affect mercury methylation north of the Tailings Basin and further downstream. The FEIS notes that sulfate can contribute to mercury methylation; however, the FEIS also notes that the NorthMet Project Proposed Action would reduce sulfate concentrations within the Embarrass River Watershed and that may result in downstream reductions in mercury methylation.

Effects on flows (and, by extension, water surface elevations) generated by the NorthMet Project Proposed Action are anticipated to be within the natural variation of flow within the St. Louis River Watershed (e.g., less than 1 percent reduction in average annual flow as measured at the confluence of the Embarrass River with the St. Louis River). Therefore, no potential indirect or cumulative wetland effects are identified for the wetlands within the St. Louis River Watershed below the ordinary high water mark, from its confluence with the Embarrass River to Lake Superior and it is not expected that the NorthMet Project Proposed Action would contribute to water level fluctuations than can promote mercury methylation. Additional information in regards to water level and flows to surrounding watersheds is included in FEIS Section 5.2.2.

Theme AQ 29

Theme Statement

The SDEIS underestimates the effects on aquatic species in the area affected by the Land Exchange, due to the decrease of first-order streams in the federal estate.

Thematic Response

Effects of the Land Exchange Proposed Action on headwater streams are discussed in detail in FEIS Sections 5.3.6.2.2 and 5.3.6.3.2. A paragraph in FEIS Section 5.3.6.2.2 has been revised to include: "...however, the net reduction to the Superior National Forest of 0.3 miles of first order streams may result in slightly less habitat available for headwater stream dependent species."

Theme AQ 30

Theme Statement

The FEIS should provide details on monitoring that would be conducted on site and elsewhere to ensure that nearby aquatic life is not affected.

Thematic Response

PolyMet, as the assigned permittee for the NorthMet Project Proposed Action, would be responsible of carrying out the proposed monitoring activities described in any legally enforceable permits. The permits, supported by state and federal laws, would include provisions that address failure to comply with the terms and conditions of the permit, including those related to conducting required monitoring.

Details on any aquatic monitoring would be finalized during permitting; however, overviews of water monitoring plans at the Mine Site and Plant Site are presented in FEIS Section 5.2.2.3.6. Monitoring would be used on a continual basis to document compliance with permit conditions, annually validate and update water models, and provide input to optimize operations of adaptive engineering controls. The FEIS provides information on objectives, monitoring summary and general location for monitoring of process water streams, stormwater, surface discharges, groundwater, wetlands, and surface water in the Partridge River and Embarrass River watersheds (as applicable). For groundwater monitoring, the general number of sampling locations and frequency are identified. For surface water, general sampling locations and timeline are identified. As mentioned in the FEIS, the water monitoring plans would be finalized in detail (including specific locations, frequencies, and parameters) during the NPDES/SDS water permitting, and water appropriations processes and updated as required during the Project's life.

A.5.4 Issue: US Army Corps of Engineers 404 Permit (COE)

Theme COE 01

Theme Statement

Compensatory mitigation for wetland effects should be located within the Lake Superior Basin, and should take into account wetland losses/replacements from a quality standpoint as well as the wetlands functions. Wetland mitigation efforts should focus on wetlands that have been completely or significantly drained, or significantly modified by agricultural practices. The replacement ratio for the mitigation of the loss of high quality wetlands and difficult to replace forested and bog wetland plant communities should be higher, such as 2:1. In addition, the Federal Mitigation Rule and the Guidelines require that compensatory mitigation be based on a watershed approach to the extent appropriate and practicable. Furthermore, the mitigation plan in the Section 404 Wetlands Permit should exclude mitigation credits for post-mining, on-site wetland mitigation. If the USACE determines that a greater percentage of the compensation for direct impacts should be accomplished within the St. Louis River Watershed/Great Lakes Basin, the public should be notified.

When mitigating outside of the watershed, consider other methods to replace wetland functions (i.e. water retention ponds, shore land buffers, and other "green" technology to collect and store runoff in these watersheds).

Thematic Response

Please refer to the response to theme WET 03 for a discussion of wetland mitigation, mitigation study limits and replacement of wetland functions. Please refer to response to theme WET 04 for a discussion on the mitigation plan and measure for direct compensatory mitigation. FEIS Section 5.2.3.3.2 includes a discussion on the wetland mitigation study limits, site selection process, and mitigation proposed for the NorthMet Project Proposed Action.

The post-closure establishment of the estimated 101.8 acres of on-site wetland is not included in the wetland mitigation credits. The generation of wetland credits in these areas has the potential to be used on a contingency basis, but compensatory credit would not be considered up front due to the post-closure timeframe. The summary of proposed wetland mitigation credits, presented in FEIS Table 5.2.3-17, does not include the on-site wetland restoration. The FEIS Executive Summary and Section 5.2.3.3.3 have also been updated note that the on-site wetland would not be considered in the wetland mitigation credits.

Theme COE 02

Theme Statement

The Section 404 Wetlands Permit application should include the following information:

- a quantitative assessment of all indirect wetland impacts;
- a description of the impact thresholds and how the fragmentation impact criteria were developed;
- an estimate of the change in functions and values at wetlands;
- a more detailed description of, and rationale for, how the impacts analysis would be used to ensure that indirect impacts are avoided, minimized, and mitigated—including more comprehensive monitoring and reporting for indirect impacts at the plant and mine sites as well as to vegetation and headwater streams surrounding the site;
- inclusion of hydroperiod in the quantitative assessment;
- design of Phase II monitoring prior to permit issuance, as well as a description of the threshold for determining the need for Phase II; and
- discussion of how the reference sites would be used to predict impacts.

Identified indirect impacts should be mitigated upfront; the SDEIS did not provide for such upfront mitigation. The ROD for the USACE and permit conditions should include advance commitment to mitigation for all indirect impacts, including identification of mitigation sites, compensation ratios, and notification to the public. If no mitigation for the foreseeable “indirect” wetland losses can be identified, the USACE should not issue a Section 404 permit. A robust monitoring design should require monitoring in all potential impact categories, not just in Highly and Moderately impacted zones. The Section 404 Wetlands Permit and the FEIS should contain more information on how the monitoring would be performed to determine if indirect impacts are occurring, including who would perform the monitoring. The SDEIS failed to describe what would be included in the adaptive management plan. The FEIS should include the criteria and process for determining when and what additional mitigation is needed.

Thematic Response

FEIS Section 5.2.3.3 has been revised to include more information on the monitoring and mitigation plan for the potential indirect wetland effects. The indirect effects analyses performed for the EIS were not performed to characterize impacts but were done to inform where monitoring should take place for those areas that were identified as having a potential for indirect wetland effects. As a result of these analyses performed to determine where monitoring should occur, quantification of wetland types and acres of potential indirect wetland effects were also generated. FEIS Section 5.2.3 provides these quantitative values of potential indirect wetland effects. Potential Indirect wetland effects from the NorthMet Project Proposed Action were assessed as a result from one of the following six factors: 1) wetland fragmentation; 2) change in wetland hydrology from changes in watershed area; 3) changes in wetland hydrology from groundwater drawdown resulting from open pit mine dewatering; 4) changes in wetland hydrology from groundwater drawdown resulting from operation of the Plant Site, including groundwater mounding and seepage containment; 5) changes in stream flow near the Mine Site and Plant Site and associated effects on wetlands abutting the streams; and 6) change in wetland water quality related to atmospheric deposition of dust and rail car spillage associated with Mine Site and Plant Site operations. The assessments provided wetland type and acreage for all six factors; however, only wetland acreages were provided for factor 6 (change in wetland water quality related to atmospheric deposition of dust and rail car spillage associated with Mine Site and Plant Site operations). The identification of specific mitigation for indirect effects and a monitoring plan is not a requirement for an EIS; however, the FEIS has been updated with additional information on the approach for determining mitigation if the monitoring shows indirect effects are occurring. The monitoring and mitigation for potential indirect effects would be determined during permitting. Section 5.2.3.3 of the FEIS has been revised to include more information on the monitoring and mitigation plan for the indirect wetland effects, including how the reference sites would help determine potential indirect effects. The proposed wetland impact, avoidance, minimization, mitigation and monitoring plan presented in the FEIS would be reviewed, modified as required, and approved during permitting; therefore, this information could change during permitting. Please refer to response to theme FIN 11 for more information on financial assurance.

Both the USACE and MDNR require functions to be replaced; however, both agencies use a set of defined ratio requirements to determine the number of acres required to replace functions lost, as there is currently no suitable quantitative functional assessment method in Minnesota. Based on the findings and where impacts occur (e.g., types of wetlands), the mitigation ratios and credits have been increased to take into account the functions lost due to the NorthMet Project Proposed Action. Please refer to response to theme WET 05 for more information on functions.

Section 5.2.3.1.2 of the FEIS provides information on the methodology and criteria for the indirect effects assessments for fragmented wetlands.

When an agency is evaluating reasonably foreseeable significant adverse effects on the human environment in an EIS and there is incomplete or unavailable information because the overall costs of obtaining it are exorbitant or the means to obtain it are not known, NEPA directs the agency to make it clear that such information is lacking, discuss the relevance of the lacking information, and discuss any information relevant to evaluation of the future impacts. In these cases, NEPA also directs the agency to evaluate these impacts based upon theoretical approaches or research methods generally accepted in the scientific community provided that the analysis of the impacts is supported by credible scientific evidence, is not based on pure conjecture, and is within the rule of reason.

The Co-lead Agencies believe this is the case for evaluating indirect wetland effects. The Co-lead Agencies have thoroughly considered throughout the development of the EIS and through the Wetland Impact Assessment Planning Work Group, how to assess potential indirect wetland effects. As a result, strengths and weaknesses of the approach used as well as other suggested approaches have been carefully considered. The Co-lead Agencies ultimately decided the use of the analog method and the 20 percent metric described in Section 5.2.3 of the FEIS as factors considered in identifying potential indirect effects to wetlands is a credible and reasonable approach consistent with the requirements of NEPA.

Theme COE 03

Theme Statement

Residents of the state have clearly expressed their interest in water quality protection/enhancement. The mine runs counter to that public interest. The Section 404 Wetlands Permit should be denied because PolyMet's discharge would violate the Clean Water Act, violate water quality standards, affect our aquifers, groundwater, and water supplies (municipal and private wells), affect climate change due to the loss of peatlands, destroy animal and fish habitats, and threaten natural resources. In addition, the Permit should be denied due to an unaccepted amount of wetland loss.

Thematic Response

The USACE is the federal agency responsible for regulating the discharge of dredged or fill material into Waters of the United States, including wetlands under Section 404 of the Clean Water Act. PolyMet has applied for a Section 404 Individual Permit from the USACE for the proposed fill into the Waters of the United States. In addition, if a permit from the USACE is issued, it is not valid until the State has either certified under Section 401 of the CWA that the proposed discharges to aquatic resources comply with the State's water quality standards or waived the 401 certification requirements. When making a decision, the USACE takes into consideration numerous factors. Permit decisions are based on the probable expected effects associated with a proposed project including direct, indirect, and cumulative impacts. Public interest review factors include: conservation, economics, aesthetics, general environment, wetlands, cultural values, fish and wildlife, land use, flood hazards, property ownership, flood plain values, navigation, recreation, shore erosion and accretion, water supply and water quality, energy needs, safety, mineral needs, safety, food and fiber production, and the needs and welfare of the people. The decision to grant or deny a permit by the USACE is explained and described in a ROD. If the permit is issued, a copy of the permit is sent to the project sponsor for their signature, which signifies that they accept the permit requirements. If the USACE decides to deny the permit or the project sponsor does not agree with the conditions contained in the permit, the project sponsor may request an administrative appeal of the permit decision. A decision by the USACE on whether to grant or deny a Section 404 Individual Permit has not yet been made.

Theme COE 04

Theme Statement

The SDEIS fails to identify alternatives to minimize and/or mitigate effects to wetlands as well as a Least Environmentally Damaging Practicable Alternative ("LEDPA"), which is required before approving a Section 404 Wetlands Permit. In addition, no agency-preferred alternative was identified in the SDEIS. Therefore, after an agency preferred alternative and the LEDPA are identified, the USACE should re-notice the 404 permit and MPCA should re-notice the 401 certification.

Thematic Response

Alternatives have been developed and evaluated in three stages during the Environmental Review Process; the scoping stage (2005), the DEIS stage (2009), and the SDEIS stage (2011). Section 3.2.3 of the FEIS includes a discussion of the process and alternatives that were considered for the NorthMet Project Proposed Action. The modifications that have occurred during the development of the EIS have resulted in avoidance and minimization of impacts to wetland resources. To date, these modifications have reduced the acreage of wetlands impacted from 1,257 to 913.8 acres, a 27 percent decrease. In addition to the NorthMet Project Proposed Action, a "No Action Alternative" is also being considered. Section 5.2.3.3.1 of the FEIS includes six considerations that were proposed in order to avoid unnecessary impacts to wetland resources and seven considerations that were proposed that would minimize impacts to wetland resources as part of the NorthMet Project Proposed Action. Section 5.2.3.3 of the FEIS also describes, in depth, the mitigation strategies for the NorthMet Project Proposed Action including how sites were selected, mitigation ratios, and other factors. Please refer to responses to themes WET 03, WET 05, and WET 06 for more information on siting and mitigation.

The agency preferred alternative and LEDPA process are discussed in Sections 7.4 and 7.5 of the FEIS.

The USACE is not anticipating the need to re-issue the Section 404 public notice for the NorthMet Project Proposed Action. However, MPCA would need to re-issue the Section 401 public notice for the Project. Under the provisions of the Clean Water Act, the MPCA has one year from the public notice (December 3, 2014) to act upon an application for 401 Certification. However, the MEPA (Minn. Stat. 116.04, subd. 2b) and rules regarding environmental review (Minn. R. 4410.3100) prohibit final agency decisions, such as the Section 401 Certification, until all environmental review steps are completed. The environmental review process being undertaken by the Co-lead Agencies would not be completed within the one year time frame for issuance of the Section 401 Certification. Therefore, PolyMet has made a procedural decision to withdraw the Section 401 application before MPCA and resubmit it in the near future to allow for processing of the application.

Theme COE 05

Theme Statement

The Section 404 Wetlands Permit application should provide information on the accuracy of the wetland boundaries for the project areas, perform a reassessment of likely impacts to surrounding wetlands outside the project footprint, and should include an assessment of wetland functions in order to provide an assessment of lost wetland functions and a mitigation plan designed to replace those functions.

Thematic Response

As described in FEIS Section 4.2.3, wetland characterization, mapping, and surveys for the Mine Site, Transportation and Utility Corridor, Plant Site, Area 1, and Area 2 were conducted between 2004 and 2010 (Barr 2006d; Barr 2007c; Barr 2008k; Barr 2011d; PolyMet 2015b, as cited in the FEIS). Wetland acreages were determined using USGS topographic and USFWS National Wetlands Inventory (NWI) maps, aerial photographs, soil survey data, and field investigations. The Co-lead Agencies agreed to use the Eggers and Reed Classification system for the NorthMet Project Proposed Action, and have reviewed the accuracy of the wetland characterization, mapping, and surveys. Wetland boundaries were identified using the routine wetland delineation procedures of the Corps of Engineers Wetlands Delineation Manual (USACE 1987, as cited in the FEIS), and were reviewed by the appropriate agencies. An abbreviated MnRAM functional assessment, which was agreed upon by the USACE, was utilized to assess wetland functions for the Mine Site, Transportation and Utility Corridor, and Plant Site. Please refer to the responses to themes WET 03 and WET 05 for more information on how the NorthMet Project Proposed Action considered wetland functions. FEIS Section 5.2.3 includes a detailed discussion of the direct impacts and potential indirect effects as a result of the mining activities.

The USACE is currently reviewing the Section 404 permit application. The ROD for the USACE would include the Section 404(b)(1) analysis and the public interest review, and would determine the LEDPA. Furthermore, the ROD for the USACE cannot be finalized until 30 days after release of FEIS; comments to the FEIS must also be addressed in the ROD for the USACE. The ROD for the USACE would recommend issuance, issuance with conditions, or denial of the Section 404 permit for NorthMet Project Proposed Action. Please refer to FEIS Sections 7.4 and 7.5 for more information on the USACE permit process.

Theme COE 06

Theme Statement

The Section 404 Wetlands Permit should require the following monitoring conditions:

- continued monitoring by the applicant at existing wells where they are outside the direct mine impact locations, because changes in wetland hydrology, if they occur, should be evident at these locations;
- wetland and stream monitoring sites for the east side of the tailings basin;
- baseline vegetation monitoring prior to permitted impacts, and increased post-construction monitoring frequency to every 2 years.

In addition, an independent agency, such as BWSR, should be given the task of monitoring and determining the mitigation required for the project.

Thematic Response

Mitigation and monitoring requirements would be determined during permitting. The USACE, MDNR, and MPCA have a suite of approaches for measuring effects for projects, based on an established set of procedures resulting in a better understanding of project effects. Monitoring requirements for each project that is permitted by the agencies is site-specific and tailored to the project.

FEIS Section 5.2.3.3 (wetland mitigation and monitoring) has been revised to include additional details on the proposed monitoring and wetland adaptive plan. Wetland mitigation and monitoring would be reviewed by the appropriate regulatory agencies responsible for authorizing the permit application during the permitting process. Monitoring is proposed within all wetlands containing a potential indirect wetland impact factor rating of 3 to 5, as well as a sampling of wetlands with factor ratings of 1 or 2, as described in FEIS Section 5.2.3.3 (see FEIS Figures 5.3.2-31 and 5.2.3-32).

Many suggestions were provided regarding how best to quantify indirect impacts. While changes to wetland plant communities would be monitored, changes in the vegetation community are typically slower to manifest and identify compared to changes in hydrology. The USACE believes that closely monitoring hydrology early and often during the NorthMet Project Proposed Action provides sufficient assurances of observing any indicators of anticipated changes to the wetland communities.

Theme COE 07

Theme Statement

The Section 404 Wetlands Permit application should include the most recent and comprehensive information on the cumulative effect assessment, including cumulative indirect effects to aquatic resources within the watersheds. The cumulative loss of different wetland types (e.g. as a result of indirect impacts such as changes in hydrology) should also be evaluated in the Section 404 Wetlands Permit application.

Thematic Response

FEIS Section 6.1.1 describes the rationale for how the cumulative effects assessment areas (CEAAs) were identified for NorthMet Project Proposed Action, and provides a list of projects and actions that were considered in the cumulative effects wetland analysis. The CEAAs for individual resource areas vary based on the potential for cumulative effects and not on a single overall assessment area. FEIS Section 6.2.3 describes the wetland resource CEAA. The spatial area for the wetland analysis for the DEIS was determined to be the Partridge and Embarrass River watersheds. It was determined during the Wetland IAP Working Group that the FEIS spatial area would not change from the DEIS. The wetland cumulative effects methodology and assessment approach was developed based on the Wetland IAP Working Group and is presented in the Wetland Analysis Work Plan (PolyMet 2011m, as cited in the FEIS). FEIS Section 6.2.3.1 provides a description of the wetland cumulative analysis.

It is difficult to predict potential indirect wetland effects within the CEAA, or to know what the potential indirect wetland effects would be for projects other than the NorthMet Project Proposed Action. Based on the amount of potential indirect wetland effects from the NorthMet Project Proposed Action, loss of wetlands could cumulatively be 0.1 to 12.0 percent of total wetland acres in the Partridge and Embarrass River watersheds. This would be in addition to the direct wetland impacts assessed in FEIS Section 6.2.3.

Theme COE 08

Theme Statement

Additional information on crediting, drainage, plant recommendations and sustainability, and permit requirements is needed for the Atkin wetland mitigation site.

Thematic Response

The Aitkin Mitigation Plan, updated in 2014, provides additional details related to crediting, drainage, plant recommendations and sustainability, and permit requirements. The updated Aitkin Mitigation Plan would be reviewed by the appropriate agencies and approved during the permitting process. The USACE has concluded that the mitigation sites selected and the wetland credits generated at the three mitigation sites would be acceptable for use in compensating for direct wetland losses. The USACE has not made a final decision on the mitigation ratios that would be required to compensate for direct wetland impacts; if fully successful, it is likely these three mitigation sites would generate sufficient credits to compensate for the 940 acres of direct wetlands impacts, as well as wetland fragmentation associated with the NorthMet Project Proposed Action. In the event that not all of the credits generated by these sites are utilized to compensate for direct wetland impacts, any excess credits could be used to compensate for indirect losses (USACE 2015a, as cited in the FEIS).

Theme COE 09

Theme Statement

The Section 404 Wetlands Permit must be denied because the proposed action has substantial and unacceptable impacts on aquatic resources of national importance (ARNI).

Thematic Response

A Clean Water Act Section 404(q) Memorandum of an Agreement between the Environmental Protection Agency and the Department the Army was signed on 11 August 1992. Part IV of that MOA which is titled Elevation of Individual Permit Decisions, provides exclusive procedures for elevation of specific cases that involve aquatic resources of national importance (ARNI). Elevation of issues related to specific individual permit cases would be limited to those cases that involve aquatic resources of national importance. In such cases, the USEPA determines that issuance of the permit for a proposed project as proposed would result in unacceptable adverse effects to ARNI. Regarding the NorthMet Project Proposed Action, the USEPA raised ARNI as an initial concern in their February 18, 2010 comment letter on the USACE public notice. The SDEIS has addressed many of the USEPA's concerns regarding ARNIs, and the lead agencies continue to work with the USEPA to address their comments on the SDEIS. The USACE may also consult with the USEPA on issues of interest to them while writing the ROD.

The USEPA reviews and comments on Federal EISs pursuant to its authorities and responsibilities under NEPA, Section 309 of the CAA, and Section 404 of the CWA. Under Section 404(c) of the CWA, the USEPA has the authority to prohibit, restrict, or deny the discharge of dredged or fill material at defined sites in Waters of the United States (including wetlands) whenever it determines, after notice and opportunity for public hearing, that use of such sites for disposal would have an unacceptable adverse impact on one or more resources, including fisheries, wildlife, municipal water supplies, or recreational areas. The 404(q) Memorandum of Agreement between the USACE and USEPA provides a procedure for considering both agencies' views on projects, including procedures for elevating unresolved issues to regional and national levels. The 404(q) process is used by the USEPA when they wish to initiate consultation regarding concerns they may have about the impacts of a proposed project.

Theme COE 10

Theme Statement

The SDEIS and/or 404 Permit process should evaluate whether wetlands restoration mitigation project sites would require a Section 404 Wetlands Permit, and if so they must be included in the FEIS as connected actions. In addition, a wetland delineation and additional hydrologic monitoring information is needed for the wetland mitigation sites.

Thematic Response

Under Section 404 of the CWA, impacts to regulated aquatic resources considered to be Waters of the United States, including wetlands, must be mitigated to offset the impact to those resources. Compensatory mitigation is intended to compensate for the impacts associated with permitted activities and is intended to increase the acreage and/or function of other wetlands. Since compensatory mitigation is usually required in order receive a Section 404 permit, the USACE neither requires a separate permit for the proposed mitigation nor do they require that the beneficial impacts proposed by the mitigation be included in the final impact tally for a proposed project. Mitigation efforts that involve the discharge of dredged or fill material into Waters of the United States would require Department of the Army authorization. For project specific mitigation, the impacts are disclosed in the NEPA EIS document, evaluated in the ROD for the USACE, and required as a condition of the permit. Any required authorization would be conveyed by that permit condition.

A wetland delineation of the mitigation sites by PolyMet may be required, and would be submitted as part of the permitting process, if needed. Restoration activities at the mitigation sites have not commenced, and would not be initiated until appropriate approvals and permits have been obtained. Hydrology monitoring has begun at the mitigation sites; however, the state and federal agencies have not yet made a determination on the drainage status of the mitigation sites (i.e., drained, partially drained, etc.). This determination, including credit ratios, would be made during permitting. FEIS Section 5.2.3.3.2 discusses the wetland mitigation for the NorthMet Project Proposed Action, while Section 5.2.3.3.4 discusses the monitoring as part of the proposed mitigation.

Theme COE 11

Theme Statement

The USACE does not have jurisdiction on this project.

Thematic Response

FEIS Section 4.2.3 includes a discussion on the regulatory jurisdiction regarding the wetland resources on the NorthMet Project Proposed Action. As discussed in that section, wetlands in Minnesota are protected under both federal and state laws. The USACE regulates the discharge of dredged or fill material into Waters of the United States, including wetlands, under Section 404 of the CWA. Any project that proposes to impact federally-regulated wetlands must apply for a permit from the USACE to do so. In addition, if a permit from the USACE is issued, it is not valid until the State of Minnesota has either certified (under Section 401 of the CWA) that the proposed discharges to aquatic resources comply with the State of Minnesota's water quality standards or waived the Section 401 certification requirements.

As discussed in the FEIS, the different federal and state programs that regulate aquatic resources differ in respect to the specific types of resources that are under the jurisdiction of the respective regulatory agencies. While each agency has the authority to regulate most wetlands in Minnesota, neither agency has jurisdiction over all wetlands in the state. For example, "incidental" wetlands are not regulated by the State of Minnesota, may be jurisdictional under Section 404 of the CWA; and in some circumstances wetlands not be subject to regulation under Section 404 of the CWA (see 33 CFR 328.3 for a definition of waters of the U.S.) may be regulated by the state of Minnesota. The wetlands within the NorthMet Project Proposed Action area are either regulated by the USACE under Section 404 of the CWA, under the various state regulatory programs previously discussed, or both, with the exception of two wetland areas that would not be regulated by either program, as a result of being located within an actively permitted waste storage facility. These two wetland areas are discussed in FEIS Section 4.2.3.2.

Theme COE 12

Theme Statement

The mitigation ratios proposed in the USACE (404) Memorandum are reasonable.

Thematic Response

These comments provide general information regarding the USACE Section 404 permit application review. No changes to the FEIS were made as a result of these comments.

Theme COE 13

Theme Statement

Once implemented, the Northeast Minnesota Wetland Mitigation Strategy should be used to identify additional wetland mitigation sites within the St. Louis River and Lake Superior Watersheds to compensate for indirect wetland effects at the PolyMet Site. Until then, mitigation options for indirect effects must be discussed in the 404 permit application.

Thematic Response

These comments provide general information regarding mitigation that should be considered for wetland mitigation in the future. No changes were made to the FEIS as a result of these comments.

A.5.5 Issue: Cultural Resources (CR)

Theme CR 01

Theme Statement

The SDEIS does not adequately discuss the federal government's trust responsibility as part of the 1854 Treaty, nor does it adequately address potential impacts to, and proposed mitigation/compensation for loss of access to, resources important to the Bands.

Thematic Response

The Cultural Resources section of the Final EIS Chapters 4 and 5 addresses the federal Co-lead Agencies' federal tribal trust responsibilities under the 1854 Treaty. These sections, along with other relevant natural resources sections of Chapters 4, 5, and 6, also address effects on, and any proposed mitigation for effects on cultural resources and culturally significant natural resources. Mitigation for effects on cultural resources and culturally significant natural resources is considered to the extent possible within the parameters of the statutes and regulations providing the federal authorities for the NorthMet project review.

Theme CR 02

Theme Statement

The Area of Potential Effect (APE) discussed in the SDEIS does not encompass the true APE within which the proposed project could affect cultural resources.

Thematic Response

FEIS Section 4.2.9.2.3 provides a detailed discussion and analysis of the area in which cultural resources may be affected by the undertaking. The APE takes into account both direct and indirect effects using a geographically expansive area that accounts for direct effects as well as visual, audible, atmospheric, hydrological, and water quality effects. The APE is based on extensive modeling and other analysis completed for the NorthMet Mining Project and Land Exchange, and includes an area much broader than the Plant Site and Mine Site. Since the SDEIS, the APE has been revised slightly to include the Dunka Road corridor, several federal parcels included in the Land Exchange Proposed Action, and the Colby Lake Pumphouse and pipeline.

Theme CR 03

Theme Statement

The SDEIS does not adequately discuss and address cumulative effects to cultural and treaty resources.

Thematic Response

FEIS Section 4.2.9.2.3 provides a detailed discussion and analysis of the area in which cultural resources may be affected by the undertaking. The APE takes into account both direct and indirect effects using a geographically expansive area that accounts for direct effects as well as visual, audible, atmospheric, hydrological, and water quality effects. The APE is based on extensive modeling and other analysis completed for the NorthMet Mining Project and Land Exchange, and includes an area much broader than the Plant Site and Mine Site. Since the SDEIS, the APE has been revised slightly to include the Dunka Road corridor, several federal parcels included in the Land Exchange Proposed Action, and the Colby Lake Pumphouse and pipeline.

Theme CR 04

Theme Statement

Tribal cooperating agencies consider a 216,300-acre area bounded by the St Louis River, Lake Superior, Lake Vermilion and the Beaver Bay to Vermilion Trail to be a Tribal Historic District. The cumulative effects analysis for cultural resources should include this Tribal Historic District.

Thematic Response

The historic district proposed by the Grand Portage Band in a June 27, 2013 letter was addressed. The federal Co-lead Agencies do not believe that this area meets the definition of a district, nor does it have sufficient integrity as a district to qualify for inclusion in the NRHP. The federal Co-lead Agencies have considered an expanded area for analysis of cumulative effects on cultural resources and natural resources of significance to the Bands, including use of the 1854 Ceded Territory as the CEAA. Use of the 1854 Ceded Territory as the CEAA for cultural resources would actually diminish the significance of any cumulative effects. By evaluating the effects of the NorthMet Project Proposed Action along with other past, present, and reasonably foreseeable future projects in the context of a much larger area with a much larger number of resources similar to those affected by the NorthMet Project Proposed Action, the effect of the NorthMet Project Proposed Action on those resources is diminished. The cumulative effects analysis focuses on the specific resources, or types of resources, affected by the NorthMet Project Proposed Action within an area that is geographically meaningful considering the project under review.

Cumulative effects are discussed and addressed differently based on the affected resource. Discussions related to socioeconomics, for instance, use an expanded analysis area compared to other resources. Such expanded analysis areas are used as appropriate. The Cultural Resources sections in FEIS Chapters 4, 5, and 6 address the Co-lead Agencies' determination of the NorthMet Project Proposed Action's direct, indirect, and cumulative areas of potential effect.

Theme CR 05

Theme Statement

The Section 106 survey and SDEIS did not adequately identify, address impacts to, and provide mitigation measures for cultural resources.

Thematic Response

The federal Co-lead Agencies have made a reasonable and good-faith effort to identify cultural resources potentially affected by the NorthMet Project Proposed Action, and to determine which resources qualify for inclusion in the NRHP as historic properties. Impacts to historic properties have been appropriately assessed, and the federal Co-lead Agencies are actively consulting with the federally recognized Bands, the Minnesota SHPO, and other consulting parties to develop appropriate mitigation measures. Effects on resources significant to the Bands that do not qualify as historic properties, as well as general effects on natural resources, are considered within the parameters of the statutes that shape this review. Effects on cultural resources and culturally significant natural resources are addressed in the Cultural Resources sections in FEIS Chapters 4, 5, and 6.

Theme CR 06

Theme Statement

The Section 106 consultation and survey, and government to government consultation should be complete prior to the Final EIS, to address the presence of and impacts to cultural resources and use of resources by tribal members.

Thematic Response

The federal Co-lead Agencies have actively consulted with the federally recognized Bands that have expressed an interest in consulting on the NorthMet Project Proposed Action. Historic properties affected by the NorthMet Project Proposed Action have been identified and the impacts to those properties have been assessed. This also includes an assessment of actual use of those historic properties, as well as other resources in the APE, by tribal members. Effects on historic properties would be fully considered prior to the issuance of any permit or land exchange, pursuant to the NHPA and its implementing regulations. Effects on cultural resources and culturally significant natural resources are addressed in the Cultural Resources sections in FEIS Chapters 4, 5, and 6.

Theme CR 07

Theme Statement

The proposed avoidance and mitigation measures identified in the SDEIS are adequate to allow for the proposed Project to have a minimal effect on Cultural Resources.

Thematic Response

The federal Co-lead Agencies are actively consulting to avoid, minimize, and mitigate effects on historic properties to the extent practicable and within the parameters of the underlying statutes. Effects on cultural resources and culturally significant natural resources are addressed in the Cultural Resources sections in FEIS Chapters 4, 5, and 6.

Theme CR 08

Theme Statement

The FEIS should use the USEPA's 2011 NEPA review guidance titled "Applying Cumulative Impact Analysis Tools to Tribes and Tribal Lands."

Thematic Response

The 2011 USEPA guidance document on cumulative effects has been reviewed and discussed with the USEPA. The FEIS complies with CEQ guidance for the cumulative effects analysis.

A.5.6 Issue: Cumulative Effects (CU)

Theme CU 01

Theme Statement

The cumulative effects assessment areas (CEAAs) were incorrectly defined, and should include the BWCAW, Voyageurs National Park, Lake Superior (including Isle Royale and Apostle Island National Parks), the St. Louis River Watershed, and the 1854 Ceded Territory. The FEIS should also consider cumulative impacts within a larger region beyond just the Mesabi Iron Range, such as the Duluth Complex south and east of the range.

Thematic Response

The cumulative effects section in the FEIS (Sections 6.1.1.1 and 6.1.2.1) describes the rationale for the identification of cumulative effects assessment areas (CEAAs). The CEAAs for individual resource areas vary based on the potential for cumulative effects, and not on a single overall assessment area. FEIS Table 6.1.1-2 summarizes the spatial areas used for each resource area.

Theme CU 02

Theme Statement

The SDEIS did not consider the correct projects in the cumulative effects assessment. The FEIS should not exclude speculative projects just because they are not yet at the permitting stage. Instead, the cumulative effects analysis should include all potential projects, including those for mineral exploration and possible future expansion of the NorthMet Mine itself. Eventual Northshore Mine closure should also be considered.

Thematic Response

FEIS Sections 6.1.1.2 and 6.1.2.1 includes an updated list of projects and actions that were considered in the cumulative effects assessment. The Northshore Mine closure has been included in the list of actions as a reasonably foreseeable action. Any potential future expansion of the NorthMet Mine would be considered a speculative project.

The FEIS considered for the cumulative effects assessment “reasonably foreseeable” actions, which are defined as those actions that are included in approved planning documents and have approved funding, are permitted, or have a currently active federal or state permit or site plan application under review. The Co-lead agencies have followed cumulative effects guidance from CEQ and sources, as they relate to reasonably foreseeable projects, including other mining projects.

Theme CU 03

Theme Statement

The SDEIS did not use the correct methodology to consider cumulative effects. The FEIS should apply USEPA's approach for the Pebble Mine (Bristol Bay, Alaska) assessment. It should also reference USEPA guidance for considering cumulative effects and the "Cumulative Impact Analysis Tools to Tribes and Tribal Lands" guide. The FEIS should also include information from other sources, such as the Regional Copper-Nickel Study, in order to estimate the amount of mining potential in northern Minnesota.

Thematic Response

The Co-lead agencies consulted a wide range of sources to conduct the cumulative effects assessment of the NorthMet Project Proposed Action and Land Exchange Proposed Action. In addition, the Co-lead agencies followed USEPA (USEPA 1999b, as cited in the FEIS) and CEQ (CEQ 1997 and Connaughton 2005, as cited in the FEIS) guidance on how to conduct the cumulative effects analysis. FEIS Section 6.1.1.1 describes the cumulative effects analysis approach. The cumulative effects analysis meets the requirements of MEPA/NEPA.

Theme CU 04

Theme Statement

The FEIS cumulative effects analysis should describe how permitting the Proposed NorthMet Mining Project would facilitate the eventual permitting of additional similar mines in northern Minnesota, thus establishing a sulfide mining district. The FEIS should also discuss the possibility that excess capacity at the proposed NorthMet processing plant would also facilitate additional mining in the region.

Thematic Response

The FEIS considered for the cumulative effects assessment "reasonably foreseeable" actions, which are defined as those actions that are included in approved planning documents and have approved funding, are permitted, or have a currently active federal or state permit or site plan application under review. The degree to which the NorthMet Project Proposed Action and Land Exchange Proposed Action could facilitate future permitting of additional mines is outside the scope of the FEIS, and is thus not included in the analysis. The Co-lead agencies followed USEPA (USEPA 1999b, as cited in the FEIS), CEQ (CEQ 1997 and Connaughton 2005, as cited in the FEIS), and other cumulative effects guidance relating to reasonably foreseeable projects, such as other mining projects. The use of the NorthMet Processing Plant by other potential speculative mining projects is outside the scope of the FEIS.

Theme CU 05

Theme Statement

The cumulative effects analysis of the FEIS should be revised to better describe how the spatial and temporal boundaries were established. The FEIS should also make clear that the findings of the cumulative effects analysis rely on complete and successful implementation of mitigation measures.

Thematic Response

FEIS Sections 6.2 and 6.3 describe how each resource's cumulative effects assessment area was determined, including spatial and temporal areas. FEIS Table 6.1.1-2 summarizes the spatial areas used for each resource area.

Theme CU 06

Theme Statement

The zone of impact for PolyMet extends beyond the State of Minnesota to other states and foreign countries within the Lake Superior basin.

Thematic Response

The FEIS describes the cumulative effects of the NorthMet Mining Project. Refer to FEIS Chapter 6 under the individual resource topics for further information. The rationale for each resource CEAA have been defined as noted in the response to theme CU 01 and in FEIS Section 6.2. FEIS Table 6.1.1-2 summarizes the spatial areas used for each resource area.

Theme CU 07

Theme Statement

The FEIS should consider all other "actions" and not just "projects." The assessment is therefore unreasonably limited to reasonably foreseeable projects only.

Thematic Response

Section 6.1.1.2 describes all past, present, and reasonably foreseeable projects/actions that were considered in the NorthMet Project Proposed Action cumulative effects assessment. Section 6.1.2.2 describes the cumulative forest service land actions that were considered in the Land Exchange Proposed Action cumulative effects assessment.

Theme CU 08

Theme Statement

The FEIS cumulative effects analysis should include various land exchanges that are being considered, and should specifically evaluate how these exchanges could affect the potential environmental impacts related to the Proposed Action. This includes the Proposed School Trust Lands/Boundary Waters Land Exchange.

Thematic Response

FEIS Section 6.1.2 includes an updated list of projects and actions that were considered in the cumulative effects assessment for the Land Exchange Proposed Action, which includes the School Trust Lands project.

Theme CU 09

Theme Statement

The FEIS cumulative effects analysis should include numerous vegetation management projects conducted by the U.S. Forest Service (USFS). Some of these include: the Kabetogama Project, the Mixed Use Motorized Use Project, the Pearl Project, the Glacier Project, the Skibo Project, the Tracks Project, the Birch Project, the Echo Trail Project, the Travel Management Plan of 2009, the Pelican Project, the Tracks Project, the Virginia Project, and the Big Grass Project. Simply listing "forestry practices" as part of the analysis is not sufficient.

Thematic Response

The FEIS includes a qualitative cumulative effects assessment of USFS's ongoing management activities on the Superior National Forest in conjunction with the NorthMet Mining Project and Land Exchange. The vegetation management projects listed in theme CU 09 address Superior National Forest Landscape Ecosystems objectives stated in the Forest Plan. These projects' effects on the Forest Plan Landscape Ecosystems are cumulatively incorporated into the Superior National Forest databases. The cumulative effects analysis for the NorthMet Mining Project and Land Exchange used the Superior National Forest Landscape Ecosystems data in estimating potential effects, as shown in FEIS Section 6.3.4.3.2 and Table 6.3.4-2. Motorized Use and Travel Management projects are outside the scope of the effects of, and therefore would not be affected by the NorthMet Project Proposed Action.

Theme CU 10

Theme Statement

The SDEIS does not adequately address cumulative effects on National Forest lands from other mining projects that may require National Forest lands for tailings, ore processing, stockpiles, and other infrastructure.

Thematic Response

Sections 6.1.1 and 6.1.2 describes all past, present, and reasonably foreseeable projects/actions that were considered in the cumulative effects assessment.

Theme CU 11

Theme Statement

The Proposed NorthMet Mine would cause irreversible cumulative effects in the region, including impacts on treaty rights and subsistence practices.

Thematic Response

The FEIS describes the cumulative effects of the NorthMet Project Proposed Action and Land Exchange Proposed Action. FEIS Sections 6.2 and 6.3 have been updated with additional information that has become available since publication of the SDEIS. FEIS Section 6.2.9 describes cumulative effects for cultural resources.

Theme CU 12

Theme Statement

The cumulative effects analysis conducted by the Tribal Cooperating Agencies must be considered by the lead agencies.

Thematic Response

The Co-lead Agencies considered the information included in the Tribal Cooperating Agencies' cumulative effects assessment and found no compelling information or analysis to change the original approach or conclusions.

Theme CU 13

Theme Statement

The cumulative effects analysis must include a conceptual analysis of the impact of multiple copper/nickel mines operating in these headwaters. These projects are occurring because the State of Minnesota is permitting mine development anywhere in the Duluth Complex but restricting processing to the St. Louis River drainage only.

Thematic Response

The FEIS analyzed the direct, indirect and cumulative effects of the NorthMet Project Proposed Action and Land Exchange Proposed Action to include past, present, and reasonably foreseeable projects as defined in USEPA (USEPA 1999b, as cited in the FEIS) and CEQ (CEQ 1997 and Connaughton 2005, as cited in the FEIS) guidance. Speculative projects are considered outside the scope of the analysis. There are currently no copper/nickel mining projects permitted in the State of Minnesota. The NorthMet Project is the only proposed copper/nickel mining project currently under Environmental Review (EIS process). The State of Minnesota does not have any restrictions limiting mine processing to the St. Louis River Watershed.

Theme CU 14

Theme Statement

Cumulative effects analysis requires quantified or detailed information. Absent specific justification, general statements about possible effects and some risk do not constitute the NEPA-required "hard look."

Thematic Response

The FEIS includes both quantitative and qualitative analysis of the cumulative effects of the NorthMet Project Proposed Action and Land Exchange Proposed Action. Where quantification of conditions could not be ascertained, a qualitative analysis of the potential cumulative effects was used. The Co-lead Agencies considered these qualitative effects carefully where data did not exist or could not be collected using reasonable methods consistent with the CEQ regulations (40 CFR 1502.22).

Theme CU 15

Theme Statement

The FEIS should reveal the cumulative effects from all sources together on impacted resources, acknowledging that the Proposed Action would be one of many sources that cause the impacts.

Thematic Response

The FEIS describes the cumulative effects of the NorthMet Project Proposed Action and Land Exchange Proposed Action in conjunction with other projects on individual resources from a variety of sources. For example, water impacts to the Partridge River take into account the effect that the Northshore Mine has on flows, including projecting the conditions at future closure of the Northshore Mine. In addition, impacts to wildlife take into account the effects from noise, direct mortality (e.g., traffic), habitat fragmentation to wildlife corridors, and loss of treaty resources due to other reasonably foreseeable projects.

Theme CU 16

Theme Statement

Post-closure impacts should be included in the cumulative effects analysis because some mine features would become permanent features on the landscape.

Thematic Response

The FEIS describes the cumulative effects of the NorthMet Project Proposed Action, including those expected during closure and post-closure. The FEIS discloses post-closure effects in Section 6.2.

Theme CU 17

Theme Statement

The SDEIS underestimated the cumulative effects on native habitats in this region. Native habitat has been destroyed from Grand Rapids to the BWCAW by mining, urbanization, and settlement, among other factors.

Thematic Response

FEIS Section 6.1.1.2 states that past effects on all resources are described as the current environmental conditions in FEIS Chapter 4. The FEIS discloses how native habitats have been modified in the past by human activity. Using the descriptions in FEIS Chapter 4 as a baseline, the FEIS describes how the NorthMet Project Proposed Action and Land Exchange Proposed Action, in addition to reasonably foreseeable projects and actions, would cause cumulative effects in the future.

Theme CU 18

Theme Statement

The state should conduct a regional or programmatic cumulative effects study of all sulfide mining in the Lake Superior Basin, including previous and potential future mining activities, before approving the NorthMet Mine.

Thematic Response

The preparation of a regional or programmatic analysis of past and potential mining activities is outside the scope of the FEIS. The cumulative effects analysis meets the requirements of MEPA/NEPA.

Theme CU 19

Theme Statement

A generic or programmatic EIS for sulfide mining would be the appropriate way to evaluate multiple mining projects currently being planned. Such an EIS should be used to determine whether sulfide mining in the Duluth Complex will be beneficial to the long-term interests of the State.

Thematic Response

The preparation of a regional or programmatic analysis of past and potential mining activities is outside the scope of the FEIS. The cumulative effects analysis meets the requirements of MEPA/NEPA.

Theme CU 20

Theme Statement

The SDEIS correctly identified the cumulative effects study areas, cumulative projects, and analysis approach.

Thematic Response

These comments provide general information regarding the cumulative effects assessment. Because no specific information was provided, no changes to the EIS were made.

A.5.7 Issue: Financial Assurance (FIN)

Theme FIN 01

Theme Statement

The SDEIS does not clearly state who will be financially responsible, how those parties will be held responsible for the Proposed Action, or who will monitor this process. Such considerations are crucial, given the mining industry's history and the 200-500 year or possible perpetual (even through bankruptcy) timeframe of the Project. The FEIS should also identify the parties that would monitor this process over such a long timeframe. Restrictions should be placed on PolyMet (with respect to financial assurance obligations) for any transfers of ownership or organizational restructuring once the project permits are granted.

Thematic Response

FEIS Section 3.2.2.4 provides available details regarding financial assurance. The project proponent (PolyMet) would be responsible for financial assurance costs. As stated in *Minnesota Rules* 6132.1200, Subpart 5, financial assurance criteria require that funds must not be dischargeable through bankruptcy and are fully binding and enforceable under state and federal law. *Minnesota Rules* 6132.1200, Subpart 7 state that the Permit to Mine could be suspended or revoked if the proponent does not comply with financial assurance criteria. The Commissioner may also order imposition of a civil penalty in such a situation, under *Minnesota Rules* 6132.5100. *Minnesota Rules* 6132.1200 Subpart 4 also state that the Commissioner shall evaluate all financial assurance cost estimates and adjustments to cost estimates using individuals with documented experience in material handling and construction and mining costs. Costs incurred by the Commissioner in hiring third parties to perform the evaluation must be paid by the applicant. *Minnesota Rules* 6132.1200, Subpart 4, item F states that any new permittee would be responsible for complying with the Permit to Mine and any outstanding obligations before the former permittee could be released from the requirements. Additional details on the financial assurance required for the project would be addressed during permitting.

Theme FIN 02

Theme Statement

Since PolyMet (Minnesota) has no assets, PolyMet's parent company (PolyMet, Canada) and major shareholder (Glencore Xstrata), must be included as responsible parties for financial assurance.

Thematic Response

FEIS Section 3.2.2.4 provides available details regarding financial assurance. PolyMet, the project proponent and not its shareholders, would be responsible for financial assurance. As stated in *Minnesota Rules* 6132.1200, Subpart 5, financial assurance criteria require that funds must not be dischargeable through bankruptcy and are fully binding and enforceable under state and federal law. *Minnesota Rules* 6132.1200, Subpart 4, item F states that any new permittee would be responsible for complying with the Permit to Mine and any outstanding obligations before the former permittee could be released from the requirements. Additional details on the financial assurance required for the project would be addressed during permitting.

Theme FIN 03

Theme Statement

The FEIS should describe the legal framework for financial assurance that would result in bankruptcy-proof and perpetual financial assurance investments/instruments, as well as the repercussions if PolyMet fails to meet its obligations.

Thematic Response

FEIS Section 3.2.2.4 provides available details regarding financial assurance. As stated in *Minnesota Rules* 6132.1200, Subpart 5, financial assurance criteria require that funds must not be dischargeable through bankruptcy and are fully binding and enforceable under state and federal law. *Minnesota Rules* 6132.1200, Subpart 7 state that the Permit to Mine could be suspended or revoked if the proponent does not comply with financial assurance criteria. The Commissioner may also order imposition of a civil penalty in such a situation, under *Minnesota Rules* 6132.5100. Additional details on the legal framework for the financial assurance required for the project would be addressed during permitting. Also see the response to theme FIN 08, which addresses long-term financial assurance instruments/investments.

Theme FIN 04

Theme Statement

The State of Minnesota should not let a foreign corporation (PolyMet, Canada and Glencore Xstrata) make profits off of U.S. land and/or send minerals to China, especially without financial assurances that address long-term cleanup of the site. The FEIS should provide a discussion of the feasibility and methods of enforcing U.S. laws regarding foreign companies.

Thematic Response

Financial assurance is required up front, and would be updated throughout the project under the Permit to Mine, which would be required prior to the start of mining. The purpose of financial assurance, as stated in *Minnesota Rules* 6132.1200, Subpart 1, is to ensure that MDNR has a "source of funds" to perform reclamation activities if the permittee fails to do so. As stated in *Minnesota Rules* 6132.1200, Subpart 5, financial assurance criteria require that funds must not be dischargeable through bankruptcy and are fully binding and enforceable under state and federal law. The NorthMet Project's financial assurance requirements are independent of PolyMet's parent company and its shareholders. FEIS Section 3.2.2.4 provides available details regarding financial assurance and applicable regulations. Additional details on the financial assurance required for the project would be addressed during permitting.

Theme FIN 05

Theme Statement

Relative to cost estimates, the SDEIS does not contain information regarding:

- Adequate reclamation and closure cost estimate information to ensure a sufficient amount is available when needed to meet evolving long-term care standards;
- How often the cost estimates for water treatment will be updated;
- How long the covers, liners, treatment equipment, Wastewater Treatment Plant (WWTP) and Wastewater Treatment Facility (WWTF) will last, and how they would be replaced;
- How cost estimates would be determined for contingency plans/unforeseen challenges (natural events and man-made accidents);
- Adaptive management as a mechanism to address uncertainties;
- How the economic value of water and human health is considered; and
- How alternative estimates (e.g., from the Grand Portage Band of Lake Superior Chippewa) are considered and reconciled with PolyMet's estimate.

Thematic Response

FEIS Section 3.2.2.4 provides available details regarding financial assurance. Additional details on the cost estimates, timeframes, contingency plan amounts for unforeseen challenges, and calculations that would be required for the project would be addressed during permitting. Specific infrastructure timelines and life expectancies of equipment would be accounted for during permitting as well. Table 3.2-15 provides financial assurance cost estimates for various years of closure, as well as monitoring and mitigation costs. FEIS Section 3.2.2.4.1 discusses what activities would be considered in cost estimates, and that cost estimates would be updated at least annually under the Permit to Mine. *Minnesota Rules* 6132.1200, Subpart 3, states that cost estimates shall be annually adjusted using current dollar value at the time of the estimate. The liner and cover systems for waste containment are selected on the basis of numerous factors discussed in the Rock and Overburden Management Plan and FEIS Sections 3.2.2.1.8 and 3.2.2.3.10. The WWTP and WWTF would undergo continued inspection and maintenance during operations, long-term treatment, and in closure. The WWTP and WWTF replacement costs would be included in long-term financial assurance estimates. USEPA guidance on utilization of adaptive management defines it as a decision making process that can be adjusted in the face of uncertainties as outcomes from management actions and other events become better understood. *Minnesota Rules* 6132.1200, Subparts 4 and 5, require the MDNR to evaluate financial assurance cost estimates, terms, and conditions using individuals with documented experience in the relevant field. Those individuals would consider all relevant information in making their evaluations.

Theme FIN 06

Theme Statement

The FEIS should provide reasonable estimates on how long closure/post-closure treatment and maintenance will be required to assess project effects and risks in the context of financial assurance requirements.

Thematic Response

FEIS Sections 3.2.2.1.10, 3.2.2.3.12, and 5.2.2.3.1 provide available information regarding long-term water treatment and maintenance. Temporal aspects of financial assurance are addressed in *Minnesota Rules* 6132.3200 Subpart 2, item E, which state that financial assurance is required for all areas that require continued maintenance following closure, and that no release from the Permit to Mine would be granted for portions of mining areas that require post-closure maintenance until the maintenance activities are no longer necessary.

Theme FIN 07

Theme Statement

The State of Minnesota should set a value for financial assurance obligations and should require PolyMet to pay that amount as a condition of issuance of the Permit to Mine.

Thematic Response

FEIS Section 3.2.2.4 provides available details regarding financial assurance. Financial assurance is required up front, and would be updated throughout the project under the Permit to Mine, which would be required prior to the start of mining. *Minnesota Rules* 6132.1200, Subpart 4 also dictate that the Commissioner shall evaluate all financial assurance cost estimates and adjustments to cost estimates using individuals with documented experience in material handling and construction and mining costs. Additional details on the cost estimates that would be required for the project would be addressed during permitting.

Theme FIN 08

Theme Statement

The SDEIS provides detailed project modeling, analysis, and discussion concluding the need for long term (perpetual) treatment, yet the financial assurance section presents very minimal, general information on how this long term treatment will be financed. It is unclear what methods (assumptions on discount rates, inflation, and rate of return on investments) or instruments (e.g., cash up front within the custody and control of the State, reliance on a reputable third-party insurer such as Lloyd's of London) will be used to do so, how to assure the investments are risk-free and account for market fluctuations, and determination of how the funds would be dedicated to this project. Annual adjustment of financial assurance is a "reactive" approach that does not seem adequate for project with such large potential risks and effects.

Thematic Response

FEIS Section 3.2.2.4 provides available details regarding financial assurance. Table 3.2-15 provides financial assurance cost estimates for various years of closure, as well as monitoring and mitigation costs. Section 3.2.2.4.1 discusses what activities would be considered in cost estimates, and that cost estimates would be updated annually under the Permit to Mine to account for the proceeding year's activities. *Minnesota Rules* 6132.1200, Subpart 3 state that cost estimates shall be annually adjusted using current dollar value at the time of the estimate. FEIS Section 3.2.2.4.2 discusses the types of financial assurance instruments that could be used in combination to assure the project. Additional details on the cost estimates, methods, and instruments that would be required for the project, and how the instruments would be updated and dedicated to the project would be addressed during permitting.

Theme FIN 09

Theme Statement

The State of Minnesota does not have the staff expertise necessary to protect tax payers when assessing the types and adequacy of financial assurance and financial instruments necessary for this project.

Thematic Response

FEIS Section 3.2.2.4 provides available details regarding financial assurance. *Minnesota Rules* 6132.1200 Subpart 4 states that the Commissioner shall evaluate all financial assurance cost estimates and adjustments to cost estimates using individuals with documented experience in material handling and construction and mining costs. Costs incurred by the Commissioner in hiring third parties to perform the evaluation must be paid by the applicant. Additional details on the financial assurance required for the project would be addressed during permitting.

Theme FIN 10

Theme Statement

The potential benefits from a limited number of jobs are outweighed by potential effects of open-pit sulfide mining on thousands of acres for hundreds of years. These costs cannot really be measured, and they are likely to fall on the shoulders of current and future generations of Minnesota taxpayers.

Thematic Response

The FEIS discusses the number of jobs potentially created by (and other socioeconomic impacts of) the NorthMet Project Proposed Action in Section 5.2.10. Other effects of the project, such as environmental effects, are discussed throughout FEIS Chapter 5. Long-term environmental monitoring and maintenance cost estimates are part of financial assurance, as discussed in FEIS Section 3.2.2.4. As stated in *Minnesota Rules* 6132.1200, Subpart 5, financial assurance criteria require that funds must not be dischargeable through bankruptcy and are fully binding and enforceable under state and federal law. Additional details on the financial assurance cost estimates and commitment required for the project would be addressed during permitting.

Theme FIN 11

Theme Statement

The proposed extent of Financial Assurance is inadequate and should also be required for potential effects (indirect and unforeseen) to resources such as wetlands, waters, and wild rice. Financial Assurance should also address monitoring and maintenance costs, mitigation costs, and legacy contamination.

Thematic Response

FEIS Section 3.2.2.4 provides available details regarding financial assurance, including for reclamation of all disturbed areas and ongoing long-term monitoring and maintenance. Additional details on the financial assurance required for the project effects, monitoring, mitigation, and legacy contamination would be addressed during permitting. The FEIS analyzes the reasonably foreseeable effects of the NorthMet Project, and includes monitoring systems (i.e., environmental/compliance samples or measurements) to confirm modeled predictions. MDNR has the authority to require remedial action for unforeseen effects, and to adjust financial assurance on at least an annual basis when changes are necessary to the reclamation plan. To the extent that the reclamation plan includes maintenance, mitigation, and cleanup of legacy contamination, those items would be covered by financial assurance.

Guidance for USACE permits that are conditioned to include any type of financial assurance to ensure that required compensatory mitigation is completed can be found in FEIS Section 5.2.3.3.2, or at:

- 33 CFR Parts 325 and 332, Compensatory Mitigation for Losses of Aquatic Resources; Final Rule, dated April 10, 2008. Financial assurances are specifically discussed at 33 CFR 332.3(n).
- Regulatory Guidance Letter No. 05-1 Date: 14 February 2005 titled: Guidance on the Use of Financial Assurances, and Suggested Language for Special Conditions for Department of the Army [i.e., USACE] Permits Requiring Performance Bonds, provides additional guidance on the use of financial assurances.

Theme FIN 12

Theme Statement

The FEIS should include a Failure Analysis, and should account for risks (e.g., mine pit wall failures or operation failures) associated with unprecedented duration of monitoring and treatment. This was the approach taken in USEPA's assessment of the Pebble Mine.

Thematic Response

The referenced document (USEPA's "Assessment of Potential Mining Impacts on Salmon Ecosystems of Bristol Bay, Alaska") does not address any specific mining proposal, and thus cannot appropriately be applied to the NorthMet Project Proposed Action. FEIS Section 3.2.2.4 provides available details regarding financial assurance. Additional details on the financial assurance would be addressed during permitting. The FEIS analyzes the reasonably foreseeable effects of the NorthMet Project Proposed Action, and includes monitoring systems (i.e., environmental/compliance samples or measurements) to confirm modeled predictions. MDNR has the authority to require remedial action for unforeseen effects or events, and to adjust financial assurance on at least an annual basis when changes are necessary to the reclamation plan.

Theme FIN 13

Theme Statement

Detailed financial assurance information must be included up front, as part of the Environmental Review process, as required by NEPA/MEPA. Without sufficient information on Financial Assurance in the SDEIS, the public's opportunity to comment on it during the public comment period was reduced, as was with the opportunity to understand key elements of the proposed financial assurance. The Project's Financial Assurance discussion should include a robust public debate involving financial and legal experts.

Thematic Response

FEIS Section 3.2.2.4 provides available details regarding financial assurance as required under NEPA/MEPA. *Minnesota Rules* 6132.1200, Subpart 4 state that the Commissioner shall evaluate all financial assurance cost estimates and adjustments to cost estimates using individuals with documented experience in material handling and construction and mining costs. Additional details on the financial assurance that would be required for the project would be addressed during permitting. The Permit to Mine, which would include financial assurance information, includes an opportunity for public input. Neither NEPA nor MEPA rules require that all financial assurance mechanisms be in place before the EIS is finalized.

Theme FIN 14

Theme Statement

State statutes and rules (such as *Minnesota Rules* part 6132.3200) prohibit projects requiring perpetual maintenance after closure. Financial Assurance laws are also inadequate for this project.

Thematic Response

The FEIS describes the state statutes and rules (specifically *Minnesota Rules* 6132.3200) as they relate to long-term maintenance. *Minnesota Rules* 6132.3200, Subpart 2, item E states that financial assurance is required for all areas that require continued maintenance following closure, and that no release from the Permit to Mine would be granted for portions of mining areas that require post-closure maintenance until the maintenance activities are no longer necessary.

Theme FIN 15

Theme Statement

The SDEIS does not discuss federal requirements for Financial Assurance.

Thematic Response

FEIS Section 3.2.2.4 describes how financial assurance would be incorporated into the state Permit to Mine. If issued, USACE permits would require mitigation for indirect wetland effects. Guidance for USACE permits that are conditioned to include any type of financial assurance to ensure that required compensatory mitigation is completed can be found in FEIS Section 5.2.3.3.2, or at:

- 33 CFR Parts 325 and 332, Compensatory Mitigation for Losses of Aquatic Resources; Final Rule, dated April 10, 2008. Financial assurances are specifically discussed at 33 CFR 332.3(n).
- Regulatory Guidance Letter No. 05-1 Date: 14 February 2005 titled: Guidance on the Use of Financial Assurances, and Suggested Language for Special Conditions for Department of the Army [i.e., USACE] Permits Requiring Performance Bonds, provides additional guidance on the use of financial assurances.

Theme FIN 16

Theme Statement

PolyMet has the ability to financially assure the project.

Thematic Response

These comments include general information supporting PolyMet's ability to provide sufficient financial resources for the NorthMet Mining project. No changes were made to the EIS as a result of these comments.

Theme FIN 17

Theme Statement

The Project should be permitted because Financial Assurance will protect against any future problems, and Financial Assurance laws and regulations are sufficient for this purpose.

Thematic Response

These comments include general support for the NorthMet Mining project because the company would provide sufficient funds to financially assure the project. Because no specific information was provided, no changes were made to the EIS as a result of these comments.

A.5.8 Issue: General Opinion (GEN)

Theme GEN 01

Theme Statement

General opposition to the project due to broad environmental concerns, such as “pollution” or “environmental damage.”

Thematic Response

These comments include general opposition to the NorthMet Mining project. Because no specific information was provided, no changes were made to the EIS as a result of these comments.

Theme GEN 02

Theme Statement

General support for the project.

Thematic Response

These comments include general support for the NorthMet Mining project. Because no specific information was provided, no changes were made to the EIS as a result of these comments.

Theme GEN 03

Theme Statement

General opposition to the project due to multiple environmental and/or social concerns.

Thematic Response

These comments include general opposition to the NorthMet Mining project. Because no specific information was provided, no changes were made to the EIS as a result of these comments.

A.5.9 Issue: Geotechnical Stability (GT)

Theme GT 01

Theme Statement

The SDEIS does not properly address the stability risks of using the existing tailings basin, including using the existing LTV tailings basin as a base, and the presence of erosion, peat, and LTV slimes, faults and streams.

Thematic Response

The FEIS summarizes the design of the proposed Tailings Basin in Section 5.2.14.2.2, and includes information on the analyses pertaining to its stability. Existing conditions are accounted for in the design through data gathered from surveys, material testing, and site exploration. Peat represents some of the weaker material within the existing LTVSMC Tailings Basin. The NorthMet Project Proposed Action includes adding a rock buttress within the existing dams to reinforce those areas where peat and fine tailings and slimes layers occur. Peat would be removed from locations where rock buttress would be added to allow the rock to tap into the more competent glacial till. Peat, fines, and slimes layers within the existing tailings basin would also be strengthened through cement deep soil mixing prior to use in the Tailings Basin for NorthMet. The proposed water containment system would capture and remove water that seeps from the Tailings Basin. Results of a probabilistic seismic hazard analysis indicated that a severe earthquake is highly unlikely in Minnesota, and that any seismically induced forces would not likely affect the stability of the Tailings Basin. Geotechnical stability modeling undertaken for the FEIS takes into account the above proposed design measures, as well as the location where peat would remain after construction of the on-site facilities. Modeling indicates that the Factors of Safety would be met. Monitoring and adaptive management would be implemented throughout construction, operation, and maintenance of the Tailings Basin to account for measured stability characteristics to manage the risk of failure. Refer to FEIS Section 5.2.2 for more information about water management at the Tailings Basin. The Geotechnical Data Package, Volume 1 (Tailings Basin) (PolyMet 2015l, as cited in the FEIS) contains specific detail on the design and stability modeling. Stability would be monitored throughout construction and operation in accordance with permit requirements, and adaptive management could be implemented as necessary based on monitoring results (see FEIS Section 5.2.14.2.2). The Flotation Tailings Management Plan (PolyMet 2015n, as cited in the FEIS) contains details of monitoring and management for the Tailings Basin. The details of the design, as well as monitoring and management requirements would be further refined for permitting under the MDNR Dam Safety Permit and the Permit to Mine.

After the close of the comment period on the SDEIS, but prior to publication of the FEIS, an Independent Expert Engineering Investigation and Review panel issued a *Report on Mount Polley Tailings Storage Facility Breach* (January 2015). This report was reviewed by Co-lead Agency geotechnical staff as part of developing this response. Site specific information and design features are essential to understanding geotechnical stability of any tailings basin. The Co-lead Agencies are confident in the site specific data that has been collected for the NorthMet Project and that was used to model geotechnical stability. The design of the NorthMet Project tailings basin is sufficiently different (i.e., shallower slopes, use of buttressing, incorporation of cement deep soil mixing technology) from the Mount Polley Tailings Storage Facility that a direct comparison cannot be made.

Theme GT 02

Theme Statement

The SDEIS does not properly address the stability risks of the tailings basin related to the design standards, including the risk of the liquefaction factor of safety 1.1 being too low. Design criteria are vague and shouldn't be based on existing tailings basins in Minnesota.

Thematic Response

The Co-lead Agencies believe that the design criteria and minimum Factors of Safety required for the NorthMet Project are adequate and are in-line with the state of the industry. These criteria are consistent with world-wide industry standards and not limited or restricted by local Minnesota regulations. The Geotechnical Data Package, Volume 1 (Tailings Basin) (PolyMet 2015l, as cited in the FEIS) contains specific detail on the design and stability modeling. Stability would be monitored throughout construction and operation in accordance with permit requirements, and adaptive management could be implemented as necessary based on monitoring results. Details of monitoring and management for the Tailings Basin are provided in the Flotation Tailings Management Plan (PolyMet 2015n, as cited in the FEIS). The details of the design, as well as monitoring and management requirements would be further refined for permitting under the MDNR Dam Safety Permit and the Permit to Mine. FEIS Section 5.2.14.2.2 summarizes the design, stability modeling results, monitoring and adaptive management measures for the proposed Tailings Basin.

Theme GT 03

Theme Statement

The SDEIS does not properly address the stability risks of the tailings basin related to components of the design proposal, including the suitability of the rock buttresses (including construction on top of peat) and the hydrostatic pressure resulting from the water containment system.

Thematic Response

The FEIS summarizes the design of the proposed Tailings Basin in Section 5.2.14.2.2 and includes information on the analyses pertaining to its stability, including the proposed rock buttress. Peat would be removed prior to the construction of the buttress so that the buttress could key tap into the stronger underlying glacial till. Since the SDEIS, PolyMet has included cement deep soil mixing in the proposed design to further stabilize the fines and slimes layers in the existing LTVSMC tailings before placing NorthMet tailings in the Tailings Basin. See FEIS Sections 3.2.2.3.3 and 3.5.2.14.2.2 for more information on cement deep soil mixing. The proposed water containment system would capture and remove water that seeps from the Tailings Basin. Hydrostatic pressure from this system was considered in the design and stability modeling. The Geotechnical Data Package, Volume 1 (Tailings Basin) (PolyMet 2015l, as cited in the FEIS) contains specific detail on the design and stability modeling. Stability would be monitored throughout construction and operation in accordance with permit requirements, and adaptive management could be implemented as necessary based on monitoring results (see FEIS Section 5.2.14.2.2). The Flotation Tailings Management Plan (PolyMet 2015n, as cited in the FEIS) contains details of monitoring and management for the Tailings Basin. The details of the design, as well as monitoring and management requirements would be further refined for permitting under the MDNR Dam Safety Permit and the Permit to Mine.

Theme GT 04

Theme Statement

The FEIS should clarify the design of the waste rock stockpiles with respect to geotechnical stability, including:

- angle of repose;
- recommended minimum cover slope of least 2 %;
- site-specific and material specific tests prior to construction, and rigorous construction quality assurance;
- the required factors of safety; and
- design details.

Thematic Response

The design of the stockpiles would need to conform with Minnesota Rule 6132.2400. FEIS Section 5.2.14.2.1 provides a summary of the design requirements for the stockpiles including angles of repose, configured stockpile slopes, factors of safety, as well as the material tests that have occurred to date and that would be required prior to permitting. Geotechnical Data Package Volume 3 (Stockpiles) (PolyMet 2014p, as cited in the FEIS) and the Rock and Overburden Management Plan (PolyMet 2015h, as cited in the FEIS) contain further information on the design and management of the stockpiles. Additional geotechnical investigations to address site conditions, materials and design would be required prior to stockpile construction approval under the Permit to Mine.

Theme GT 05

Theme Statement

The SDEIS does not properly address the stability risks of the tailings basin related to unusual but possible events, including:

- seismic events (e.g. using probabilistic method for determining maximum credible seismic event);
- dynamic modeling (as recommended by Chambers and Levit report); and
- extreme weather events (what was the probable maximum precipitation event modeled).

Thematic Response

Geotechnical analysis conducted for the FEIS included consideration for potential seismic liquefaction and extreme weather events. Details are provided in the Flotation Tailings Management Plan (PolyMet 2015n, as cited in the FEIS) and the Geotechnical Data Package Volume 1 (PolyMet 2015l, as cited in the FEIS). The results are summarized in FEIS Section 5.2.14.2.2. The details of the design, as well as monitoring, maintenance, and adaptive management requirements would be further refined for permitting under the MDNR Dam Safety Permit and the Permit to Mine.

A seismic liquefaction analysis was undertaken for the Tailings Basin. Results indicated that a significant earthquake is unlikely in Minnesota, and a seismic design event (2,475-year return period) is not likely to trigger liquefaction in the Tailings Basin materials. Seismic deformation was also considered, and the effect of settlement resulting from a design earthquake event would not affect the stability or pond containment of the Tailings Basin.

Extreme weather events are accounted for in the design of the Tailings Basin, whereby the freeboard requirements have been determined to accommodate pond bounce from the Probable Maximum Precipitation (PMP) event. The design of the Tailings Basin also includes an emergency overflow spillway to help limit pond storage if an event occurs where the freeboard is not sufficient to contain all stormwater. Tailings Basin stability modeling was undertaken to assess the effect of a PMP event pond bounce. Results indicated that the required Factor of Safety would be met.

Modeling showed that liquefaction was unlikely to occur; therefore, dynamic modeling was neither required nor performed for the design of the facility. Instead, a fully liquefied condition was analyzed to represent the critical condition.

Theme GT 06

Theme Statement

Would peat beneath the dikes present stability problems?

Thematic Response

Peat represents some of the weaker material within the existing LTVSMC tailings basin. It occurs in some areas under the existing LTVSMC dams, and beyond the toe of the dams. The NorthMet Project Proposed Action includes adding a rock buttress within the existing dams to reinforce those areas where peat and fine tailings and slimes layers occur. Virgin peat at the toe of the dams would be removed from the location of rock buttresses to allow the rock to tap into the more competent glacial till. Peat, fines, and slimes layers within the existing tailings basin would also be strengthened through cement deep soil mixing prior to use of the Tailings Basin for NorthMet. See FEIS Sections 3.2.2.3.3 and 3.5.2.14.2.2 for more information on cement deep soil mixing. Geotechnical stability modeling undertaken for the FEIS takes into account the above proposed design measures, as well as the location where peat would remain after construction of the on-site facilities. Modeling indicates that the Factors of Safety would be met. Monitoring and adaptive management would be implemented throughout construction, operation and maintenance of the Tailings Basin to account for measured stability characteristics to manage the risk of failure. FEIS Section 5.2.14.2.2 provides information on the design criteria, stability modeling methodology and results, and monitoring, maintenance and adaptive management relating to stability of the proposed Tailings Basin. Additional detail is provided in

Geotechnical Data Package, Volume 1 (Tailings Basin) (PolyMet 2015l, as cited in the FEIS) as well as the Flotation Tailings Management Plan (PolyMet 2015n, as cited in the FEIS).

Theme GT 07

Theme Statement

More information should be provided on operations and monitoring, potential contingency actions (e.g. physical modifications), and response to unplanned and catastrophic events (e.g. extreme weather events, equipment failure, human error) at the Tailings Basin, Hydrometallurgical Residue facility, and stockpiles.

Thematic Response

FEIS Section 5.2.14 includes subsections addressing the waste rock Stockpiles, Tailings Basin, and Hydrometallurgical Residue Facility respectively that describe operations, monitoring and contingency management actions. These sections have been revised since the SDEIS to provide additional information and clarity. The Rock and Overburden Management Plan (PolyMet 2015h, as cited in the FEIS), the Residue Management Plan (PolyMet 2014r, as cited in the FEIS), and the Flotation Tailings Management Plan (PolyMet 2015n, as cited in the FEIS) provide detailed information on the monitoring and mitigation of these features. Details on operation and monitoring would be further refined during permitting.

Theme GT 08

Theme Statement

The FEIS should include additional detail regarding the borrow, tailings, and bentonite materials considered for construction of the waste facilities.

Thematic Response

FEIS Sections 3.2 and 5.2.14 provide a summary of the material to be used and disposed of in the proposed stockpiles, Tailings Basin, and Hydrometallurgical Reside Facility. FEIS Section 5.2.14 addresses the stability of the waste facilities (proposed stockpiles, Tailings Basin, and Hydrometallurgical Reside Facility), while the remainder of Chapter 5 addresses other potential environmental consequences relating to those materials (e.g., water impacts are addressed in FEIS Section 5.2.2). Additional information pertaining to tailings and construction materials is provided in the corresponding Geotechnical Data Packages for the Tailings Basin (PolyMet 2015l, as cited in the FEIS), Hydrometallurgical Residue Facility (PolyMet 2014c, as cited in the FEIS), and stockpiles (PolyMet 2014p, as cited in the FEIS), as well as the Flotation Tailings Management Plan (PolyMet 2015n, as cited in the FEIS), Residue Management Plan (PolyMet 2014r, as cited in the FEIS), and the Rock and Overburden Management Plan (PolyMet 2015h, as cited in the FEIS). Additional detail on construction materials would be included in the MDNR Dam Safety Permit and Permit to Mine.

Theme GT 09

Theme Statement

The FEIS should clarify closure concepts, including plans to address existing over-steepened embankments on Tailings Basin Cell 2W, as well as long term monitoring and maintenance (e.g. bentonite, erosion and vegetation cover) for the waste facilities.

Thematic Response

The NorthMet Project Proposed Action does not include actions to redesign the existing Cell 2W apart from utilizing coarse LTVSMC tailings as borrow for the construction of the new NorthMet Project Proposed Action lifts. Removing some of those coarse LTVSMC tailings could reduce the slope of the Cell 2W embankments. The conditions and stability of the entire basin is monitored and maintained under the existing permit requirements, and would be monitored under the NorthMet Project Proposed Action permit requirements, should the project be permitted. Closure of the NorthMet Project Proposed Action facilities is described in the respective parts of FEIS Section 3.2. FEIS Section 5.2.14 has been revised in the FEIS to improve clarity on closure requirements, including monitoring and maintenance for the waste facilities as it relates to stability. Additional detail can be found in the Flotation Tailings Management Plan (PolyMet 2015n, as cited in the FEIS), Residue Management Plan (PolyMet 2014r, as cited in the FEIS), and the Rock and Overburden Management Plan (PolyMet 2015h, as cited in the FEIS).

Theme GT 10

Theme Statement

The FEIS should provide additional details on the proposed stockpile liner and geomembrane systems including:

- Ground preparations, installation, and use;
- Short- and long-term performance (conductivity). The same conductivity (10-6) should be prescribed for both the Category 2/3 and Category 4 stockpiles;
- The potential for long-term deterioration due to acid, extreme weather, or other factors, and the impact of this deterioration on factors of safety;
- The potential for spreading and separation of the panel overlaps due to settling;
- Additional citations for expected liner performance;
- Site-specific and material-specific tests prior to construction and rigorous construction quality assurance; and
- Long term monitoring and maintenance.

Thematic Response

FEIS Sections 3.2.2.1.7 and Section 5.2.14.2.1 summarize the design of the proposed stockpiles and liners; these sections have been supplemented since the SDEIS. FEIS Section 3.2.2.1.10 provides a summary of the design of the Category 1 Stockpile geomembrane cover system. The Geotechnical Data Package, Volume 3 (Stockpiles) (PolyMet 2014p, as cited in the FEIS) and the Rock and Overburden Management Plan (PolyMet 2015h, as cited in the FEIS) provide technical and design information for the stockpiles and liners (including liner leakage analysis and foundation settling).

The permanent Category 1 Stockpile would not be lined, but would instead be surrounded by a containment system to that would capture groundwater and surface runoff and direct it to a WWTF for treatment. At closure, the Category 1 Stockpile would be covered with a geomembrane system that would be vegetated to meet the requirements of *Minnesota Rules* part 6132.2200, subpart 2, item B. The design of the Category 1 Stockpile cover system was derived from landfill requirements in *Minnesota Rules* part 7035.2815, subpart 6, item D. Long-term maintenance of the Category 1 Stockpile would include repair of erosional damage and removal of woody species and trees from the stockpile cover system. The factors of safety estimated during slope stability are not anticipated to change due to long-term performance variation in the geomembrane.

Liners would be used at the temporary Category 2/3 and Category 4 stockpiles. Additional detail on the foundation materials and design would be required for permitting; however, local soils appear suitable (or could be treated) for foundation material in order to meet permeability design criteria. The Category 4 Stockpile liner has a lower permeability design criteria than the Category 2/3 Stockpile liner because the Category 4 waste rock would be more reactive. These stockpiles would be removed and reclaimed prior to the end of mining (i.e., prior to year 20). The liners for these stockpiles would perform to expectations throughout the duration of their need.

The Co-lead Agencies believe the level of analysis and information provided in the FEIS is sufficient for an environmental impact statement as required under NEPA and MEPA. Additional geotechnical analysis and design details would be required for permitting, including more detail on the foundation material characteristics, design details to ensure foundation and liner integrity, and details on the installation, operation, monitoring, and maintenance of the liners, covers, and stockpiles.

Theme GT 11

Theme Statement

The SDEIS does not properly address the stability risks of the Hydrometallurgical Residue Facility, including:

- Potential liquefaction scenarios;
- How seepage from the Tailings Basin may affect the Hydrometallurgical Residue Facility;
- The presence of emergency LTVSMC tailings at the base of the Hydrometallurgical Residue Facility—this material should be removed;
- Consequences of unsuccessful wick drain installation;
- Dynamic modeling, as recommended by the Chambers and Levit report;
- Insufficient consolidation tests and assumption of homogeneity in the settling analysis of LTVSMC tailings and slimes; and
- The presence of faults.

Thematic Response

FEIS Section 5.2.14.2.3 summarizes the geotechnical stability of the Hydrometallurgical Residue Facility. Details are provided in the Geotechnical Data Package, Volume 2 (PolyMet 2014c, as cited in the FEIS) and design, construction, monitoring, maintenance, and adaptive management is addressed in the Residue Management Plan (PolyMet 2014r, as cited in the FEIS).

The Hydrometallurgical Residue Facility would be constructed using the downstream methods at the existing LTVSMC Emergency Tailings basin. The LTVSMC emergency tailings would be consolidated and compacted prior to the construction of the proposed facility. New dams would be located beyond the extent of the emergency basin and founded on existing silty sand, gravel glacial till, and Giants Range granite.

Materials placed in thin, well-compacted lifts such as that proposed for the Hydrometallurgical Residue Facility embankment fill are understood to be sufficiently dense of critical state that liquefaction is not anticipated under the various loading conditions considered for the design of the Hydrometallurgical Residue Facility. Although liquefaction of the hydrometallurgical residue (within the basin) may occur, the facility is designed such that containment is not reliant upon the strength of the residue. Therefore, the integrity of the facility would not be impacted by a loss of strength associated with potential residue liquefaction.

Seeps have been observed along the southern edge of the LTVSMC Tailings Basin Cell 2W. These seeps have diminished since the termination of LTVSMC operations and are expected to remain minimal, because Cell 2W is not proposed for use as part of the NorthMet Project Proposed Action. The current design of the Hydrometallurgical Residue Facility acknowledges the presence of this seep by including a collection drain that would collect water from the seep below the proposed constructed embankment and liner systems to transmit the collected seep to the exterior of the facility. This seepage collection system would consist of a layer of free draining soil that would reduce the potential for phreatic build-up below the liner.

Construction monitoring and mitigation plans would require further detail for permitting to evaluate consolidation of the LTVSMC tailings, settlement for the Hydrometallurgical Residue Facility and performance of the wick drains.

One Minnesota Geological Survey figure indicates an inferred (but not confirmed) fault underlying the proposed Hydrometallurgical Residue Facility; however, the area has also been mapped without an inferred fault (PolyMet 2014c, as cited in the FEIS). The potential presence of faults within the footprint of the Hydrometallurgical Residue Facility is not anticipated to have a negative impact on the storage of residue within the double-lined facility. Results of a probabilistic seismic hazard analysis for the Hydrometallurgical Residue Facility indicated that a severe earthquake is highly unlikely in Minnesota, and that seismically induced forces would not likely affect the stability of the Hydrometallurgical Residue Facility.

A fully dynamic model was not developed for the Hydrometallurgical Residue Facility. Because the facility would be constructed of compacted borrow material in the downstream method, the effects of the relatively small earthquake event are not believed to be significant relative to the performance of the Hydrometallurgical Residue Facility.

Theme GT 12

Theme Statement

The FEIS should provide additional geotechnical details on the proposed Hydrometallurgical Residue Facility liner and cover systems, including:

- Ground preparations, installation, and use;
- Short- and long-term performance (conductivity);
- The potential for long-term deterioration due to acid, extreme weather, or other factors, and the impact of this deterioration on factors of safety;
- The potential for spreading and separation of the liner panel overlaps due to settlement;
- Additional citations for expected liner performance;
- Site-specific and material-specific tests prior to construction and rigorous construction quality assurance; and
- Long term monitoring and maintenance.

Thematic Response

FEIS Section 3.2.2.3.7 summarizes the Hydrometallurgical Reside Facility design and construction, Section 3.2.2.3.10 summarizes water management at the Hydrometallurgical Reside Facility, and Section 3.2.2.3.12 summarizes reclamation of the Hydrometallurgical Reside Facility. FEIS Section 5.2.14.2.3 provides details pertaining to geotechnical stability, including ground preparations, construction, monitoring, and maintenance of the Hydrometallurgical Reside Facility. This section has been supplemented since the SDEIS to include additional detail and clarity.

The Hydrometallurgical Reside Facility design includes a double liner system using geosynthetic materials. Stress on the liner system resulting from settling of the foundation material would be mitigated by consolidation of the existing LTVSMC emergency tailings prior to construction of the facility. A collection drain would also be installed to collect water from below the proposed constructed embankment and liner systems and transmit it to the exterior of the facility to reduce the potential for phreatic build-up below the liner. A stress deformation analysis found that strain on the liner system would be within acceptable limits of most geosynthetics. Results would not be noticeably affected by a large precipitation event.

PolyMet initiated laboratory testing to consider the chemical compatibility of the potential geosynthetic liner to be used with leakage from residue (PolyMet 2014r). Results indicated the use of a polymer-treated geosynthetic liner that is manufactured specifically in anticipation of the chemical characteristics of the liquid and the pore water that would be contained within the facility. The hydraulic conductivity of the soil leakage collection system is not expected to degrade over time. Typical liner performance assumes a 500-year service life of the geomembrane; therefore, hydraulic conductivity of the liner is not expected to degrade over that time. Specific attributes would be determined during the geosynthetic clay layer development to achieve the desired performance before final installation.

Findings of studies on geosynthetic liners indicate that performance is minimally affected by freeze-thaw cycles (PolyMet 2014c, as cited in the FEIS). At the Hydrometallurgical Residue

Facility, the majority of the geosynthetic liner system would be below the water elevation, and therefore not exposed to freeze-thaw cycles.

Reclamation of the Hydrometallurgical Residue Facility would include removal of ponded water, removal of pore water from the residue, construction of the cover system, and establishment of vegetation and surface water runoff controls. Maintenance activities that would continue throughout reclamation and post-reclamation include dam slope erosion repair, and woody species and tree removal.

The Co-lead Agencies believe the level of analysis and information provided in the FEIS are sufficient for an EIS, pursuant to NEPA and MEPA. Additional geotechnical analysis and design details would be required for permitting, including more detail on the foundation material characteristics, design details to ensure foundation and liner integrity, and details on the installation, operation, monitoring and maintenance of the liners, covers, and the stability of the Hydrometallurgical Residue Facility.

Theme GT 13

Theme Statement

Tailings Basin stability model inputs are inadequately explained (e.g. terms of methodology for selection validity and reliability). There seems to be missing values of compression index (Cc) and swell index (Cs) for the LTVSMC tailings, peat, and residue.

Thematic Response

FEIS Section 4.2.14.2 summarizes the existing conditions and material inputs for the proposed Tailings Basin geotechnical modeling. FEIS Section 5.2.14.2.2 summarizes the design, modeling methodology and results, as well as the monitoring, maintenance and adaptive management for the proposed Tailings Basin. These sections have been revised since the SDEIS to improve clarity and to incorporate updated modeling information. Details on geotechnical modeling for the Tailings Basin are provided in Geotechnical Data Package, Volume 1 (Tailings Basin) (PolyMet 2015l, as cited in the FEIS), and proposed monitoring and management of the Tailings Basin is described in the Flotation Tailings Management Plan (PolyMet 2015n, as cited in the FEIS).

Theme GT 14

Theme Statement

The project enhancements for geotechnical stability from the DEIS to the SDEIS were not clearly stated.

Thematic Response

The proposed design and management of the proposed waste management facilities has evolved throughout the EIS. These modifications have resulted in improved expected stability as well as enhanced environmental outcomes (such as water impacts). Notable enhancements to the design of the proposed waste management facilities since the DEIS include:

- improving stability at the Tailings Basin by adding rock buttressing along the northern edge, and adding cement deep soil mixing in the fines and slimes layers along the northern sections of the LTVSMC tailings basin;
- moving the Hydrometallurgical Residue Facility from on top of the LTVSMC tailings basin, to a site adjacent to the LTVSMC tailings basin, and designing the Hydrometallurgical Residue Facility as a double-lined facility constructed using the downstream construction method;
- designing the Category 1 Stockpile as a permanent feature with a containment system for groundwater runoff and seepage, and geomembrane cover for closure (progressively reclaimed); and
- designing the Category 2/3 and 4 waste stockpile as temporary features, with liners, and to use reclaim the stockpiles but using the waste rock as backfill in the East and Central pits.

FEIS Sections 2.3, 2.4 and 3.2.3 provide an overview of the evolution of the NorthMet Project Proposed Action. Details of the current NorthMet Project Proposed Action are provided in Section 3.2. FEIS Section 5.2.14 provides details of the design factors, management, and modeling results pertaining to geotechnical stability of the waste material storage facilities.

Theme GT 15

Theme Statement

The SDEIS does not properly address the potential environmental consequences of a geotechnical failure due to unplanned and catastrophic events (e.g. extreme weather events, equipment failure, human error) at the Tailings Basin, Hydrometallurgical Residue facility, stockpiles, or pit.

Thematic Response

If incorrectly designed, constructed, and/or managed, or from other unforeseen circumstances, waste material storage facilities would have the potential to result in increased hydrologic and/or water quality effects and could potentially lead to slope or dam failure. Because the risk of failure is mitigated through application of design and safety requirements, including adaptive management procedures, the potential effects of hypothetical failure scenarios are not assessed in the FEIS. Design and safety requirements are summarized in FEIS Section 5.2.14, and detailed in the Geotechnical Data Packages (PolyMet 2015l, PolyMet 2014c, PolyMet 2014p, as cited in the FEIS) and management plans (PolyMet 2015n, PolyMet 2014r, and PolyMet 2015h, as cited in the FEIS).

The design of the NorthMet Project Proposed Action geotechnical features has been developed using an iterative approach, whereby the design has been amended until modeling results meet the required design criteria, including Factors of Safety and other requirements for permitting. Stability modeling undertaken to inform these design requirements included extreme scenarios such as maximum precipitation events and earthquakes. This process resulted in additional engineering design features to strengthen the waste disposal facilities that now form part of the NorthMet Project Proposed Action. These include moving the Hydrometallurgical Reside Facility to a location adjacent to, but off of the existing tailings basin, and proposing construction of that facility using the downstream construction method. The design of the proposed Tailings Basin was also enhanced through the addition of the rock buttress and cement deep soil mixing. Designs would be further refined during the permitting process and optimized during construction, operation and closure, based on monitoring and adaptive management that required under permits.

The large-scale waste material storage facilities proposed for the NorthMet Project Proposed Action require compliance with MDNR nonferrous mining and dam safety rules, as well as the MPCA NPDES/SDS Permit. The Dam Safety permit requires that design and safety criteria be met to reduce the risk of potential failure. Under Minnesota Rule 6115.0490, Class 1 dams require contingency plans that inform emergency responders in the unlikely event of dam failure. As such, a dam break analysis may be required for the Tailings Basin and considered for safety management purposes under the Dam Safety Permit.

A.5.10 Issue: Hazardous Materials (HAZ)

Theme HAZ 01

Theme Statement

The EIS does not adequately describe how hazardous materials would be managed within the project area, or the potential impacts of hazardous materials spills or other incidents. Materials of concern include gasoline, diesel, oil, chemicals, explosives, and reject concentrate. Impacts of concern include human health, groundwater, surface water, vegetation, or other natural resources.

Thematic Response

FEIS Section 5.2.13 provides descriptions and references or citations regarding hazardous materials management; hazardous material management plan requirements (transportation, storage, use and disposal); emergency planning and community right-to-know recordkeeping and reporting requirements; and hazardous material spill response management and mitigation measure requirements.

A hazardous substance is defined by 40 CFR 302.3 as any substance designated pursuant to 40 CFR Part 302.

Hazardous waste as defined by *Minnesota Statutes* 116.06, subdivision 11:

> means any refuse, sludge, or other waste material or combinations of refuse, sludge or other waste materials in solid, semisolid, liquid, or contained gaseous form which because of its quantity, concentration, or chemical, physical, or infectious characteristics may (a) cause or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible illness; or (b) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed. Categories of hazardous waste materials include, but are not limited to: explosives, flammables, oxidizers, poisons, irritants, and corrosives. Hazardous waste does not include source, special nuclear, or by-product material as defined by the Atomic Energy Act of 1954, as amended.

Hazardous waste may simply be defined as a waste that is a listed hazardous waste, or waste that exhibits ignitability, corrosivity, reactivity, toxicity, lethality, or is an oxidizer as described in *Minnesota Rules* 7045.0131: Characteristics of Hazardous Waste.

Potential impacts of hazardous materials to human health, groundwater, surface water, vegetation, and other natural resources may be found within the resource topic areas of FEIS Section 5.2.

The EIS process is not intended to replace good compliance planning, nor is it meant to provide explicit detail of spill response plans, hazardous material reduction plans, hazardous material or waste management plans, and contingency plans. Hazardous materials would be managed according to applicable Minnesota and Federal regulations.

Theme HAZ 02

Theme Statement

Materials deposited in the HRF should be assessed/characterized to determine whether HRF wastes or any part of them are hazardous wastes under Minnesota Law. Contaminants include nickel, arsenic, and mercury. The HRF should be considered a hazardous waste landfill and be regulated as such. Leakage will occur.

Thematic Response

Hazardous waste as defined by *Minnesota Statutes* 116.06, subdivision 11, "means any refuse, sludge, or other waste material or combinations of refuse, sludge or other waste materials in solid, semisolid, liquid, or contained gaseous form which because of its quantity, concentration, or chemical, physical, or infectious characteristics may (a) cause or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible illness; or (b) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed. Categories of hazardous waste materials include, but are not limited to: explosives, flammables, oxidizers, poisons, irritants, and corrosives. Hazardous waste does not include source, special nuclear, or by-product material as defined by the Atomic Energy Act of 1954, as amended."

Minnesota Rules 7045.0120 Subpart 1.I provides exemption to waste from extraction, beneficiation, and processing of ores and minerals in regard to storage, labeling, transportation, treatment, processing and disposal. Waste, hazardous only due to zinc, copper, nickel, and some other less common metals are not regulated as RCRA hazardous wastes. The MPCA anticipates that PolyMet would be licensed as a hazardous waste generator and not as a treatment, storage, and disposal facility.

The Hydrometallurgical Residue Facility would be constructed with the following layers from lower to higher: liner subgrade, geosynthetic clay liner, 60 millimeter low density polyethylene geomembrane, geocomposite leachate collection layer, 80 millimeter low density polyethylene geomembrane, geocomposite leachate drainage collection layer, and LTVSMC coarse tailings. Hydrometallurgical residue would be placed above the LTVSMC coarse tailings layer. The Residue would settle out within the Hydrometallurgical Residue Facility and remaining process water would be pumped from the Hydrometallurgical Residue Facility back to the Hydrometallurgical Plant. Water would be lost from this closed loop system to evaporation from the cell surface, and entrapment within the Residue's pore space. The double liner system would limit leachate leakage from the bottom of the cell. Precipitation falling within the Hydrometallurgical Residue Facility would be retained. During operations, leachate collected in the system would be recycled back into the Hydrometallurgical Residue Facility pond. During reclamation and long-term closure, leachate would be routed and cycled through the WWTP (PolyMet 2014r, as cited in the FEIS).

Material from the existing coal ash landfill is anticipated to be placed into the Hydrometallurgical Residue Facility during operations (PolyMet 2014b). Chemical and physical characteristics of materials placed in the Hydrometallurgical Residue Facility would be approved by the MPCA, within permit requirements, and would be placed in a manner as to not compromise the integrity of the liner system (Personal Communication from Jennifer Saran (PolyMet) RE: Additional detail on addition of Coal Ash landfill material to HRF, November 4, 2014).

PolyMet reports (Reference: "Information Provided By PolyMet Regarding Hydrometallurgical Residue Testing for RCRA Thresholds," August 2014) indicate that 17 residue samples from 2005 pilot-plant testing and one residue sample from 2009 pilot-plant testing were analyzed using the Toxicity Characteristic Leaching Procedure (TCLP) (EPA Method 1311). The method is typically used to assess solid waste to determine if the waste has toxicity characteristics exceeding RCRA hazardous waste thresholds. All 18 analytical tests resulted in TCLP analytical results less than the RCRA hazardous waste thresholds, indicating that for the metal parameters analyzed, the hydrometallurgical residue is not characteristically hazardous. All of the residues that were produced during the pilot plant testing in 2005 and 2009 represent residues that would be deposited into the Hydrometallurgical Residue Facility. Once Phase 2 is operational and as part of initial operational optimization, individual and combined residue samples would be analyzed weekly for physical characteristics, total metals, and TCLP. Once operations are optimized, individual and combined residue samples would be analyzed monthly for the same parameters. Hydrometallurgical Residue Facility pond and Hydrometallurgical Residue Facility leachate samples are expected to be sampled and analyzed for metals on a quarterly basis. These samples would continually be collected to confirm that physical and chemical characteristics of the hydrometallurgical residue are not characteristically hazardous, subject to RCRA, and are in compliance with the Permit to Mine and NPDES/SDS permits (Personal Communication from Jennifer Saran (PolyMet) to Bill Johnson (DNR), September 12, 2014).

The MPCA reviewed residue pilot-testing and analysis data provided by PolyMet and has established the following statements (Personal Communication from Richard Clark (MPCA) to Lisa Fay (DNR), October 24, 2014) 1) TCLP testing results of pilot test residues in 2005 and 2009 did not meet the thresholds to be regulated as a RCRA hazardous waste; 2) Elimination of the bulk hydrometallurgical mode from the project would not materially affect the chemical composition of residue stored in the Hydrometallurgical Residue Facility, and 2005 and 2009 testing results would be representative of the residue stored in the Hydrometallurgical Residue Facility if the current project is approved; and 3) New residue resulting from future hydrometallurgical pilot-testing and/or Phase 2 of the project should be tested to verify that the residue remains under RCRA hazardous waste thresholds.

Theme HAZ 03

Theme Statement

The EIS does not adequately define the toxicity of mining-related wastes. Mining-related waste could possibly release sulfuric acid and metals to the environment. Radioactive minerals could also be released.

Thematic Response

Mining-related waste and waste in general that has not been excluded from regulation as hazardous waste under *Minnesota Rules* 7045.0120, is a hazardous waste if the waste exhibits ignitability, corrosivity, reactivity, toxicity, lethality, or is an oxidizer as described in *Minnesota Rules* 7045.0131: Characteristics of Hazardous Waste.

Toxicity in the context of mining-related waste refers to the hazardous toxic characteristic of a solid waste. Toxicity of the waste is determined through laboratory analysis using the TCLP method (see response to theme HAZ 02). If the extract from a representative sample of the waste contains any of the contaminants at concentrations equal to or greater than the concentration values listed in *Minnesota Rules* 7045.0131, Subpart 8: Maximum Concentration of Contaminants for the Toxicity Characteristic; the waste exhibits toxicity characteristics and is considered toxic hazardous waste, unless that waste has been excluded from hazardous waste regulation under *Minnesota Rules* 7045.0120.

Generally, a waste has the characteristic of corrosivity if the waste is aqueous and 1) has a pH less than or equal to 2.0 or greater than or equal to 12.5, or 2) corrodes steel at a rate greater than 6.35 mm per year.

Analytical testing of nine hydrometallurgical residue samples from 2005 pilot-testing produced pH values ranging from 4.74 to 9.8. Analytical testing of one sample of autoclave leach residue from bulk concentrate from 2005 pilot-testing produced a pH value of 4.94. Analytical testing of one sample of autoclave leach residue from nickel rich concentrate from 2009 pilot-testing produced a pH value of 4.93 (SRK 2014, as cited in the FEIS).

Radiation or radionuclides, if detected, would be regulated through applicable *Minnesota Rules* 4731-Radiation Safety, by the Minnesota Department of Health and/or the USEPA through the Clean Water Act and Clean Air Act.

FEIS Section 4.2 describes existing conditions that may be affected directly or indirectly by the NorthMet Project Proposed Action.

Theme HAZ 04

Theme Statement

The EIS does not adequately describe the toxicity, fate, and transport to the environment of chemicals used in the flotation processes.

Thematic Response

FEIS Sections 3.2.2 and 3.2.3 describe large-quantity chemicals to be used at the Mine Site and the Plant Site, as well as transport through the processes and the consumption/fate of these chemicals. Toxicity of each individual chemical or consumable product/compound would be described on specific Material Safety Data Sheets (MSDSs) for each substance. MSDSs would be retained as part of Hazardous Material Management planning/compliance, and EPCRA documentation and reporting requirements.

Theme HAZ 05

Theme Statement

The EIS should provide additional information on Areas of Concern (AOCs), especially the current status and costs of clean-up, PolyMet's responsibilities, and requirements for mitigation.

Thematic Response

Table 4.2.1-2: NorthMet Project Proposed Action Area of Concern Summary List for Voluntary Investigation and Cleanup Program, has been updated in the FEIS to show the current status and additional information where available. Costs for assessment, investigation, and cleanup are not available or reasonably calculable at this time..

The April 6, 2010, Consent Decree is a court registered agreement between Cliffs Erie LLC and the MPCA to resolve alleged violations of Cliffs Erie's NPDES/SDS permits for its Hoyt Lakes and Dunka mining area facilities. Of particular relevance to the NorthMet project, the Consent Decree addresses issues at the current Cliffs Erie tailings basin (including outfall SD026) and discharges from the Cliffs Erie Area 5 mining area (SD033). The tailings basin is part of the NorthMet Project Proposed Action, whereas Area 5 is not; however, PolyMet has entered into an agreement with Cliffs Erie whereby both areas would be transferred to PolyMet upon issuance of project permits. Until that time, Cliffs Erie retains responsibilities for permit-related activities at the tailings basin and Area 5. While certain Consent Decree-related activities have been in progress or have been completed for these areas since preparation of the SDEIS, there has been no change in ownership or responsible parties since that time.

Theme HAZ 06

Theme Statement

The EIS does not adequately describe how accidents resulting from transportation of hazardous materials to and from the project site will be handled. Materials being shipped by rail and/or truck include copper concentrate, mixed nickel/copper hydroxide, PGE precipitate, and potassium amyl xanthate. Would local communities and emergency first responders be prepared to handle emergency releases of these products, and what would be the environmental impacts of such releases?

Thematic Response

FEIS Section 5.2.13.2.1 addresses transportation and incident response for hazardous materials.

Accidental spills or incidents resulting from rail or truck transportation of hazardous material or any materials would initially be assessed by the nearest first responders, including local community fire departments or other emergency personnel. Local communities and emergency responders are trained in hazardous material awareness and operations, and are familiar with (or have access to) the 2012 Emergency Response Guidebook (PHMSA 2012c, as cited in the FEIS).

The guidebook describes safety precautions, material identification and associated hazards, response steps to take based on the specific material, and notification requirements and request for additional technical information or assistance.

In the event of releases, first responders typically request additional resources through the State Duty Officer and/or the National Response Center, based on the assessed severity of the event. Where appropriate, the State Duty Officer or National Response Center may notify the State's Homeland Security and Emergency Management Division (part of the Minnesota Department of Public Safety), along with other appropriate state agencies, the USEPA, and the carrier company, among others. In the event of an incident or accident involving the release of a hazardous material, 49 CFR also requires that the carrier notify local emergency response personnel, the National Response Center, and the State Duty Officer. Additional emergency resources are available from the City of Duluth's Haz Mat team. Haz Mat team members are trained as hazardous materials Technicians and Specialists (those capable of full understanding of hazardous material characteristics, assessment, and mitigation of "hot-spot" zones). The team is also capable of initial or intermediate cleanup, dependent upon the nature and characteristics of the material, the severity, and the media affected as a result of the accident.

Should an incident or accident require additional soil, surface water, or groundwater investigation or cleanup, the MPCA, MDH or MDA would be the responsible agency to administer or provide oversight to an environmental engineering contractor, if hired by the transportation carrier. Under certain situations, state agency contractors might conduct the investigation or cleanup. St. Louis County maintains a Hazard Mitigation Plan (Reference 2013), and an Emergency Operations Plan (Reference) for reference or general response guidance for a wide variety of hazards. The Western Lake Superior Area Maritime Security Committee and the Western Lake Superior Port Area Committee also maintain plans for recovery of hazardous materials. The Bois Forte Band of Chippewa maintains a Hazard Mitigation Plan.

Hazardous materials, hazardous waste management, and spill response training is stipulated by the administrative rules, statues, and regulations described in FEIS Section 5.2.13.2.

A.5.11 Issue: Human Health (HU)

Theme HU 01

Theme Statement

A Human Health Impact Assessment (HIA) should be prepared to address the human health risks of the NorthMet project. Specifically, the HIA should characterize the potential health impacts from the Project's effects on air water quality, and food (including drinking water). Societal costs from mining-related pollution should be identified. The HIA would integrate human health into the EIS from its current piecemeal fashion.

Thematic Response

The SDEIS analyzed risks to human health, specifically how the NorthMet Project Proposed Action could affect air quality, surface water quality, and ground water quality, including effects to drinking water and food sources. However, this information was presented in various media-specific chapters of the SDEIS, rather than in a consolidated section on the assessment of human health risks.

The MDNR and the Minnesota Department of Health (MDH) met after the close of the public comment period for the SDEIS to discuss the MDH comments, including the suggestion that a Health Impact Assessment (HIA) be completed for the NorthMet project. The agencies agreed that an HIA is not required for an EIS, but that it is a tool that can help inform the public about potential health impacts from a proposed project. Although additional HIA information can be developed as part of an EIS, the Co-lead Agencies in this instance took a more customary approach and addressed public health impacts based on water and air quality evaluation criteria and regulatory standards that are protective of human health. Public health impacts were addressed in document sections related to water quality, air quality and toxics, including potential effects to drinking water and food sources as required by MEPA and NEPA. The Co-lead Agencies carefully considered the additional information that could be obtained by completing an HIA, as well as the time and effort to obtain that information and how relevant that information would be to regulatory decisions. In evaluating these considerations, the Co-lead Agencies concluded that:

- Completing an HIA between the SDEIS and FEIS would require significant time and effort, and would represent a considerable delay to the FEIS;
- The SDEIS did include extensive public health information relative to air and water quality; and
- The additional information from an HIA would not significantly inform regulatory permits required for the project.

Based on these conclusions, the Co-lead Agencies have determined that an HIA would not be prepared as part of the EIS. However, the Co-lead Agencies agreed the human health information in the EIS could be more clearly articulated and better organized. The FEIS, therefore, includes a new section (7.3.4) that concisely summarizes all human health-related information and impact assessments included in the document. This section also directs readers to specific sections in the FEIS where human health risks are addressed in detail.

As presented in FEIS section 5.2.10, the FEIS found that predicted levels of environmental impacts from the NorthMet Project Proposed Action are not expected to cause substantial changes in local socioeconomic conditions, and therefore would not result in adverse societal costs.

Theme HU 02

Theme Statement

The FEIS should assess the human health risks in terms of: neurologic morbidity from manganese and lead release; carcinogenic effects of air emissions of diesel, nickel, and other particulates; arsenic releases to water; metals as endocrine disruptors; cumulative mercury and methylmercury exposure; and reproductive pathology.

Thematic Response

The AERA contains toxicological information for arsenic, diesel, nickel, manganese, mercury, and methyl mercury (plus additional chemicals), as well as an analysis of the potential health effects of those chemicals. While the toxicological information was not included in the AERA summary in FEIS Section 5.2.7.2.3, this information is included in FEIS Section 7.3.4, the summary of human health findings. The AERA includes an evaluation of the most sensitive health endpoint for each chemical (e.g., neurological morbidity from manganese, reproductive toxicity of methyl mercury, and the carcinogenic potential of diesel, nickel, and arsenic). Arsenic released to groundwater and surface water were extensively evaluated in FEIS Section 5.2.2.3.2, and modelled concentrations were compared to drinking water standards. Drinking water standards would not be exceeded for arsenic.

Theme HU 03

Theme Statement

The NorthMet Project could have significant adverse impacts on human health as a result of pollutants released to the air, surface water, and drinking water (including residential wells), such as mercury, arsenic, manganese, cadmium, lead, asbestos, diesel, and thallium.

Thematic Response

These chemicals and their releases to air and drinking water are extensively studied in the FEIS, and the potential concentrations are compared to health-based air and water standards. These chemicals are assessed according to current regulatory methodology. No adverse health risks have been identified. For discussion of these chemicals and their releases to surface water and drinking water, see FEIS Sections 5.2.2.1.1, 5.2.2.1.2, and 5.2.2.3.4. For a discussion of these chemicals and their releases to air, see FEIS Sections 5.2.7.1.1, 5.2.7.1.3, 5.2.7.2.3, 5.2.7.2.5, and 5.2.7.5.

Theme HU 04

Theme Statement

The discussion of human health risks and impacts should be expanded to include on-site worker exposure to pollution and worker safety.

Thematic Response

Off-site worker exposure is discussed in the air section of FEIS Chapter 5, specifically in sections 5.2.7.5.2 and 5.2.7.5.3. On-site worker health and safety is regulated by other agencies such as the MSHA, NIOSH, and the OSHA.

Theme HU 05

Theme Statement

The Arrowhead region already reaches the Minnesota Department of Health (MDH) additional lifetime cancer risk guidance level, and the NorthMet Project would increase this cancer risk.

This includes increased risk of cancer due to increased exposure to amphibole mineral fibers and arsenic releases to drinking water supplies. Other risk drivers are also present.

Thematic Response

These calculations are based on an increased risk of contracting cancer using very conservative assumptions. The increased risk of contracting cancer due to the Project's emissions is extremely small. For further discussions, see FEIS Sections 5.2.7.2.3 and 7.3.4.3.

Theme HU 06

Theme Statement

The SDEIS should assess cumulative cancer and non-cancer risks using a 70-year lifetime.

Thematic Response

The AERA is a multi-step process, comparing a pollutant-specific exposure estimate and a toxicity value, and then summing these through pollutants and exposure pathways. All toxicity values used for comparison are 1) based on a lifetime of exposure and 2) are values where, if exposure occurs over a lifetime, health effects are unlikely. The exposure estimates for inhalation risks are not adjusted for exposure time (e.g., time spent outdoors, away from home, or operation time of the mine); therefore, they reflect the 70 year lifetime recommended in the theme. The ingestion risks assume 30 years of exposure for the resident scenario and 40 years of exposure for the farmer scenario from air pollutant deposition and subsequent uptake into the food chain. The AERA assumes that 100 percent of the pollutants at the exposure levels are absorbed into the human body. The total multi-pathway risks are then the sum of ingestion and inhalation. The AERA process follows USEPA guidance, and is considered a human health protective methodology.

Theme HU 07

Theme Statement

Information cited in SDEIS does not correlate with--and the SDEIS itself improperly characterizes the findings of--the University of Minnesota Taconite Workers Health Study.

Thematic Response

FEIS Section 5.2.7.5 contains an extensive discussion of various types of fibers, as well as the health effects found in the scientific literature, including a summary of toxicity information from an extensive scientific literature review conducted in 2009. FEIS Section 5.2.7.5 concludes with a finding of "an uncertain level of potential public health risk" being present due to airborne fibers in the area, and provides a summary of the dust suppression practices that would be used to minimize fiber generation. This information is referenced in the human health section of Chapter 7 (FEIS Section 7.3.4).

Theme HU 08

Theme Statement

The Taconite Workers Health Study contains several findings that support the conclusion in the SDEIS that amphibole mineral fiber emissions pose no threat to the health and safety of mine workers or the general public.

Thematic Response

The Taconite Workers Health study did not identify any areas of concern for community health. However, the study does not rule out amphibole mineral fibers as a potential source of health risk or from playing some role in the incidence of disease among taconite workers. The MPCA would consider this issue during the air permitting process.

Theme HU 09

Theme Statement

The Barr Engineering studies on mineral fibers rely on outdated information, the wrong aspect ratio, and the faulty assumption that low levels of fibers suggests no health harm is likely. A DNR literature review showed short fibers contributed to health effects.

Thematic Response

The literature cited in Section 5.2.7.5 supports a connection between longer fibers and adverse health effects; the information on the health impacts of shorter fibers is still under investigation. The 2007 Mineral Fibers Report (Barr 2007, as cited in the FEIS) assessed the shorter fibers by comparing toxicity to Fine particulates (PM2.5). There is an extensive body of literature on PM2.5 health effects. The FEIS concludes "public health risk of uncertain magnitude", and this conclusion is supported by the scientific literature. Additionally, the Barr report referenced in the comment was used solely to support the conclusion that the Project has the potential to release amphibole mineral fibers. For this reason, the FEIS focuses on how to avoid, minimize, and mitigate and potential fiber releases. See the responses to themes HU 07 and HU 08.

Theme HU 10

Theme Statement

The mineral fibers testing was tainted by additional grinding of samples.

Thematic Response

The additional grinding is discussed in FEIS Section 5.2.7.5.1. According to the laboratory conducting the analysis, this only affects fiber counts, not the identification of asbestiform fibers, since asbestiform fibers have high tensile strength and flexibility (Barr 2007). Additionally, the Barr report was used solely to support the conclusion that the Project has the potential to release amphibole mineral fibers.

Theme HU 11

Theme Statement

The SDEIS should assess the cumulative health risks from air emissions resulting from coal combustion to supply the project's energy needs.

Thematic Response

Air quality cumulative effects are addressed in FEIS Section 6.2.3.8. A cumulative analysis that considers the cumulative health risks from air emissions resulting from coal combustion to supply the Project's energy needs is outside the scope of the FEIS. The studies described in FEIS Chapter 6 meet the requirements of MEPA/NEPA.

Theme HU 12

Theme Statement

Metals concentrations in the tailings basin are high.

Thematic Response

The tailings basin would be isolated from surface and groundwater so metals from the Tailings Basin would not adversely impact water quality. See FEIS Section 3.2.2.3.10 for a discussion of the Tailings Basin seepage containment system.

Theme HU 13

Theme Statement

How were the results of the tests on residential wells treated?

Thematic Response

This information was used as a baseline for groundwater quality downgradient from the existing LTVSMC Tailings Basin. The results of the water quality testing done on 15 residential wells is summarized in FEIS Table 4.2.2-24 and is discussed in Section 4.2.2.3.1.

Theme HU 14

Theme Statement

The FEIS should use 300 µg/L for the copper groundwater evaluation criterion instead of 1,000 µg/L, as was done in the SDEIS.

Thematic Response

This change does not affect any human health analysis. The MCL for copper is 1,300 µg/L; therefore, adverse human health effects would not be expected at copper concentrations below 1,000 µg/L. See the response to theme WR 177.

A.5.12 Issue: US Forest Service Land Exchange (LAN)

Theme LAN 01

Theme Statement

The FEIS should clearly and concisely summarize the analysis of the Proposed Land Exchange under 36 CFR 254.3(b), including a clear explanation of the rationale and criteria for selecting the preferred Land Exchange alternative, and should demonstrate that the public interest has been well served.

Thematic Response

CEQ regulations (40 CFR 1502.14) state that an EIS should present the environmental impacts of a proposal and its alternatives in comparative form to provide a clear basis for choice among the alternative options by the decision makers and the public. The regulations further state (40 CFR 1502.14(e)) that agencies shall identify their preferred alternative (or alternatives, if one or more exists) in the DEIS as well as the FEIS, unless another law prohibits the expression of such a preference; however, the regulations do not require a rationale for the choice. The ROD from the USFS would contain the rationale for the selected alternative, as well as a discussion of how the public interest is served under 36 CFR 254.3(b).

The FEIS includes the factors relating to how the public interest would be served by the Land Exchange Proposed Action, Land Exchange Alternative B, and the Land Exchange No Action Alternative. The ROD would incorporate these findings in its determination. As stated in FEIS Section 1.4.3, factors that must be considered include:

- the opportunity to achieve better management of federal lands and resources;
- to meet the needs of state and local residents and their economies; and
- to secure important objectives, including but not limited to: protection of fish and wildlife habitats, cultural resources, watersheds, and wilderness and aesthetic values; enhancement of recreation opportunities and public access; consolidation of lands and/or interests in lands, such as mineral and timber interests, for more logical and efficient management and development; consolidation of split estates; expansion of communities; accommodation of existing or planned land use authorizations; promotion of multiple-use values; implementations of applicable Forest Land and Resource Management Plans; and fulfillment of public needs. See 36 CFR 254.3(b) and 254.4(c)(4).

Table 7.3.5-1 presents a comparison of how the alternatives address these factors.

To determine that a land exchange serves the public interest, the authorized officer must find that:

1. the resource values and the public objectives served by the non-federal lands or interests to be acquired must equal or exceed the resource values and the public objectives served by the federal lands to be conveyed; and
2. the intended use of the conveyed federal land will not substantially conflict with established management objectives on adjacent federal lands, including Indian Trust lands (36 CFR 254.3(b)(2)).

The findings and supporting rationale for the public interest determination would be documented and made part of the administrative record pursuant to 36 CFR 254.3(b)(3).

Theme LAN 02

Theme Statement

The Proposed Land Exchange violates the Weeks Act of March 1, 1911; Federal Land Policy and Management Act of 1976; Federal Land Exchange Facilitation Act of 1988; the Minnesota Environmental Rights Act; NEPA; and MEPA. The Proposed Land Exchange would remove the protections intended under these laws. The FEIS should clarify whether the lands exchanged would have equal surface protections compared to the lands currently protected by the Weeks Act.

Thematic Response

The Co-lead agencies are following the applicable state and federal laws and regulations to the best of their knowledge, and with the guidance of agencies' legal counsel. The USFS manages the Superior National Forest in conformance with many laws, regulations, executive orders, and policies. In all cases, the Forest Plan is consistent with national law, policy, and direction (USFS 2004c, as cited in the EIS). As discussed in the FEIS, the USFS' position is that the mineral rights that were reserved do not include the right to surface mine as proposed by PolyMet. In order to resolve this conflict, a proposed land exchange has been presented as part of the NorthMet Mining Project. The Weeks Act authorizes land exchanges so long as "public interests would be benefitted thereby" (16 USC 516). Lands acquired by the United States pursuant to the Weeks Act, whether by purchase or exchange, are subject to all provisions of the Act (16 USC 516). Lands conveyed from federal ownership would no longer be under federal control, and therefore would not be managed under the Forest Plan and/or influenced by the authority (the Weeks Act) under which the United States acquired them. This is consistent with other land exchanges that have occurred in the Superior National Forest. The NEPA analysis would inform the USFS decision on the public interest determination, and the decision would be presented in the ROD. While the federal lands, if transferred to PolyMet, would still be located within the proclamation boundary of the Superior National Forest, they would be private lands and no longer managed by the Forest Service.

The proposed Land Exchange must comply with FLPMA's requirement that the values of the lands exchanged are equal or, if they are not equal, that the values shall be equalized by the payment of money so long as the payment does not exceed 25 percent of the total value of the lands transferred out of federal ownership. Appraisal reports completed in 2013 indicate that the Land Exchange Proposed Action would meet federal value requirements if all five non-federal land tracts (6,722.5 (GLO) acres) offered by PolyMet would be exchanged for 6,650.2 (GLO) acres of federal land. The appraisal reports indicate that Land Exchange Alternative B would meet the federal value requirements if non-federal Tract 1, Hay Lake (4,651.5 [GLO] acres), would be exchanged for a smaller federal parcel of 4,887.3 (GLO) acres. If the ROD approves the Land Exchange, a current appraisal, approved by the USFS, will be required to verify equal value. Appraisals must conform to Uniform Appraisal Standards for Federal Land Acquisitions and the Uniform Standards of Professional Appraisal Practice of the Appraisal Foundation.

As part of the pending USFS decision, the Responsible Official must determine if the proposed exchange serves the public interest and supports the direction and guidance in the forest land management plan. The public interest determination must show that the resource values and the public objectives of the non-federal lands equal or exceed the resource values and the public objectives of the federal lands, and that the intended use of the conveyed federal land would not substantially conflict with established management objectives on adjacent federal lands, including Indian Trust lands (36 CFR 254.3(b)(2)). The findings and supporting rationale shall be made part of the decision (Forest Service Handbook 5409.13, section 34.1; 36 CFR 254.3(b)). The ROD would contain the findings and supporting rationale for the selected alternative, would discuss how the public interest is served under 36 CFR 254.3(b), and would provide information for compliance with Forest Service requirements and Forest Plan. As part of the land exchange, several alternatives to the Land Exchange Proposed Action were identified and screened, including underground mining. The underground mining alternative is discussed in FEIS Section 3.2.3.4.1 and Appendix B, as well as the response to theme ALT 01.

Theme LAN 03

Theme Statement

The proposed lands involved for exchange are not a fair trade or of equal value and/or environmental quality, and the Land Exchange should not result in less acreage being acquired. In addition, the FEIS should include the real estate appraisals for the proposed exchanged lands.

Thematic Response

As described in FEIS Section 1.4.3, FLPMA requires that the values of the lands exchanged are equal or, if they are not equal, the values shall be equalized by the payment of money so long as the payment does not exceed 25 percent of the total value of the lands transferred out of federal ownership (36 CFR 254.12). The USFS relies on professional appraisals to determine market value. Such appraisals must conform to Uniform Appraisal Standards for Federal Land Acquisitions and the Uniform Standards of Professional Appraisal Practice of the Appraisal Foundation. Refer to the response to theme LAN 02 for more information.

The Land Exchange Proposed Action must also comply with two EOs related to wetlands and floodplains. EO 11990 applies to land exchanges such that, as much as practicable, the exchange does not result in the loss of wetland resources. EO 11988 applies to land exchanges such that, as much as practicable, the exchange does not result in an increase in the flood damage potential. USFS policy (Forest Service Handbook 5409.13 § 33.43c) provides that any of three conditions satisfy the requirements of EOs 11990 and 11988:

1. the value of the wetlands or floodplains for properties received and conveyed is equal (balancing test) and the land exchange is in the public interest;
2. reservations or restrictions are retained on the unbalanced portion of the wetlands and floodplains on the federal lands when the land exchange is in the public interest but does not meet the balancing test; and
3. the federal property is removed from the exchange proposal when the conditions described in the preceding paragraphs 1 or 2 cannot be met.

The Land Exchange Proposed Action and the Land Exchange Alternative B meet the first condition (balancing test), which requires the value of the wetlands or floodplains is equal for properties received and conveyed. Therefore, as stated in FEIS Section 5.3.3, the Land Exchange Proposed Action would comply with EOs 11990 and 11988. All of the lands proposed for exchange are located throughout the 1854 Ceded Territory of northeastern Minnesota.

The Land Exchange Proposed Action equalization requirements are discussed in the response to theme LAN 02, as well as in FEIS Section 1.4.3. Furthermore, the FEIS discloses which non-federal tracts would be required for each land exchange alternative (see FEIS Section 5.3). Appraisal reports completed in 2013 indicate that the Land Exchange Proposed Action would meet federal value requirements if all five non-federal land tracts (6,722.5 (GLO) acres) offered by PolyMet would be exchanged for 6,650.2 (GLO) acres of federal land. The appraisal reports indicate that Land Exchange Alternative B would meet the federal value requirements if non-federal Tract 1, Hay Lake (4,651.5 (GLO) acres), would be exchanged for a smaller federal parcel of 4,887.34 (GLO) acres. If the ROD approves the Land Exchange, a current appraisal, approved by the USFS, will be required to verify equal value. Copies of appraisal reports and appraisal review reports are not released to parties outside the USFS, except through the Freedom of Information Act (FOIA) process, and only after a preferred alternative is selected or a decision is made.

As part of the pending USFS decision, the Responsible Official must determine if the proposed exchange serves the public interest and supports the direction and guidance in the forest land management plan. The public interest determination must show that the resource values and the public objectives of the non-federal lands equal or exceed the resource values and the public objectives of the federal lands, and that the intended use of the conveyed federal land would not substantially conflict with established management objectives on adjacent federal lands, including Indian Trust lands (36 CFR 254.3(b)(2)). The findings and supporting rationale shall be made part of the decision (Forest Service Handbook 5409.13, section 34.1; 36 CFR 254.3(b)). The ROD would contain the findings and supporting rationale for the selected alternative and how the public interest is served under 36 CFR 254.3(b), and would provide information for compliance with Forest Service requirements and Forest Plan.

The lands to be exchanged are not required to be of a certain size, contiguous of each other, within the same watershed of the federal lands, within a reasonable distance to the federal lands to be exchanged, and/or within the 1854 Ceded Territory.

Theme LAN 04

Theme Statement

The Proposed Land Exchange does not comply with the USFS Superior National Forest Plan and other USFS policies. In particular, the Land Exchange would not consolidate the surface and mineral ownership of the lands. The FEIS needs to clarify title, mineral rights, and encumbrances on the lands involved.

Thematic Response

The Applicant's purpose and need states that the purpose of the Land Exchange Proposed Action is to "consolidate the surface and mineral ownership of the lands involved at the Mine Site." However, the USFS purpose of the Land Exchange Proposed Action is to resolve the conflict between USFS legal mandates for managing its lands (surface estate) and how PolyMet is proposing to exercise its mineral rights/leases. The conflict to be resolved does not result from the existence of the split estate alone, but rather from PolyMet's proposal to access the mineral estate by surface mining. As described in FEIS Section 1.3.2.2, the USFS purpose is to meet desired conditions in the Forest Plan, which includes: 1) ensuring the Land Exchange Proposed Action eliminates conflict, and 2) ensuring mineral resources are produced in an environmentally sound manner contributing to economic growth. To eliminate the conflict, a land exchange has been proposed, since the Mine Site is located on National Forest System lands but the mineral rights are privately held and under lease to PolyMet. It is the position of the United States that the mineral rights leased by PolyMet do not include the right to open pit mine the National Forest System land. PolyMet disagrees with the USFS position and argues that the mineral rights it seeks to utilize provide for access to the minerals by any mining method, including open pit or surface mining. The Land Exchange Proposed Action is being considered to resolve this fundamental conflict, rather than possible litigation that has no certain outcome. The desired conditions, D-LA-1 and D-MN-2, for the Land Exchange Proposed Action inform the USFS purpose for the project, while the Forest Plan standards and guidelines help to inform how the project would be designed. Although the desired condition for land adjustments, D-LA-1, identifies improving management effectiveness, the USFS is focusing on eliminating conflict in response to PolyMet's specific proposal to surface mine, as well as ensuring mineral resources are produced in an environmentally sound manner (D-MN-2). FEIS Section 3.3.1.1 discusses how the standards and guidelines help to inform how the Land Exchange Proposed Action would be designed.

The Weeks Act authorizes land exchanges so long as "public interests would be benefitted thereby" (16 USC 516). Lands acquired by the United States pursuant to the Weeks Act, whether by purchase or exchange, are subject to all provisions of the Act (16 USC 516). Lands conveyed from federal ownership would no longer be under federal control and therefore would not be managed under the Forest Plan and/or influenced by the authority (the Weeks Act) under which the United States acquired them. This is consistent with other land exchanges that have occurred in Superior National Forest. The NEPA analysis would inform the USFS decision on the public interest determination. This decision would be presented in the ROD.

Title, mineral rights, and encumbrances are evaluated as part of the USFS due diligence process prior to any land acquisition. If the mineral estate is severed from the land to be acquired, due diligence includes evaluating mineral character. The Forest Supervisor relies on the mineral character determination, prepared by a geologist, to analyze the potential for future mineral development that would conflict with USFS surface management. If that conflict is likely, the USFS would decline to acquire the land. While most of the non-federal lands in the Land Exchange Proposed Action do not include mineral rights, the mineral character has been evaluated to determine there is a low potential for mineral development. Mineral development potential was considered as part of the Feasibility Analysis as well as in the FEIS (Section 5.3.1.2.5). Title commitments for the non-federal lands were reviewed and due diligence evaluations are presented in FEIS Section 5.3.1.2.5, along with the proper citations for the information. While it is preferable (but not required) to acquire lands from which minerals have not been severed, the lands are being acquired for multiple-use in accordance with the Forest Plan. Final title approval is not made at the Forest level. Any lands acquired by the USFS must meet the U.S. Department of Justice Title Standards 2001. The USDA, Office of the General

Counsel determines whether title evidence meets the requirements of the Attorney General (see FSH 5409.13, 11.3).

The Land Exchange Proposed Action and the Land Exchange Alternative B would be designed to be consistent with the goals and objectives of the Forest Plan, including G-LA-2 and G-LA-3 (Forest Plan, pages 2-51 and 2-52; FEIS Section 3.3.1.1). The development of the FEIS under NEPA addresses Forest Plan desired conditions D-LA-1 and D-MN-2. The ROD would discuss whether and how the Land Exchange Proposed Action and the Land Exchange Alternative B meets these desired conditions. The non-federal lands for Land Exchange Proposed Action and the Land Exchange Alternative B would be incorporated within the adjacent federal ownership and managed in accordance with the Forest Plan direction for the particular management area.

In addition, the Land Exchange Proposed Action and Land Exchange Alternative B would be consistent with the goals of the Forest Plan for wetlands (page 2-15). The conveyance and acquisition of lands under either the Land Exchange Proposed Action or Land Exchange Alternative B would not result in wetland impacts. The mining activities of the NorthMet Proposed Action would result in wetland effects that cannot be avoided, although these losses would be minimized and/or compensated for. The Land Exchange Proposed Action and Land Exchange Alternative B would not result in a net loss of wetland acres to the federal estate and/or result in reduced water quality within a wetland, or upstream or downstream of a wetland. The NorthMet Project Proposed Action is subject to a number of regulatory permits, reviews, and approvals, including determination of whether the proposed mining activity would result in a change to water quality. Please see FEIS Section 5.2.2 for a detailed discussion on water resources and FEIS Section 5.2.3 for a discussion of wetland resources.

Theme LAN 05

Theme Statement

The Proposed Land Exchange would result in a loss of access to or use of public lands within the 1854 Ceded Territory, thereby affecting the ability to exercise Treaty rights. Additional information on the natural heritage and timber resources of the exchange lands should be provided. The federal agencies cannot approve permits that would have effects on treaty resources without additional evaluation and mitigation. No mitigation has been identified in the SDEIS for this permanent loss of lands and resources. The USFS should consider exchanging for private lands only in order to maintain—or better yet, increase—the total public land acreage within the 1854 Ceded Territory.

Thematic Response

The Agency's obligation is to ensure that Band members have ample opportunity to exercise their treaty-reserved usufructuary rights; that federal lands are managed to maintain both the diversity and abundance of natural resources; and to ensure that the Bands' usufructuary rights to treaty resources are not impaired. The Land Exchange Proposed Action was analyzed to understand the potential effects on usufructuary rights. The Co-lead Agencies have consulted, and continue to consult with the Bois Forte Band of Chippewa, the Grand Portage Band of Lake Superior Chippewa, and the Fond du Lac Band of Lake Superior Chippewa, the three principle Bands that retain usufructuary rights in the proposed project area. In addition, the Co-lead

Agencies have consulted with the GLIFWC and the 1854 Treaty Authority, the principal natural resource agencies representing the aforementioned Bands.

Through consultation, the Co-lead Agencies understand that the Bands' principle interest with regards to the Land Exchange Proposed Action are the following: to retain or increase the amount of public land within the 1854 Treaty Ceded Territory, shoreline wetlands, culturally important natural resources used in exercising treaty rights of hunting, fishing, and gathering, cultural or religious properties, and access to culturally important natural resources and cultural or religious properties. The Co-lead Agencies have a fiduciary obligation to understand and consider the effects that the Land Exchange Proposed Action would have on Band members exercising their Treaty rights in the 1854 ceded territory. While the Land Exchange Proposed Action would remove certain lands from federal ownership, this loss is potentially offset by incoming private lands that would become part of the federal estate within the 1854 Ceded Territory. Outside of the Land Exchange Proposed Action, the Co-lead Agencies have also analyzed the potential effects posed by the Proposed Connected Actions. The potential affects posed to natural resources and cultural resources of importance to the Bands have been disclosed and would be considered during the Co-lead Agency decision process.

Land exchanges do not include mitigation; instead, the resource values and public objectives of the non-federal lands must equal or exceed the resource values and public objectives of the federal lands. See FEIS Section 1.4.3. Mitigation for cultural resources as a result of the NorthMet Project Proposed Action is discussed in FEIS Section 5.2.9. The NorthMet Project Proposed Action mining activities would result in a loss of bogs; however, as part of the NorthMet Proposed Action, the Applicant is required to provide compensatory mitigation for wetland impacts in accordance with state and federal permits. One of the proposed mitigation sites for wetland impacts (Zim Site) would be a compensation site for the loss of bogs, and would be located within the 1854 Ceded Territory.

The Lake County lands were tax forfeit lands that were offered for sale by the County through a public auction. The Lake County lands would still be accessible to the Bands for their use if the exchange took place, because the lands would become part of the SNF managed lands.

No heritage surveys were conducted on the non-federal lands. If any cultural resources are located on the non-federal lands, those cultural resources would be transferred to federal ownership. Such transfer would not adversely affect the heritage resource, but would provide greater preservation protection under federal law.

The non-federal lands that contain wild rice beds would not be affected as a result of the Land Exchange Proposed Action or Land Exchange Alternative B, because no activities are proposed on these lands and the proposed mining activities would not affect these lands. As noted in the FEIS, the Land Exchange Proposed Action and Land Exchange Alternative B would increase wild rice stands within the federal estate. FEIS Sections 5.3.2 and 5.3.4 clarify that, although the Land Exchange would result in an increase in wild rice stands within the federal estate boundaries, there would be no change to the existing public access to Tract 1 wild rice stands via the Pike River. Consequently, there would be no increase in wild rice harvest opportunities for the public. No wild rice stands are known to occur on the federal lands, and suitable habitat is limited.

Please refer to the response to theme LAN 01 for more information on the public interest determination.

Theme LAN 06

Theme Statement

The selection process and the locations of the non-federal lands to be exchanged needs to be clarified. It is not clear why the non-federal lands were selected. In particular, the FEIS should clarify why non-federal lands in these locations were selected, as opposed to non-federal lands located closer to the federal lands. The FEIS should also justify the failure to select larger non-federal parcels or parcels within the same watershed, as well as the failure to consider restoring impacted lands instead of getting rid of lands. The FEIS needs to include information about how the boundaries for the federal lands to be exchanged were drawn and why, as well as an explanation of the rationale for giving up the riparian lands along the Partridge River. The FEIS also needs to acknowledge that the additional federal buffer lands in the proposed exchange most likely will be used to facilitate and expedite future mining.

Thematic Response

An assembled land exchange means an "exchange of Federal land for a package of multiple ownership parcels of non-Federal land consolidated for purposes of one land exchange transaction" (36 CFR 254.2). The selection process for the non-federal lands is described in FEIS Section 3.3.1.1. A goal of the land exchange, but not the USFS purpose for the NorthMet Project Proposed Action, is to consolidate landownership, reduce the managed boundary, and reduce managed land fragmentation. The five tracts of non-federal lands are located within St. Louis, Lake, and Cook counties (see Figure 3.3-1 and Table 3.3-2) and lie within the Superior National Forest proclamation boundary and within the 1854 Ceded Territory. Lands to be exchanged are not required to be of a certain size, contiguous of each other, within the same watershed of the federal lands, within a reasonable distance to the federal lands to be exchanged, and/or within the 1854 Ceded Territory. As previously stated, it is the position of the United States that the mineral rights leased by PolyMet do not include the right to open-pit mine the National Forest System land. Simply performing restoration of the mining lands would not meet the purpose and need for the USFS (see FEIS Section 1.3.2.2). A land exchange must conform to the standards and guidelines of the Forest Plan, as well as be of equal value and need to meet Executive Orders 111990 and 11998. A description of the tracts to be exchanged is provided in FEIS Section 3.3.2.2, and the environments resources on each tract are described in Sections 4.3 and 5.3.

The recommendation for the boundaries of the federal lands was based on standards and guidelines in the Forest Plan, as described in FEIS Section 3.3.1.1. The lands in the Land Exchange Proposed Action were included to avoid intermingled and inefficient ownership patterns that would result by retaining isolated federal lands without legal access.

A land exchange is a change of ownership of land; once an exchange occurs, the federal land then becomes private land, allowing the private landowner to use the land in accordance with necessary local, state, and federal permits and approvals. Any future work on the exchanged lands, which could include mining on these lands, would require the necessary permits and/or approvals from state and federal agencies. Most mineral rights within the federal lands are privately held. The United States owns 181 acres of mineral rights on lands that are not part of the NorthMet Project Proposed Action mine pits (Figure 3.2-3). The USFS would reserve ownership of these mineral rights. These mineral rights are located near the eastern boundary of the federal lands north of Dunka Road, and near the southeast corner of the federal lands south of Dunka Road (Figure 3.2-3).

The lands involved in the Land Exchange Proposed Action or Land Exchange Alternative B are not intended to be the wetland mitigation sites that are required as part of permitting of the mining activities (i.e., under Section 404, Section 401, and WCA). The wetlands mitigation sites for the wetland effects of the mining activities are discussed in FEIS Section 5.2.3.

The Lake County lands were tax forfeit lands that were offered for sale by the County through a public auction. The Lake County lands would still be accessible to the Bands for their use if the exchange took place, because the lands would become part of the Superior National Forest managed lands.

Theme LAN 07

Theme Statement

The Proposed Land Exchange would not result in a reduced boundary length to be accessed and/or maintained by the USFS, would increase the fragmentation of forest lands, and would complicate USFS land management.

Thematic Response

As stated in the FEIS, Section 5.3.1.2.2, a reduced boundary length is more desirable for the USFS because it reduces the difficulty of accessing and managing the forest. The Land Exchange Proposed Action would result in a 33.2-mile net reduction of the perimeter around the USFS-controlled portions of the Superior National Forest. In addition, the underlying assumption regarding land fragmentation of USFS-controlled portions of the Superior National Forest is that a lower ratio of boundary to area is more desirable, because it reduces the difficulty of accessing and managing the forest, in addition to increasing the forest's overall quality and function. All of the non-federal parcels are contiguous with existing National Forest System lands, thus decreasing the ratio of boundary to area. The Land Exchange Proposed Action would not measurably alter the existing ratio of fragmentation in the Superior National Forest of approximately 0.005 linear mile of boundary per acre of USFS-controlled Superior National Forest land (see Table 5.3.1-2). The Land Exchange Proposed Action would consolidate land ownership, which is an effect of the land exchange and is not part of the purpose and need of the NorthMet Project Proposed Action. Consolidation is one of the guidelines designed to achieve the Forest Plan's desired condition for land adjustment (see FEIS Section 3.3.1.1).

Theme LAN 08

Theme Statement

The FEIS should more clearly state that the Land Exchange Proposed Action can proceed regardless of what happens with the NorthMet Mining Project Proposed Action. In addition, the FEIS should clarify that the Land Exchange Proposed Action may occur independently of the NorthMet Mining Project Proposed Action.

Thematic Response

As noted in FEIS Section 1.0, the Land Exchange Proposed Action is considered a "connected action" to the NorthMet Project Proposed Action. The purpose of the Land Exchange Proposed Action is to consolidate the surface and mineral ownership of the lands involved at the Mine

Site. PolyMet has a lease to mine the minerals on its NorthMet Deposit, which is surrounded by active and abandoned taconite mines near Hoyt Lakes. The surface of these lands is owned by the United States. The purpose for the USFS is to meet desired conditions in the Forest Plan, including ensuring that the Land Exchange Proposed Action eliminates existing conflict, and ensuring mineral resources are produced in an environmentally sound manner contributing to economic growth. The USFS would implement the National Environmental Policy Act per 36 CFR part 220, and would use the FEIS to support the ROD documenting its decision on the Land Exchange Proposed Action.

Theme LAN 09

Theme Statement

If Lake County has indeed entered into an agreement with PolyMet, this would be illegal. Minnesota law requires that state agencies (including county governments) not take final action on a project prior to the completion of environmental review. Lake County actions would be prejudicial to the final approval of the NorthMet Project. The USFS should address whether the Lake County Lands were acquired in violation of Minnesota law and, if so, remove them from consideration in the Proposed Land Exchange.

Thematic Response

The Lake County lands were purchased by PolyMet at a public auction at which other private buyers could have purchased these lands. Lake County had already decided to auction the lands before they were identified as potential non-federal lands for the Land Exchange Proposed Action.

Theme LAN 10

Theme Statement

The Proposed Land Exchange should not be accelerated. Furthermore, the Land Exchange should have its own environmental review.

Thematic Response

The Land Exchange Proposed Action is proceeding consistent with all legal and procedural requirements. Under state and federal regulations, multiple actions or projects that are connected actions must be considered in total in preparing an EIS. NEPA requires that federal agencies consider the potential environmental consequences of proposed actions in their decision-making process. For the NorthMet Mining Project and Land Exchange FEIS, because the Land Exchange Proposed Action is closely related to the NorthMet Project Proposed Action, it is considered a connected action and, as such, is included in the analysis of environmental effects. Therefore, the Land Exchange Proposed Action is considered a “connected action” to the NorthMet Project Proposed Action (40 CFR part 1508.25), meaning that it is part of the overall Project proposal, and therefore would be included in the analysis of environmental impacts.

Theme LAN 11

Theme Statement

The Land Exchange Proposed Action would be consistent with the management of the Superior National Forest, the Forest Plan, and applicable regulatory standards. In addition, the Land Exchange Proposed Action will enhance the overall resources of the Superior National Forest and enable the USFS to better meet its long term mission. Environmental degradation will not occur on these existing forest lands.

Thematic Response

These comments generally support the Land Exchange Proposed Action. Because no specific information was provided, no changes were made to the EIS.

A.5.13 Issue: Land Use (LU)

Theme LU 01

Theme Statement

The EIS should provide additional information on the existing condition of public access to the USFS lands proposed for exchange.

Thematic Response

As discussed in FEIS Section 5.3.1.2.1, the only public access to the federal lands is via the Partridge and Embarrass Rivers. The remainder of the federal lands is surrounded by private lands (or by other public lands that are themselves surrounded by private lands) (see Figure 4.3.1-1). While members of the public may obtain permission to cross these private lands and access the federal lands, there is no designated land-based access for the federal lands.

Theme LU 02

Theme Statement

The EIS should provide a clearer discussion of future land use after reclamation of the tailings basin including a timeframe for completion.

Thematic Response

FEIS Section 3.2.2.3.12 discusses reclamation of the tailings basin. This is also discussed in more detail in the Flotation Tailings Management Plan (PolyMet 2013l, as cited in the EIS). To minimize water quality impacts, water would be managed at the Tailings Basin through application of bentonite on surface areas to minimize water flow into the tailings, and the containment system surrounding the Tailings Basin would be used to capture groundwater and surface water for treatment for as long as needed. Other reclamation objectives would include mulching and establishing vegetation on upland areas, controlling dust, controlling soil erosion, monitoring stability parameters, and minimizing the need for maintenance.

Theme LU 03

Theme Statement

The Cumulative Effects Analysis for Land Use should encompass the 1854 Ceded Territory.

Thematic Response

The methodology for determining the Cumulative Effects Analysis for Land Use is discussed in FEIS Section 6.2.1.2. The Cumulative Effects Assessment Area for land use includes effects associated with the NorthMet Project Proposed Action combined with other industrial (including mining) or public works projects located within the portion of the Mesabi Iron Range encompassed by St. Louis County.

Theme LU 04

Theme Statement

The NorthMet Project will adversely affect the region's aesthetic character.

Thematic Response

As discussed in FEIS Section 4.2.11.1.2, the Mine Site (including waste rock piles) would be visible from a limited number of viewpoints (such as Skibo Vista). Visibility, the Mine Site would be limited by topography and vegetation. The Plant Site would be visible from a greater number of locations, but would not look meaningfully different from existing conditions. FEIS Section 5.2.7 [Air Quality] discusses the degree to which dust and vehicle emissions would be visible.

Theme LU 05

Theme Statement

The Scenic Integrity Objective designation for the mine site and/or Land Exchange parcels is arbitrary.

Thematic Response

Scenic Integrity Objective designations were established by the US Forest Service as part of the Superior National Forest Plan; a process that is separate from the Supplemental EIS. Management direction for Scenic Resources (including SIO designations) on the Superior National Forest are located in the Forest Plan Chapter 2, pages 2-45 – 2-48.

Theme LU 06

Theme Statement

The NorthMet Project would adversely affect recreation opportunities in the region, such as hunting, fishing, berry picking, hiking, canoeing, birding, etc.)

Thematic Response

Excluding effects related to noise, fisheries, air quality, and other effects described elsewhere in FEIS Chapter 5, and given the proximity of active and past mining and industrial activity to high-quality recreational activity in the Arrowhead region (such as the BWCAW), there is no evidence that the presence of the NorthMet Project Proposed Action in and of itself would affect the public's ability to hunt, fish, and conduct other recreational activities, or affect the overall recreational experience (apart from specific activities) in the Arrowhead region as a whole. See FEIS Section 5.2.11.2.1 for further discussion of impacts to recreation opportunities.

Theme LU 07

Theme Statement

There will not be any negative impacts to land, recreation opportunities, or visual character as a result of the NorthMet Project.

Thematic Response

FEIS Sections 5.2.1 (Land Use) and 5.2.11 (Recreation and Visual Resources) discuss the impacts as a result of the NorthMet Project.

A.5.14 Issue: Mercury (MERC)

Theme MERC 01

Theme Statement

The Proposed Action would add mercury to the environment, and would cause or worsen violations of mercury water quality standards. The Proposed Action should not be permitted until compliance with these standards can be demonstrated. Applicable standards include those issued by the State of Minnesota, Great Lakes Initiative, and the Binational Program to Restore and Protect Lake Superior.

Thematic Response

Because the NorthMet Project area is located within the Lake Superior Basin, the NorthMet Project Proposed Action is subject to the Great Lakes Initiative mercury discharge standard of 1.3 ng/L. Mercury numeric standards are based on total (particulate plus dissolved) concentrations. For the Lake Superior Basin, the Class 2B (aquatic life and recreation) numeric chronic standard for mercury in the water column protective of wildlife (1.3 ng/L) is the most stringent applicable standard (with the exception of the downstream human health chronic standard of 0.77 ng/L at the Fond du Lac Reservation). Discharges from the Plant Site WWTP and Mine Site WWTF would be at or below the Great Lakes Initiative discharge standard of 1.3 ng/L, as the WWTP and WWTF would be designed to meet the mercury standard for the effluent. The WWTP and WWTF would use a greensand filtration process followed by RO technology, which is known to remove mercury, particularly when the influent to the RO system is pretreated. Therefore, the total mercury concentration in the WWTP and WWTF discharge are expected to meet the evaluation criteria of 1.3 ng/L.

The following adaptive management strategies have been proposed for mercury and are included in FEIS Section 5.2.2.3.5:

- Pretreatment modifications such as chemical scavenger addition to obtain additional metals;
- Use of tighter RO membranes for the primary RO system;
- Treatment of some portion of the VSEP permeate by the primary RO system to further remove some dissolved constituents; and
- Addition of polishing treatment units for removal of trace metals (e.g., ion exchange).

Overall, mercury loadings are predicted to increase slightly in the Embarrass River (from 1 to 3 percent) as a result of the NorthMet Project Proposed Action, but would be offset by a larger decrease (5 percent) in the Partridge River, resulting in a net decrease in overall mercury loadings (1.0 grams per year) to the St. Louis River as a result of the NorthMet Project Proposed Action. This small change in overall mercury loadings is unlikely to be detectable with respect to water concentrations. The state of Minnesota fish tissue standard for mercury of 0.2 mg/kg is lower than the USEPA criterion of 0.3 mg/kg (wet weight, per USEPA criteria) to adjust for the higher per capita consumption of wild-caught fish in Minnesota. Based on the results of scientific investigations, this standard assumes that all fish tissue mercury is in the methylmercury form. In-stream mercury concentrations in the St. Louis River, measured by the Fond du Lac Band, have been below the Great Lakes Initiative Chronic Wildlife Standard of 1.3 ng/L, but exceed the Fond du Lac Band's human health chronic standard of 0.77 ng/L. However research has found that mercury concentrations can be higher than 1.3 ng/L in the St. Louis River especially after a large storm. The majority of this mercury is from wetlands and riparian zones within the St. Louis River Watershed. Research suggests that total mercury concentrations in streams and methylmercury content in fish are roughly proportional within individual watersheds (USGS 2010, as cited in the FEIS), such that an increase in total mercury in water would be expected to result in increase in mercury content in fish within that watershed. It can reasonably be considered that that the predicted decrease in mercury loadings to the St. Louis River would result in no change in mercury loading to fish.

The goal of the Binational Program to Restore and Protect Lake Superior is to reduce the release of mercury to Lake Superior through prevention of further inputs of the chemical. The ultimate goal of the Zero Discharge Demonstration Program (ZDDP) is zero discharge (100 percent reduction) of nine designated pollutants (including mercury) by the year 2020. Most major reduction milestones were met by 2010, including an 80 percent reduction in mercury releases. The ultimate goal is to reach 100 percent reduction by 2020 (Lake Superior Binational Program 2012b, as cited in the FEIS). In September 2009, the MPCA published Guidelines for New and Modified Mercury Air Emission Sources. The guidelines were developed to limit the mercury emissions from new and expanding sources in order to meet the TMDL goal of total statewide mercury emissions of 789 lbs/year by 2025. The MPCA conducted a review of the NorthMet Project Proposed Action mercury emissions, and has determined that it would not impede the reduction goals (MPCA 2013b, as cited in the FEIS).

Theme MERC 02

Theme Statement

The FEIS should provide more evaluation and detail on the effects of the Proposed Action on already high mercury levels in the water, as well as mercury methylation and bioaccumulation in fish. Local and downstream waters, including the Embarrass River, are already impaired for fish tissue mercury levels.

Thematic Response

Based on the evaluations conducted for air emissions and water discharges for the FEIS, the NorthMet Project Proposed Action is not considered to have an appreciable effect on: 1) surface water mercury concentrations, 2) fish mercury concentrations, 3) methylation of mercury, or 4) risk to people consuming fish from lakes near the NorthMet Project area.

The MPCA's MMREM analysis for the two scenarios showed a 0.5 to 1.8 percent and 0.3 to 0.5 percent potential increase in fish mercury concentration above background. However, the change is not expected to be significant as compared to background. The increase would not be expected to have any appreciable effect on the loading estimates from permitted discharges to the Embarrass River, Partridge River, or the lower St. Louis River. Discharges are expected to meet the 1.3 ng/L standard for mercury, with an overall net decrease in mercury loading to the St. Louis River predicted for the NorthMet Project Proposed Action. Per FEIS Section 6.2.6, the NorthMet Project Proposed Action would not have any direct effects on aquatic habitat in the St. Louis River, and would not have any measureable indirect effects on fish or aquatic invertebrates as a result of changes in flow or water quality.

Theme MERC 03

Theme Statement

The FEIS should include a robust Health Impact Assessment (HIA) that evaluates the effects of the Proposed Action's mercury (methylmercury) releases. The HIA should specifically investigate risks related to fetal development from the consumption of mercury that has bioaccumulated in fish and/or wild rice.

Thematic Response

The AERA contains toxicological information for arsenic, diesel, nickel, manganese, mercury, and methylmercury (plus additional chemicals), and an analysis of the health effects of those chemicals. The AERA included an evaluation of the most sensitive health endpoint for each chemical (e.g., neurological morbidity from manganese, reproductive toxicity of methylmercury, and the carcinogenic potential of diesel, nickel, and arsenic). Therefore, these human health risks have already been assessed. While the toxicological information was not included in the AERA summary in FEIS Section 5.2.7.2.3, additional toxicological information has now been included in FEIS Chapter 7. Note that mercury impacts via air emissions and via deposition on land and water were also specifically assessed in FEIS Section 5.2.7.2.5, and were not found to be a health concern. The risk assessment assessed the health effects for recreational and tribal fishermen and their families consuming methylmercury in fish. Additional information pertaining to the effects of mercury and methylmercury on subsistence consumers has been included in FEIS Section 5.2.10.2.6, and risk assessment information is summarized in FEIS Section 7.3.4.4.3. In addition, see the response to theme HU 01.

Theme MERC 04

Theme Statement

The data used in the SDEIS to document and evaluate effects associated with mercury releases is inadequate and flawed. Data presented in the SDEIS have numerous inconsistencies related to reporting limits and method detection limits, casting doubt on overall data quality and the accuracy of impact analysis.

Thematic Response

The FEIS has been revised to include additional mercury data through the year of 2013, where available. These data are summarized in FEIS Section 4.2.2.3.1. Data presented in the FEIS were gathered from various sources, thereby leading to inconsistencies in the way the results were reported. Additionally, variability in the data and data reporting exists to some extent on large projects where sampling is conducted at many locations over long periods of time. Publicly available and relevant studies were considered in developing the SDEIS and FEIS. These include technical reports prepared by PolyMet reports from state and federal agencies, technical papers in peer-reviewed journals, and technical reports associated with other mine sites. The SDEIS and FEIS preparers drew on these information sources to the degree that they were reliable and relevant to the assessment of potential impacts from the NorthMet Project Proposed Action. Corresponding text, tables, and/or figures have been revised to include the addition of data. Furthermore, the data have been reviewed for inconsistencies, and necessary updates have been included in the FEIS.

Theme MERC 05

Theme Statement

The presentation of non-detect values as half the detection limit is an overly simplistic way of handling non-detect samples.

Thematic Response

Based on professional judgment, half of the detection limit was utilized in presenting data throughout the FEIS. Although contemporary science has refrained from utilizing half the detection limit, per the USEPA Region II Technical Guidance Document Chemical Concentration Data Near the Detection Limit (USEPA 1991) the method is valid. Additionally, the evaluation of the data provides a reasonable estimate of potential environmental effects for purposes of environmental review.

Theme MERC 06

Theme Statement

SDEIS does not provide the data to support the assumption that existing taconite within the Tailings Basin does, or that the PolyMet tailings would, remove mercury from discharged water.

Thematic Response

FEIS Section 5.2.2.3.4 provides supporting documentation and a rationale explaining tailings as a sink for mercury, including Berndt (2003, as cited in the FEIS). Berndt further explains that the reaction of mercury in the Tailings Basin (i.e., loss of mercury that is assumed to be through adsorption to solids and then burial in the sediments) results in an overall permanent retention of mercury within the basin and decreases the mercury released to receiving waters. The overall findings in Berndt demonstrated that the release of mercury to surface waters during taconite processing was insignificant with respect to the mercury concentrations found in local precipitation and existing background surface waters. The findings are supported by surface and groundwater monitoring around the existing LTVSMC Tailings Basin, which found mercury concentrations generally averaging less than 2.0 ng/L.

Furthermore, FEIS Section 5.2.2.3.4 summarizes a study conducted by Northeast Technical Services, Inc. (NTS) in 2006 (PolyMet 2015j, as cited in the FEIS) where a bench study was conducted using NorthMet tailings to determine the rate of mercury adsorption by the tailings. The study utilized large-volume shake flask tests to evaluate mercury adsorption of tailings over time. The concentration of dissolved mercury in a treatment flask containing process water and NorthMet tailings decreased from 3.3 ng/L (at time 0) to 0.9 ng/L (at 480 minutes). The study shows the ability of NorthMet tailings to adsorb mercury. In combination with the proven ability of the underlying taconite tailings to adsorb mercury, this is expected to result in an overall increase in the adsorption of mercury and subsequent lower concentrations of mercury at the Tailings Basin with the addition of the NorthMet tailings. The average concentration of mercury in samples collected from discharge locations SD026 and SD004 show seepage from the Tailings Basin with an estimated mercury concentration of 1.0 ng/L, which is lower than mercury concentrations in precipitation.

Theme MERC 07

Theme Statement

The mercury data provided in the Water Resources section of Chapter 4 of the SDEIS are inconsistent.

Thematic Response

FEIS Chapter 4 has been revised to address the comments in this theme. Such revisions included, but are not limited to:

- Inclusion of data on background methylmercury;
- Evaluation of inconsistencies in minimum detection limits for total mercury and methylmercury;
- Evaluation of a standard approach to calculating, interpreting, and presenting mercury results;
- Explanation and evaluation of unfiltered versus filtered mercury samples; and
- Reporting of mercury concentrations as presented in the text and figures of the SDEIS.

Theme MERC 08

Theme Statement

The FEIS should include an assessment of the effects of sulfur air emissions from both the Mine Site and Plant Site on mercury methylation and bioaccumulation. The FEIS should also provide an analysis of the aerial deposition of mercury into waterbodies and describe the linkage between sulfate and mercury reduction. The scientific literature indicates increased sulfate loading to freshwater systems increases methylmercury production, but the SDEIS understates these effects. There is a significant potential for increased methylmercury in downstream wetlands and surface waters.

Thematic Response

A supplemental assessment of the potential additional sulfur from stack and fugitive dust air emissions was conducted to evaluate the NorthMet Project Proposed Action's effects from sulfate as related to mercury methylation and fish concentrations. Sulfur-related emissions include SO_2, SAM, reduced sulfur compounds, and sulfur in particulate (e.g., sulfur in the mineral matrix of the ore). Because the estimated Plant Site and Mine Site emissions for each of these are below the PSD permitting thresholds and SER, no further consideration of these sources were required for environmental impact purposes (Barr 2015f, as cited in the FEIS). However, a summary of each is included in Section 4.0 of the document Mercury Overview a Summary of Potential Mercury Releases from the NorthMet Project and Potential Effects on the Environment (Barr 2015f, as cited in the FEIS). The evaluation estimates the potential sulfur deposition to the Partridge River (Colby Lake) and Embarrass River (Sabin Lake) watersheds. Based on the results of the additional assessment of sulfur deposition, the potential addition of sulfur from these emissions sources is small to negligible, and therefore would not be expected to have effects on mercury methylation or fish mercury concentrations. A summary of the evaluation is included in FEIS Section 5.2.7.2.6.

The supplemental assessment of potential additional sulfur from fugitive dust air emissions evaluated for the NorthMet Project Proposed Action's effects from potential sulfate additions to wetlands from the Plant Site and Mine Site fugitive dust emissions is summarized in FEIS Section 5.2.3. Using AERMOD to estimate estimated annual dust deposition, grams per square meter of dust containing sulfur was estimated to be deposited on the landscape. Based on a conservative assumption that all sulfur in fugitive dust converts to sulfate and mixes with surface water in wetlands, a potential incremental increase in sulfate was calculated as 4.2 mg/L. When mixed with annual precipitation, the sulfate value is 1.7 mg/L. Because the sulfur is inherent to the mineral matrix of the dust particles, it is likely that less than 100 percent of the sulfur would be weathered from the particles and be available to go into solution if deposited to soils or water. While this potential incremental change may warrant future monitoring, it would not be expected to have an effect on methylmercury concentrations in surface water. Although the actual potential for deposition of fugitive dust to wetlands, and the potential release of sulfur in that dust, is uncertain, adverse effects on wetlands are unlikely. The fugitive dust control plan for both the Mine Site and the Plant Site (including the Tailings Basin) should minimize such deposition, and the sulfur from any rock dust particles that are deposited may not be released or only released slowly through weathering. Using a conservative assumption that all sulfur in the deposited dust is both released and transformed to sulfate, no significant increase in methylmercury concentrations would be expected (Barr 2015f, as cited in the FEIS).

Because the potential additional deposition of sulfur from the NorthMet Project Proposed Action's air emissions is estimated to be small, including the potential release of sulfur from potential fugitive dust emissions, the findings and conclusions of the local mercury deposition analysis do not require changes or adjustments and no changes to current surface water methylmercury concentrations or fish mercury concentrations are reasonably expected. As currently stated in the FEIS, the NorthMet Project Proposed Action would reduce the sulfate loading to the small streams to the north of the Tailings Basin, the Embarrass River, and the downstream lakes. It is uncertain whether this reduction in sulfate discharge from the Tailings Basin would reduce methylmercury concentrations. However, the NorthMet Project Proposed Action is not expected to increase methylmercury concentrations in any of the receiving waters and would be in compliance with MPCA's guidance (MPCA 2006b, as cited in the FEIS) on the discharge of sulfate to sensitive ecosystems (Barr 2015f, as cited in the FEIS). Additional information in regards to mercury methylation is provided in FEIS Section 5.2.2.3.4. Discussion of mercury deposition and bioaccumulation in fish (Barr 2012b, as cited in the FEIS) and the assessment of the cumulative effects is provided in FEIS Section 6.2.6.

Theme MERC 09

Theme Statement

The SDEIS does not assess the effects of aerial deposition of mercury on wetlands. Groundwater-based mercury contributions to wetlands are also not assessed. The FEIS should assess these processes and their effects, including how such impacts will affect mercury bioaccumulation and compliance with existing water quality standards.

Thematic Response

The MPCA noted considerable uncertainty in modeling mercury transport and deposition (MPCA 2005, as cited in the FEIS). The results of modeling are conflicting with regards to local, regional, national, and global source contributions to a specific receptor. Ongoing efforts have been made to use computer models to estimate the amount of mercury deposition in the Midwest attributable to specific mercury emission sources. No generally accepted modeling technique has emerged, although the USEPA considers the Community Multiscale Air Quality (CMAQ) model the best available for evaluating mercury deposition (USEPA 2006, as cited in the FEIS). Overall, the models are helpful in linking deposition in an area to emissions from large regions or groups of sources, but are not accurate enough to predict the amount of mercury deposition to a site attributable to a specific remote source or group of emission sources. The assessment of potential local mercury deposition and resulting changes in fish mercury conducted for the NorthMet Project Proposed Action are consistent with the assessments conducted for other recent mining projects requiring environmental review. Such information in reference to mercury deposition has been summarized in Barr 2006g (as cited in the FEIS).

The Co-lead Agencies acknowledge that there could be water quality effects on wetlands and propose a comprehensive monitoring approach during operations, reclamation, and closure to identify such effects (if any). If effects are identified, adaptive mitigation measures would be invoked to remediate the situation and assure that water quality criteria are met. A mercury deposition impact analysis is summarized in FEIS Section 5.2.7.2.5. In addition, PolyMet conducted a cumulative effects analysis on the local mercury deposition and bioaccumulation in fish (Barr 2012b, as cited in the FEIS), and FEIS Section 6.2.6.3.3 presents an assessment of the cumulative effects of the NorthMet Project Proposed Action.

Theme MERC 10

Theme Statement

The SDEIS does not adequately assess the cumulative effects of mercury and sulfate release and methylmercury formation. The CEAA for mercury should include the entire St. Louis River Watershed.

Thematic Response

To assess cumulative effects, the potential impacts from the NorthMet Project Proposed Action were evaluated in combination with past, present, and reasonably foreseeable actions. The mercury concentrations in the St. Louis River from the NorthMet Project Proposed Action are not expected to increase. Therefore, cumulative effects are not expected. The potential increase in sulfate in the Partridge River near the Mine Site is estimated to a maximum of 0.1 mg/L. Thus, potential effects would not be noticeable in the Upper Partridge River, and even less so in the St. Louis River. As discussed in the FEIS, no cumulative impacts are expected for mercury and sulfate.

Theme MERC 11

Theme Statement

Assumptions regarding future mercury levels are questionable, due to the inaccurate water flow model in the SDEIS. Because the water model seriously underestimates the flow of groundwater through the mine and waste rock storage area into the Partridge River, it also underestimates mercury loading.

Thematic Response

The FEIS has been updated to reflect changes to water modeling. The GoldSim models are informed by a combination of groundwater flow models (MODFLOW), surface water runoff models (XP-SWMM), direct field measurements (groundwater levels, field borehole tests, groundwater and surface water sampling), and laboratory geochemical tests. For the FEIS, models (except XP-SWMM) were re-calibrated based on new field data obtained through the end of 2013. Where field data were not available, GoldSim inputs were based on a combination of literature values, experience at similar field sites, and best professional judgment. Changes in results based on the model outputs were evaluated and included in FEIS Chapters 4 and 5. The Co-lead Agencies reviewed and approved water model calibrations to existing conditions. Model calibrations, other model assumptions, and the resulting impact predictions provide a reasonable estimate of potential environmental effects for purposes of environmental review. The revised model results did not significantly change the initial and final parameter values for the mercury mass balance or the annual average load of mercury.

Theme MERC 12

Theme Statement

It appears that the waste rock (which will fill the East Pit) does leach mercury. Based on the humidity cell tests, a more appropriate value for East Pit porewater would be at least 6.5 ng/L.

Thematic Response

Information regarding the laboratory analysis of humidity cell leachates from waste rock in regards to mercury was summarized in FEIS Section 5.2.2.3.4. The NorthMet waste rock and ore contain trace amounts of mercury. Laboratory analysis of humidity cell leachates from waste rock samples found average total mercury concentrations between 5 and 7 ng/L, with concentrations unrelated to rock type or sulfur content (SRK 2007b, as cited in the FEIS). Separate 36-day batch tests using local rainfall (12 ng/L total mercury) found that contact with Duluth Complex rock actually decreased total mercury concentrations to between 1.9 and 3.2 ng/L as a result of adsorption (SRK 2007b, as cited in the FEIS). The control test only showed a decrease to 7 ng/L. The results indicate that the rock has the ability to remove mercury from solution. Therefore, the data suggest that mercury present in rainfall or released by sulfide oxidation is typically adsorbed by other minerals present in the mine waste rock. For these reasons, mercury released from waste rock and ore at the Mine Site is not expected to be a constituent of concern in groundwater seepage.

Theme MERC 13

Theme Statement

GoldSim did not evaluate elemental mercury in the water quality modeling. For the FEIS, mercury should be added to modeling and transport analysis for water quality effects.

Thematic Response

There will be no elemental mercury (Hg^0) discharge, but rather as ionic mercury (Hg^{2+}). Surface waters near the NorthMet Project area have a water quality standard for total mercury of 1.3 ng/L. Total mercury includes all species of mercury, including elemental mercury; however, elemental mercury is unlikely to exist in the water column. While mercury was not explicitly modeled in the GoldSim platform, mercury was modeled using a mass balance approach. The NorthMet Project Proposed Action would need to demonstrate during permitting that total mercury concentrations in anticipated permitted discharges would meet the effluent limit. The surface and groundwater containment system is expected to capture about 90 percent of groundwater and surface seepage from the Tailings Basin. Although mercury detected in rain water is at a concentration of ranging from 8 to 10 ng/L, mercury that now escapes the Tailings Basin is at a level of 2.0 ng/L (at the toe). Additionally, the NorthMet Project Proposed Action is expected to discharge mercury at or below the mercury standard of 1.3 ng/L, which includes treatment of water pumped from Colby Lake. Mercury concentrations at the Mine Site are projected to decrease, and effects are expected to be undetectable in the St. Louis River at the Fond du Lac reservation boundary. Therefore, the potential effects are expected to be less than significant, and the mass balance approach is appropriate to provide a reasonable estimate of potential contributions for purposes of environmental review.

The use of a mass balance approach to evaluate mercury was identified as the appropriate analytical tool for predicting mercury concentrations during scoping of this EIS, and is a common analytical tool utilized and relied upon by agencies to assess mercury impacts in Environmental Impact Statement and the like.. Given the scientific community's current understanding of the relationship between total mercury, sulfate, methylmercury, etc., the mercury mass balance approach used in the FEIS is ideal for estimating mercury impacts from the NorthMet Project Proposed Action. For the Mine Site, a mass balance model approach using annual inputs and outputs was used to estimate total mercury concentration in the West Pit lake. The estimation method is preferred over a detailed mechanistic model, because it incorporates the important input and removal processes for mercury, it is very transparent with regard to data inputs, and allows for easy assessment of the effect of changing parameter values on mercury concentrations (PolyMet 2015m, as cited in the FEIS). For the Plant Site, major mercury sources for the mining facility were included in the mass balance model, with the estimate of input and output values based on measurements taken at each stage of the ore processing as in the 2004 SGS Lakefield Pilot Study and 2005 Pilot Plant Study (PolyMet 2015j, as cited in the FEIS). Additional information supporting the evaluation of mercury by the mass balance approach is included in FEIS Section 5.2.2.3.4.

Theme MERC 14

Theme Statement

The Hydrometallurgical Residue Facility may contain 0.7 to 1.5 tons of mercury. Mercury leakage from the Hydrometallurgical Residue Facility should be modeled, and the FEIS should discuss the increased risk to groundwater due to mercury release from the aging Hydrometallurgical Residue Facility liners. The FEIS should also discuss mercury speciation versus changes in the Hydrometallurgical Residue Facility, should acid conditions develop.

Thematic Response

As summarized in FEIS Section 3.2.2.3, the Hydrometallurgical Residue Facility would be built at the existing LTVSMC Emergency Basin. A double-liner system would be installed, with each layer consisting of a geomembrane layer above a geosynthetic clay liner for leachate control (leachate collection system), and a geocomposite drainage system for leachate collection. According to FEIS Section 3.2.2.3, water captured by the liner system during operations would be returned to the Hydrometallurgical Residue Facility pond. The amount of water pumped from the leachate collection system would be monitored on a long-term basis, and repairs and mitigation measures would be implemented in the event of increased leakage. Therefore, it is assumed that the leakage from this facility into underlying groundwater or adjacent surface water would be negligible. As described in FEIS Section 3.2.2.3.6, solution neutralization would be used to neutralize acids formed as a result of the upstream process.

A polyethylene Geomembrane Chemical Resistance Chart was included in the Residue Management Plan (PolyMet 2014r, as cited in the FEIS) for the Hydrometallurgical Residue Facility. This chart lists specific chemicals, their concentration and resistance at specified temperatures (20 degrees Celsius and 60 degrees Celsius). Per the guidelines of the chart, mercury at a concentration of 100 percent and at temperatures of 20 and 60 degrees Celsius displays a satisfactory result, meaning the liner is resistant to the given reagent at the given concentration and temperature(s) and no mechanical or chemical degradation is observed.

Theme MERC 15

Theme Statement

The FEIS should disclose the influent and effluent mercury assumptions and targets for the Wastewater Treatment Facility (WWTF), and should explain mercury removal technologies.

Thematic Response

There would be no surface water discharges to the Partridge River or its tributaries from the Mine Site until approximately year 60, when the West Pit would be flooded and the overflow would be directed to the Mine Site WWTF for treatment and discharge. The Mine Site WWTF discharge would be subject to the Great Lakes Initiative standard for mercury (1.3 ng/L). Mercury concentrations in the West Pit were estimated two ways: using analog data from other natural lakes and mine pit lakes in northeastern Minnesota, and using a mass balance approach. Based on conservative assumptions, the mass balance analysis estimated the average mercury concentration of the West Pit during flooding (year 20 to about year 55) to be about 0.3 ng/L. At the time of overflow, the mercury concentration was estimated to be about 0.5 ng/L, which then reached an equilibrium concentration near 0.9 ng/L, which can be assumed for the influent to the WWTF. Because the Mine Site WWTF would discharge to the Tailings Basin pond during operations and to the West Pit during reclamation, it is anticipated that the Mine Site WWTF effluent would be considered an internal waste stream during these periods, and would not have discharge limits. However, treatment goals are expected to be part of an overall water management strategy.

Discharges from the Mine Site WWTF would be at or below the Great Lakes Initiative discharge standard of 1.3 ng/L, as the WWTF would be designed to meet the mercury standard for the effluent. Additional mercury reduction that may result from the Mine Site WWTF treatment is not accounted for in the calculations. FEIS Sections 3.2.2.1.8 and 3.2.2.1.9 summarize treatment methodologies for the Mine Site WWTF and water management. The Mine Site WWTF would be constructed to treat affected water at the Mine Site and also treat the reject concentrate from the Plant Site WWTP (see FEIS Section 3.2.2.3.10). Water treatment would include chemical precipitation and membrane filtration treatment methodologies. The design of the Mine Site WWTF is based on the predicted water loads and constituents modeling described in FEIS Section 5.2.2. The Mine Site WWTF could be expanded or treatment capabilities modified to meet water quality standards if monitoring indicates the need. As summarized in FEIS Section 3.2.2.1.10, an RO unit would be added to the Mine Site WWTF during closure. At the Mine Site, because of the low concentrations of mercury in pit lakes and the RO process at the Mine Site WWTF, the permitted discharge from the Mine Site is expected to meet the Lake Superior Basin water quality standard of 1.3 ng/L for effluent.

The WWTP at the Plant Site and the WWTF at the Mine Site would use mercury-capturing greensand filtration for pretreatment prior to RO. Adaptive management would be based on monitoring for total mercury to determine whether the treated water could be discharged to surface waters, or whether some additional treatment is needed. PolyMet has identified the following adaptive management strategies:

- Pretreatment modifications such as chemical scavenger addition to obtain additional metals;
- Use of tighter RO membranes for the primary RO system;
- Treatment of some portion of the VSEP permeate by the primary RO system to further remove some dissolved constituents; and
- Addition of polishing treatment units for removal of trace metals (e.g., ion exchange).

Theme MERC 16

Theme Statement

The SDEIS fails to clearly state the expected amount of mercury that will be released into surrounding watersheds over time. Estimates for other metals are provided, but not for mercury.

Thematic Response

As summarized in FEIS Section 6.2.2.4.2, the NorthMet Project Proposed Action is predicted to result in an overall net decrease of mercury loadings of approximately 1.0 grams per year (i.e., a net decrease of 1.2 grams per year in the Partridge River and a net increase of 0.2 grams per year in the Embarrass River), which is indistinguishable from natural background variability. Furthermore, discharges are expected to meet the 1.3 ng/L standard for mercury.

Theme MERC 17

Theme Statement

The total amount of mercury generated from the mining processes should be listed in the FEIS. This includes bulk tailings, hydrometallurgical tailings, and autoclave scrubber waste and disposal. The FEIS should also provide a detailed mercury monitoring plan.

Thematic Response

A screening total facility mercury mass balance was conducted for the NorthMet Project Proposed Action to identify the potential releases to the environment. The original mass balance included two autoclaves associated with the hydrometallurgical process. The total facility mass balance followed the MPCA’s requirements and was similar to mass balances conducted for other recent mining projects in Minnesota. Similar to other mining operations, about 95 percent of the mercury in the process is expected to stay with the solids. Also similar to other mining projects, air emissions would be a small component of the total mass of mercury associated with ore processing.

The majority of the mercury, about 95 percent, is expected to be routed to the Tailings Basin or the reactive residue cells, where available information indicates it should remain sequestered and not be released to air, surface waters, or groundwater. Mercury in the ore is the primary source of mercury at the Plant Site, and air emissions of mercury are primarily associated with the Hydrometallurgical Plant (4.1 pounds/year). A small amount of mercury emissions are estimated to potentially be emitted from natural gas combustion associated with a package boiler and a natural gas fired process heater and space heaters (0.4 pounds/year). In addition, a small amount of particle-bound mercury is associated with mining, ore crushing, milling processes, flotation concentrate handling, and fugitive dust emissions from the Tailings Basin (less than 0.1 pounds/year). A relatively small amount of mercury is estimated to be associated with diesel fuel combustion in mine vehicles. Overall, total potential emissions of mercury from the NorthMet Project Proposed Action are estimated to be 4.6 pounds/year from the Plant Site, a maximum of 0.17 pounds per year from Tailings Basin construction vehicles (diesel fuel combustion emissions), and approximately 0.6 pounds/year from diesel fuel combustion at the Mine Site.

Adaptive management would be implemented as necessary based on monitoring for total mercury to determine whether the treated water could be discharged to surface waters, or whether some additional treatment would be needed. PolyMet has identified the following adaptive management strategies:

- Pretreatment modifications such as chemical scavenger addition to obtain additional metals;
- Use of tighter RO membranes for the primary RO system;
- Treatment of some portion of the VSEP permeate by the primary RO system to further remove some dissolved constituents; and
- Addition of polishing treatment units for removal of trace metals (e.g., ion exchange).

Theme MERC 18

Theme Statement

The SDEIS relies on impermissible mercury trade-offs between the Partridge, St. Louis, and Embarrass rivers.

Thematic Response

Discharges from the Mine Site would flow to the Upper Partridge River, and discharges from the Plant Site would flow to the Upper Embarrass River and to the lower Partridge River via Second Creek. Both the Partridge River and the Embarrass River are tributaries of the St. Louis River. The SDEIS and FEIS evaluate the Embarrass River, Partridge River, and St. Louis River individually, as summarized in Barr 2015g (as cited in the FEIS). The current mercury load from the watersheds containing the NorthMet Project Proposed Action area were evaluated and compared with projected future mercury loads from these same watersheds, including discharges from the NorthMet Project Proposed Action. The analysis assessed potential impacts during long-term closure. Long-term closure is the period with maximum sustained water discharges from both the Mine Site and the Plant Site, and is thus the time period of greatest potential to impact total mercury concentrations in the St. Louis River.

These assessments showed that the mercury load from the Mine Site would slightly decrease during long-term closure, because a portion of the flow that is currently watershed yield (total mercury concentration of 3.6 ng/L) would be captured in the West Pit lake and discharged via the Mine Site WWTF at a conservatively assumed total mercury concentration of 1.3 ng/L. Flows from the Mine Site in long-term closure are not expected to change from existing conditions; therefore, the change in total mercury concentration from 3.6 to 1.3 ng/L for a portion of the flow from the Mine Site results in reduced loading to the Partridge River.

The mercury load from the Plant Site would increase slightly during long-term closure for two reasons. First, the seepage from the existing LTVSMC Tailings Basin is assumed to have a total mercury concentration of 1.0 ng/L, while the combined seepage collected by the groundwater containment system and excess Tailings Basin pond water that would be discharged via the Plant Site WWTP is conservatively assumed to have a total mercury concentration of 1.3 ng/L. Second, runoff from the vicinity of the East Dam that currently flows into the existing LTVSMC Tailings Basin and emerges as seepage (total mercury concentration of 1.0 ng/L) would become surface runoff to the Embarrass River watershed via Mud Lake Creek (total mercury concentration of 3.5 ng/L). The assumed small changes in mercury concentrations for seepage water and runoff from near the East Dam would result in a slight increase in mercury concentration and loading to the Embarrass River.

Overall, the changes in total mercury concentrations associated with the NorthMet Project Proposed Action in long-term closure at the Mine Site and Plant Site are estimated to be too small to distinguish from natural background variability in the Partridge River and the Embarrass River using available laboratory methods.

The NorthMet Project Proposed Action and NorthMet Project area watershed information used to assess the potential effects on average annual mercury loading and concentrations at the Plant Site and Mine Site (Upper Embarrass River and Upper Partridge River, respectively) were also used to assess the potential effects from the NorthMet Project Proposed Action on mercury loading in the St. Louis River. For the lower St. Louis River, estimated changes in average annual total mercury concentration from the NorthMet Project Proposed Action were smaller than the estimated changes in the Upper Embarrass River and the Upper Partridge River. When the potential mercury load from the NorthMet Project Proposed Action in long-term closure is added to the respective St. Louis River Evaluation Points, there is a slight decrease in mercury loading (-1.0 g/yr) and no detectable change in the mercury concentration (change less than 0.05 ng/L), given the variability in environmental concentrations and the current laboratory detection limits. These results indicate that the potential mercury load from the NorthMet Project Proposed Action would not degrade or lower water quality with respect to average annual total mercury concentrations at the respective evaluation points. Overall, the NorthMet Project Proposed Action is not expected to have a statistically discernible effect on mercury loading or concentrations at the St. Louis River evaluation points.

Theme MERC 19

Theme Statement

The SDEIS does not estimate the amount of mercury likely to affect the St. Louis River and Lake Superior.

Thematic Response

As summarized in FEIS Section 6.2.2.4.2, the NorthMet Project Proposed Action is predicted to result in an overall net decrease of mercury-loadings of approximately 1.0 grams per year (i.e., a net decrease of 1.2 grams per year in the Partridge River and a net increase of 0.2 grams per year in the Embarrass River), which is indistinguishable from natural background variability. Furthermore, discharges are expected to meet the 1.3 ng/L standard for mercury. The NorthMet Project Proposed Action would not contribute to cumulative effects on mercury loading to the St. Louis River. Supporting information is provided in FEIS Section 6.2.2.4.2.

Theme MERC 20

Theme Statement

The SDEIS does not address the transport and fate of mercury releases through seepage and leaching from waste rock stockpiles, mine pits, drying and re-wetting of peat overburden, tailings, or liner leaks, and thus does not adequately characterize potential mercury methylation, conversion, and bioaccumulation. The FEIS should be revised to disclose mercury and sulfate concentrations in seepage from all potential project sources, and should explain existing and proposed mitigation measures for mercury.

Thematic Response

The most reactive waste rock mined at the NorthMet site (Category 4) would be temporarily stored on liners, then placed in the East Pit and flooded with water before closure. FEIS Section 5.2.2 discusses temporary pollutant release by leakage through these liners. The less-reactive Category 1 Stockpile that remains permanently on the surface would be surrounded with a water containment trench to capture seepage during and after mining. Additionally, a proposed geosynthetic cover would decrease water infiltration, and water captured in the trench would be treated.

The recycle/reuse water management plan would result in very little wastewater discharged from the Plant Site during ore processing. Because of the demonstrated ability of both taconite tailings and copper nickel tailings to rapidly absorb mercury, seepage water from the Tailings Basin is expected to have a low concentration of mercury (i.e., less than 1.3 ng/L). The Tailings Basin seepage water would be collected and routed to the Plant Site WWTP along with other water from the Plant Site. The Plant Site WWTP would use greensand filtration followed by RO technology, which is expected to remove some additional mercury, although removal efficiency at low concentrations is not established. Because of the low concentrations of mercury in the Tailings Basin and LTVSMC tailings seepage, and greensand filtration followed by RO technology, the Plant Site WWTP would be expected to meet the numeric water quality standard of 1.3 ng/L.

Any mercury released from the decomposition process is thought to occur relatively rapidly. The mercury released from organic matter decomposition and in solution would have the potential to move with precipitation that falls on the Overburden Storage and Laydown Area. However, water coming in contact with materials in the Overburden Storage and Laydown Area is considered to be process water, and would be routed to Pond PW-OSLA. In years 1 to 11, the water from Pond PW-OSLA would be routed to the Tailings Basin and any mercury in the routed water would have the chance to be sequestered in the tailings. In years 12 to 20, some of the water from Pond PW-OSLA would be used to backfill the East Pit. Any mercury in the water routed to the East Pit would have the chance to mix with waste rock and become sequestered at depth in the East Pit. In addition, any contributions of water in years 21 to 65 from the East Pit to the West Pit would reflect water from the East Pit and its associated watershed runoff and would not reflect process water from Pond PW-OSLA. Because peat removal from the areas to be mined would be completed between years 5 and 11, any potential release of mercury from stored peat materials would have occurred, or be ending, by the time water is routed from Pond PW-OSLA to the East Pit beginning in year 12.

Section 3.0 of Barr 2015f (as cited in the FEIS) provides a summary of the NorthMet Project Proposed Action's potential releases of mercury and sulfur. Mercury and sulfate loadings are predicted to decrease overall as a result of the NorthMet Project Proposed Action. A summary of mercury and sulfur releases and methylation and deposition impact analyses are discussed in FEIS Sections 5.2.2.3.4, 5.2.7.2, 5.2.7.2.5, and 6.2.3.3.4. The following adaptive management strategies proposed for mercury are included in FEIS Section 5.2.2.3.5:

- Pretreatment modifications such as chemical scavenger addition to obtain additional metals;
- Use of tighter RO membranes for the primary RO system;
- Treatment of some portion of the VSEP permeate by the primary RO system to further remove some dissolved constituents; and
- Addition of polishing treatment units for removal of trace metals (e.g., ion exchange).

Theme MERC 21

Theme Statement

The FEIS should evaluate the use of unsaturated overburden and peat for construction and reclamation activities as a source of potential mercury release, in addition to other sources such as constructed wetlands, West Pit, and Overburden Storage and Laydown area.

Thematic Response

Unsaturated overburden and peat material would be used for construction, as approved by the MDNR. Peat (organic soils) and unsaturated overburden that could be used in immediate construction and reclamation would be stored in unlined overburden stockpiles at the Overburden Storage and Laydown Area. Unsaturated overburden (e.g., surficial mineral soil) and peat would be placed in the Overburden Storage and Laydown Area for temporary storage until the material is used for reclamation purposes. The removal of the material would occur prior to the initiation of mining. Also, the Overburden Storage and Laydown Area would be one of the first storage areas to be constructed in order to accommodate the materials associated with the start-up overburden removal. Any mercury released from the decomposition process is thought to occur relatively rapidly. The mercury released from organic matter decomposition and in solution would have the potential to move with precipitation that falls on the Overburden Storage and Laydown Area. However, water coming in contact with materials in the Overburden Storage and Laydown Area is considered to be process water, and would be routed to the Overburden Storage and Laydown Area Pond (Pond PW-OSLA). Runoff water from the Overburden Storage and Laydown Area would be collected in Pond PW-OSLA as long as materials were stored there. In years 1 to 11, the water from Pond PW-OSLA would be routed to the Tailings Basin and any mercury in the routed water would have the chance to be sequestered in the tailings. In year 12 to 20, some of the water from Pond PW-OSLA would be used to backfill the East Pit. Any mercury in the water routed to the East Pit would have the chance to mix with waste rock and become sequestered at depth in the East Pit. In addition, any contributions of water in years 21 to 65 from the East Pit to the West Pit would reflect water from the East Pit and its associated watershed runoff and would not reflect process water from Pond PW-OSLA. Because peat removal from the areas to be mined would be completed between years 5 and 11, any potential release of mercury from stored peat materials would have occurred, or be ending, by the time water is routed from Pond PW-OSLA to the East Pit beginning in year 12.

Theme MERC 22

Theme Statement

The SDEIS does not provide a rationale for allowing more mercury to be added to a water system that is already too high in mercury, especially since the existing mercury risk has not been addressed by a Total Maximum Daily Load (TMDL). A mercury TMDL for the St. Louis River should be completed before the FEIS is published and before Permits to Mine are authorized. The FEIS should state whether the company would have to buy mercury offsets, as defined by the State Mercury Implementation Plan, for any new mercury source.

Thematic Response

The comments in this theme were originally presented as part of the Tribal Position Summary included in MDO #2, and is currently addressed in Table 8-1 of the FEIS. Further explanation is provided below.

MPCA's goal is to protect high-quality waters and improve the quality of impaired waters, so water quality standards are met and beneficial uses are maintained and restored, where these uses are attainable. As summarized in FEIS Section 5.2.7.2.5, widespread contamination of fish from atmospheric pollution is why Minnesota established a statewide mercury TMDL. The TMDL seeks to reduce atmospheric deposition everywhere in the state, in order to make the state's lakes and streams fishable, as required by federal regulations, and is intended to provide the long-term framework to reduce mercury in fish. The MPCA published Guidelines for New and Modified Mercury Air Emission Sources, and revised those guidelines in 2012. The guidelines were developed to limit the mercury emissions from new and expanding sources in order to meet the TMDL goal of total statewide mercury emissions of 789 lbs/year by 2025. The MPCA has conducted a review of the NorthMet Project Proposed Action mercury emissions, and has determined that it would not impede the reduction goals (MPCA 2013b, as cited in the FEIS). Accordingly, no minimization and mitigation plan is required for the NorthMet Project Proposed Action. Based on the results of MPCA's review, the NorthMet Project Proposed Action should not be required to buy mercury offsets at this time. Should an evaluation of the NorthMet Project Proposed Action determine that an additional mercury source has been added, mercury offsets would be sought in accordance with the Implementation Plan for Minnesota's Statewide Mercury Total Maximum Daily Load (MPCA 2009d, as cited in the FEIS).

Further, the NorthMet Project Proposed Action is not anticipated to be a major source of mercury into the environment. The RO treatment is expected to discharge mercury at or below the mercury standard of 1.3 ng/L, which includes all surface water that would be discharged at the Plant Site, including water used for flow augmentation. Mercury loadings from the Mine Site are projected to decrease due to the NorthMet Project Proposed Action. The combined contributions from the Embarrass River and Partridge River are unchanged when modeled for the St. Louis River at the Fond du Lac reservation boundary; therefore, further degradation of surface water quality, and by extension increased mercury in fish, is not expected.

Theme MERC 23

Theme Statement

The Proposed Action will result in an increase (and not a decrease, as claimed by the SDEIS) in mercury loading to the Embarrass and Partridge River aquatic systems and other waterways, and its effects on water quantity will cause increased mercury methylation and bioaccumulation. Such an increase would be illegal.

Thematic Response

Based on the evaluations conducted for air emissions and water discharges for the FEIS, the NorthMet Project Proposed Action is not considered to have an appreciable effect on: 1) surface water mercury concentrations, 2) fish mercury concentrations, 3) methylation of mercury, or 4) risk to people consuming fish from lakes near the NorthMet Project Proposed Action site.

The MPCA's Cumulative Mercury Risk Estimation Method (MMREM) analysis for two scenarios showed a 0.5 to1.8 percent and 0.3 to 0.5 percent potential increase in fish mercury concentration above background. However, the small incremental change is not expected to be significant compared to background, and is not expected to affect fish consumption advisories or effect consumers of locally caught fish. The increase is not expected to have an appreciable effect on the loading estimates from permitted discharges to the Embarrass, Partridge, or lower St. Louis rivers. Discharges are expected to meet the 1.3 ng/L standard for mercury, with an overall net decrease in mercury loading predicted for the NorthMet Project Proposed Action.

Theme MERC 24

Theme Statement

The Environmental Justice section of the FEIS should evaluate effects on Band members, subsistence consumers, and other Environmental Justice populations associated with increases in mercury and methylmercury bioaccumulation in fish tissue.

Thematic Response

The effects of mercury bioaccumulation on subsistence activity are discussed in FEIS Sections 5.2.7.2.5 and 5.2.10.2.6. Additionally, the potential cumulative effects of the NorthMet Project Proposed Action on the bioaccumulation of methylmercury in fish are discussed in FEIS Section 6.2.6. The Environmental Justice analysis included disproportionately affected populations, as well as residents of the NorthMet Project area, including Band members who use the area for subsistence regardless of where they live. Operations could affect individuals who consume fish from nearby waterbodies with increased mercury concentrations and associated increases in mercury bioaccumulation in fish tissue. Additional information pertaining to the effects of mercury and methylmercury on subsistence consumers has been included in FEIS Section 5.2.10.2.6, and is also summarized with the human health considerations text in FEIS Section 7.3.4.4.3.

A.5.15 Issue: Noise and Vibration (N)

Theme N 01

Theme Statement

The NorthMet Project will result in long-term and permanent noise effects on nearby residents and visitors.

Thematic Response

Long-term noise impacts to nearby residents and visitors are addressed based on state noise standards (*Minnesota Rules* 7030) for different Noise Area Classifications (NACs), including residential and recreational land uses. Long-term noise impacts are discussed in FEIS Section 5.2.8.

Theme N 02

Theme Statement

The FEIS should assess mine noise effects on recreational sites, including residential and tourism sites near Birch Lake and within the BWCAW.

Thematic Response

Mine-related noise impacts on recreational sites such as those near Birch lake are addressed based on state noise standards (*Minnesota Rules* 7030) for different Noise Area Classifications (NACs), including residential and recreational land uses. Mine-related noise impacts on nearby recreational sites are discussed in FEIS Section 5.2.8. The FEIS also discloses that mine-related noise would not be audible within the BWCAW.

Theme N 03

Theme Statement

The FEIS should further analyze cumulative noise and vibration effects on nearby residents and recreational visitors. This analysis should include the provision of contour maps showing overlapping noise pollution from different projects and a cumulative mining vibration analysis.

Thematic Response

FEIS Section 6.2.8, under Cumulative Effects by Resource - Noise and Vibration, has been updated in the FEIS, and provides more analysis on the cumulative noise and vibration impacts on nearby residents and recreational visitors. The updated section concludes that adverse cumulative noise and vibration impacts are not expected on nearby sensitive receptors (residences/ dwelling places, recreational sites, cultural sites), due to the distance of the NorthMet Project to the closest reasonably foreseeable action, Mesabi Nugget Phase II Mine Project, (approximately 2 miles west of the Plant Site and 10 miles west of the Mine Site).

Other reasonably foreseeable projects in the region are 25 to 55 miles away from the NorthMet Project and as such, would have no cumulative effect on the nearest receptors (see Figure 6.1.1-1 and Table 6.1.1-1). Other past and present actions, such as the North Shore Mine are already accounted for in the baseline/ambient noise levels. Actual noise and vibration source terms from future projects such as the Mesabi Nugget Phase II Mine Project were not publicly available and contour maps for such future projects were not provided. It should be noted that even if noise and vibration source terms for the Mesabi Project were available, such contour maps are not expected to overlap with the NorthMet Project noise and vibration contours due to the distance between both projects (i.e., considering the rapid decay of sound with increased distance [6 decibel decrease per doubling of distance] and attenuation from individual mine pit walls (i.e., as the pits become deeper) and dense foliage [Superior National Forest]).

Theme N 04

Theme Statement

The FEIS should further analyze noise and vibration effects on wildlife, including Canada Lynx and songbirds. The analysis should include cumulative effects from other nearby mining projects, as well as additional mitigation and a clearly defined area of impact to wildlife.

Thematic Response

FEIS section 5.2.5 (Wildlife Impacts) has been updated to include noise and vibration impacts to wildlife, including Canada lynx and songbirds at the local and regional level. Appropriate mitigation and impact areas have been clearly defined. For more details please see response to theme WI 05. In addition, please see the Biological Assessment for further details on noise impacts to the Canada lynx, as well as the Biological Evaluation for details on noise impacts to wildlife.

Theme N 05

Theme Statement

The FEIS should include a quantitative analysis of blasting noise and ground borne vibration effects.

Thematic Response

Quantitative analysis of blasting noise and ground-borne vibration impacts are addressed in accordance with *Minnesota Rules* 6132.2900, for ground-borne vibration and airblast overpressures (i.e., blasting noise). Quantitative analysis of ground-borne vibration and airblast overpressures from blasting are discussed in FEIS Section 5.2.8.2.2.

Theme N 06

Theme Statement

The FEIS should analyze noise in terms of its tonality, low frequency, fluctuations, and impulsiveness.

Thematic Response

FEIS sections 4.2.8.1 and 5.2.8.2.1 include noise analysis in terms of its tonality, low frequency, fluctuation (or intermittent noise), and impulsiveness. The sections have been modified to increase clarity and provide qualitative analysis. The analysis shows no significant impacts.

Theme N 07

Theme Statement

The FEIS should assess noise effects from increased transportation in and out of the NorthMet Project.

Thematic Response

Transportation of Project consumables and products could result in some noise from increased traffic on public roads and commercial railroads. Public roads could also experience minor increases in noise levels due to additional traffic from employees and service providers, particularly along State Highway 135 and County Road 666. Traffic noise from employee vehicles, service provider vehicles, and trucks transporting process consumables and products are not expected to be significant due to the small increase in daily traffic volumes (approximately 7 trucks per day and 149 employee and service provider vehicles per day along State Highway 135; and approximately 42 employee and service provider vehicles per day along County Road 666 [see NorthMet Biological Assessment dated November 2013]) in comparison to the existing annual average daily traffic (AADT) volumes of State Highway 135 and County Road 666. The NorthMet Project Proposed Action's offsite traffic volumes are approximately 2 to 18 percent and 5 to 30 percent of existing AADT at State Highway 135 (850 to 8300 vehicles per day) and County Road 666 (140 to 810 vehicles per day), respectively (Barr 2014a, as cited in the FEIS).

Similarly, railway noise from trains carrying process consumables and concentrates from the Plant Site to Virginia, Minnesota and vice versa (via Canadian National Railroad) are not expected to be significant due to the small increase in monthly railway traffic volumes: approximately one 100-car train once per month and one 30-car train 4 times per month, year round for product shipment; and approximately one 100-car train once per week, April through October, for process consumables (see Appendix D for the Biological Assessment). This accounts for approximately 3 to 4 percent of the existing monthly traffic volumes of the Canadian National Railroad on the Iron Junction to Allen Junction rail segment. (Personal Communication from Pat Sheehy (Barr), November 6, 2014).

Based on the off-site traffic information described above, noise effects on off-site transportation are not expected to be significant. In addition, all project-related off-site roadway and railway traffic would occur during daytime hours only. The off-site trucks would not exceed 40 miles per hour, and would avoid densely populated areas to the extent practicable. Any noise sensitive receptor near the Canadian National Railway segments close to the Plant Site, State Highway 135, and County Road 666 would not be exposed to a new noise source since these infrastructures have been in operation for decades. FEIS Section 5.2.8.2.3 has been updated to include a qualitative assessment of noise effects on off-site transportation.

A.5.16 Issue: National Environmental Policy Act (NEPA) and Minnesota Environmental Policy Act (MEPA) Considerations

Theme NEPA 01

Theme Statement

The purpose and need statements should be broadened to allow consideration of other alternatives to the NorthMet Mining Project.

Thematic Response

The Co-lead Agencies' purpose and need statements are based on their respective mandates, other legal guidance, and the proposal before them for review. The Co-lead Agencies believe that the NorthMet Mining Project and Land Exchange EIS considered a reasonable range of alternatives based on the agencies' respective purpose and need statements, issues raised during scoping, and potential impacts identified during the analysis.

Theme NEPA 02

Theme Statement

The purpose and need statements need to be revised to clearly define the agencies' respective mandates and requirements. The agencies may be confused about their roles and responsibilities regarding the project. Comments in this theme questioned why the agencies' purpose and need statements matched the proponent's purpose for the project.

Thematic Response

The Co-lead Agencies' purpose and need statements are based on their respective mandates, other legal guidance, and the proposal before them for review. The Co-lead Agencies believe that their roles are accurately described and fulfill their respective responsibilities under state and federal law.

The Co-lead Agencies' purpose and need statements may be similar in some ways to the proposer's purpose for the Project; however, the agency purpose and need statements are based on state and federal laws and agency responsibilities to consider applications to mine and the Section 404 permit, as well as the Land Exchange Proposed Action.

Theme NEPA 03

Theme Statement

The agencies' purpose and need statements should define why the NorthMet Mining Project should be considered at this time and/or in this location.

Thematic Response

The MDNR and USACE are required by law to consider proposals to mine and the application for a Section 404 permit, respectively, at the time they are submitted and in the proposed location.

Theme NEPA 04

Theme Statement

The USFS purpose and need statement should more clearly define why the agency needs to consider the proposed land exchange and how it would be in the public interest. The purpose and need in the SDEIS serves a private interest, not a public interest.

Thematic Response

In addition to the USFS purpose and need statement in FEIS Section 1.3.2.2, FEIS Section 7.3 (including Table 7.3-1) identifies the factors that would be considered in the ROD to determine whether the Land Exchange Proposed Action serves the public interest.

Theme NEPA 05

Theme Statement

The project is needed because the metals proposed to be mined are of strategic and national importance. Copper, nickel, and PGEs are essential elements in the manufacture of products such as cell phones, wind turbines, electric car batteries, medical applications, computers, and many other items. Mining these resources in Minnesota ensures it is done in an environmentally controlled manner.

Thematic Response

These comments provide general information in support of the NorthMet Project Proposed Action because the minerals it would provide are of strategic and national importance. Because no specific information was provided, no changes to the EIS were made as a result of the comments.

Theme NEPA 06

Theme Statement

The project is not needed because the US need for copper is declining. Demand for metals like copper and nickel can be met by means other than a new mine, including recycling, metals resource recovery operations, and greater reliance on green energy. A more sustainable option should be first evaluated. The minerals aren't going anywhere. Hold off on mining until it can be done without endangering the watershed.

Thematic Response

During the development of the Draft EIS for the NorthMet Project (2009) and the SDEIS for the NorthMet Mining Project and Land Exchange (2013), the Co-lead Agencies screened potential alternatives based on a variety of screening criteria. These criteria included whether the possible alternative: 1) met the Co-lead Agencies and proposer's purpose and need for the Project; 2) was technically feasible; 3) was economically feasible; 4) was available (i.e., the mineral and surface rights and technologies were currently available); and 5) provided an environmental or socioeconomic benefit over the proposed Project. Of these, the alternative of using recycling, metals resource recovery, and greater reliance on green energy did not meet the Co-lead Agencies or proposer's purpose for the Project.

Although NEPA guidance (40 CFR 1502.14(c)) allows agencies to consider alternatives not within their legal jurisdiction, the suggested alternatives did not meet the overall purpose and need for the Project, as noted in criterion #1 above. The EIS discloses the potential impacts of the NorthMet Project Proposed Action, including watershed effects. To receive the necessary permits to construct and operate the mine, the proposer would need to demonstrate to permitting agencies that the NorthMet Project Proposed Action would not exceed applicable environmental quality standards.

Theme NEPA 07

Theme Statement

The SDEIS document is too complex, written in a confusing style, and too lengthy to enable the reader to understand and/or make an informed decision about the Proposed Action. SDEIS materials were also difficult to obtain and new information became available. At a minimum, the comment period is too short and should be extended to allow the public more time to consider the contents of the SDEIS.

Thematic Response

The FEIS contains a scientific analysis of the potential effects of the NorthMet Project and Land Exchange Proposed Actions necessary for such a complex project. This analysis was accompanied by plain language descriptions of the scientific analyses, notably in the introductions of each resource section and in the Executive Summary.

The Co-lead Agencies identified reference materials and included in the SDEIS relevant information believed to be necessary to understand its analysis and findings. Reference materials were made available upon request within reasonable timeframes, in accordance with the policies of state and federal agencies. The SDEIS was circulated for public comment for 90 days, which is twice the amount of time required by the federal regulations, and three times the amount of time required by state regulations.

Theme NEPA 08

Theme Statement

The SDEIS is flawed because it did not follow the legal requirements of NEPA and/or MEPA, such as by failing to properly describe mitigation measures or management plans that affect the Project's potential impacts. How can it be that the same agencies that prepared the EIS issue the critical Record of Decision?

Thematic Response

The Co-lead Agencies believe that the analysis of the Project as presented in the EIS meets the procedural and analytical requirements of NEPA and MEPA.

As a disclosure document, the EIS describes the potential effects of the NorthMet Project and Land Exchange Proposed Actions, and identifies mitigation measures that could be required as part of permitting and as conditions become better understood through monitoring. This is consistent with NEPA and MEPA rules, which stress that EISs not become encyclopedic descriptions of every possible outcome, but instead focus on likely impacts. NEPA requires that federal agencies issue RODs based on the EISs they prepare (or adopt as consistent with Council on Environmental Quality regulations). Thus, the federal agencies are meant to issue the RODs.

Minnesota Rules 4410.2800, subpart 4 requires the RGU (the MDNR) to find the FEIS adequate if it: a) addresses the potentially significant issues and alternatives raised in scoping so that all significant issues for which information can reasonably be obtained have been analyzed in conformance with EQB Rules, 4410.2300, items G and H; b) provides responses to the substantive comments received during the draft EIS review concerning issues raised in scoping; and c) was prepared in compliance with the procedures of the MEPA and the Environmental Quality Board Review Program Rules, parts 4410.0200 to 4410.6500.

Theme NEPA 09

Theme Statement

The analysis in the SDEIS is inadequate and demonstrates unacceptable environmental impacts for a variety of reasons. It is based on flawed data and inaccurate information. The EIS should be rejected.

The analyses are based on a conceptual description of the proposed action and an extensive set of assumptions of the environment and the performance of the conceptual design. Much of the information provided is encyclopedic, describing ways in which the Project purports to fit within various regulatory regimes.

The EIS assumes that all mitigation measures perform perfectly, not merely for the 20-year life of the mine, but for hundreds of years afterwards. This is simply not a supportable assumption, and the SDEIS fails to evaluate both the effectiveness of mitigation measures, and the impacts in the event that they fail.

Thematic Response

As an analysis and disclosure document and consistent with NEPA and MEPA, the NorthMet Mining Project and Land Exchange EIS does not determine which impacts are or are not acceptable. Federal Co-lead Agency decision-makers would evaluate the effects identified in the FEIS to make that determination in their respective RODs. As the RGU, the MDNR would evaluate the adequacy of the EIS under Minnesota Rules 4410.2800, subpart 4 which considers whether the significant issues and alternatives have been analyzed, whether substantive comments have been responded to, and whether the procedures of MEPA and Environmental Quality Review Program Rules have been complied with.

The Co-lead Agencies believe that the EIS contains the best available data and analyses consistent with the National Environmental Policy Act and Minnesota Environmental Policy Act guidance and best practices.

The Co-lead Agencies reviewed all applicable documentation submitted by the proposer to fully understand the NorthMet Project Proposed Action. These included detailed technical design documents, including the Project Description, Mine Plan and several resource-specific management plans, all of which are summarized in FEIS Chapter 3. The level of detail describing the NorthMet Mining Project provided in the EIS is consistent with the requirements of NEPA/MEPA for similar projects at this stage of environmental review. The Co-lead Agencies believe that the project description was sufficient to support a comprehensive scientific analysis of potential impacts to allow decision makers to make informed decisions on the NorthMet Project Proposed Action. The proposer would be required to provide more detailed information as the project is refined during the permit process, much of which would require additional public review.

NEPA (as well as MEPA) recognize that EISs are planning tools that focus agency analyses on significant environmental issues (40 CFR 1501.1(d)). As a tool, an EIS analyzes proposals at an appropriate level, given that the permitting process would require more finely tuned analyses based on further understanding of environmental conditions and project design. This means that the NEPA and MEPA phase of the environmental review process requires less specificity for proposed projects, and demands additional detail for the permitting phase.

NEPA and MEPA guidance allows agencies to assume that proposed mitigation measures considered in an EIS are able to reduce or avoid adverse environmental effects. These measures and their effectiveness have been considered in the EIS. The actual effectiveness of any approved and implemented mitigation measures would be monitored as part of permit conditions, which may lead to additional mitigation measures being required of the permit holder.

Theme NEPA 10

Theme Statement

There should have been more than three public meetings held on the SDEIS, and they should not have been held in January when it was difficult some people to attend.

Thematic Response

The Co-lead Agencies believe that the number and timing of the public meetings more than satisfied the requirements of NEPA and MEPA for public involvement. Approximately 4,500 people attended the three public meetings held in Duluth, Hoyt Lakes, and St. Paul for the NorthMet Mining Project and Land Exchange SDEIS. Hundreds of individuals provided oral and written comments at these meetings, and dozens more people provided oral comments for transcription by stenographers. These comments are included in this volume of the FEIS, along with all other written comments received during the 90-day public comment period.

Theme NEPA 11

Theme Statement

The agencies do not explain how the comments received on the SDEIS will be used in their decision making processes. For instance, will the agencies place higher value on comments if there are more of them than other comments? The public meetings did not provide all participants with equal opportunity to express their views. The process could have been more fair between individuals that are pro-mining versus anti-mining.

Thematic Response

All comments received on the SDEIS have been considered equally. Because over 58,000 submissions and over 17,000 unique comments were received on the SDEIS, the Co-lead Agencies have combined similar comments into common themes, which have been responded to in this volume of the FEIS.

The oral comment periods of the public meetings were designed to allow comments from the broadest spectrum of opinion. The Co-lead Agencies believe that the process was fair and did not favor one group's opinions over another's.

Theme NEPA 12

Theme Statement

The agencies should explain how they will resolve the Major Differences of Opinion with the Tribal Agencies. Agency responses are inadequate or not believable.

Thematic Response

During the development of the SDEIS, MDOs regarding the analysis presented in the document were identified. These MDOs are between the Co-lead Agencies and the Bands, GLIFWC, and the 1854 Treaty Authority, and represent comments from the Tribal Cooperating Agencies that the Co-lead Agencies determined were adequately addressed in the existing analysis. The MDOs are discussed in FEIS Chapter 8 (and were discussed in SDEIS Chapter 8).

Comments submitted by the Bands on the SDEIS included comments reflecting the MDOs. In addressing and developing detailed responses to those comments, the Co-lead agencies also addressed many aspects of the MDOs. In developing the FEIS, the Co-lead Agencies engaged in ongoing interaction regarding MDOs with the Bands/Tribal Cooperating Agencies. The Co-lead Agencies shared with the Bands how they intended to respond to the Bands' comments, how the MDOs were addressed in the FEIS, and which MDOs had achieved some resolution. In FEIS Chapter 8, Table 8-1 notes where and how the MDOs are addressed in the FEIS.

Although it is beneficial to resolve differences of opinion on a project, major differences of opinion often remain unresolved throughout the analysis process. In making decisions on proposed activities, responsible officials utilize information in the FEIS addressing differences of opinion to inform their decisions and to support rationale for those decisions.

Theme NEPA 13

Theme Statement

There should be a separate EIS prepared solely for the Land Exchange.

Thematic Response

The Co-lead Agencies determined that the Land Exchange Proposed Action is a connected action to the NorthMet Project Proposed Action, and therefore needs to be assessed in the same EIS as the mine. This is consistent with NEPA and MEPA guidance that require agencies to consider connected actions such as the Land Exchange Proposed Action, since it has been triggered by the NorthMet Mining Project proposal and application for a Section 404 permit.

Because the resources of the Proposed Actions for the NorthMet Project and Land Exchange differ, the impact assessment discussions for each are provided in separate sections of the EIS.

Theme NEPA 14

Theme Statement

The analysis in the SDEIS fails to meet NEPA's standards for providing a hard look at impacts, considering proper data or including proper regulatory or permitting information.

Thematic Response

The Co-lead Agencies believe that the EIS contains adequate information and analyses consistent with NEPA and MEPA guidance and best practices. Please refer to the response to theme NEPA 09 for more detail.

Theme NEPA 15

Theme Statement

Statements generally opposing the NorthMet project, or questioning the conceptual nature of the project, validity of the underlying data and/or analysis, and whether the agencies followed and balanced their respective laws and regulations in conducting the impact assessment, including independent data analysis. The co-lead agencies should choose the "No Action" Alternative.

Thematic Response

The Co-lead Agencies believe that the EIS meets the procedural and analytical requirements of NEPA and MEPA. Also, refer to the response to theme NEPA 08 for more detail.

Theme NEPA 16

Theme Statement

The SDEIS adequately addresses the impacts of the NorthMet Mining Project and Land Exchange, which should be approved, including issuance of the required permits. Comments in the theme generally support the proposed NorthMet Mining Project and Land Exchange because the minerals are needed and/or the jobs that the mine would create would be beneficial to the region. Impacts can be controlled through the project's design and permits.

Thematic Response

These comments express support for the NorthMet Project Proposed Action, including issuance of the necessary permits. Because they do not provide any specific information related to the environmental effects of the NorthMet Project Proposed Action, no changes were made to the EIS as a result of the comments.

Theme NEPA 17

Theme Statement

The public involvement process and meetings were informative and allowed for all sides to share their opinions.

Thematic Response

These comments generally support the public involvement process, including the public meetings held on the SDEIS. Because no specific information was provided, no changes were made to the EIS.

Theme NEPA 18

Theme Statement

The SDEIS is inadequate, because the Co-lead Agencies and/or their contractors had a conflict of interest: it was to their political or monetary benefit to prepare a document that generally allows the Proposed Action to proceed. The laws direct state and federal agencies to promote and regulate mining, which is an inherent conflict that restricts the agencies' objectivity.

Thematic Response

The Co-lead Agencies and their contractors acted objectively and independently to fulfill their respective roles and responsibilities under state and federal law. See FEIS Chapter 1 for more information.

A.5.17 Issue: Project Description (PD)

Theme PD 01

Theme Statement

The long-term environmental mitigation plan in the SDEIS is insufficient to provide a reasonable assurance that the Proposed Action can meet environmental regulations. In particular, the SDEIS does not provide sufficient information to adequately address wastewater containment, light pollution, and Superfund site remediation.

Thematic Response

The FEIS includes available details regarding long-term water treatment (see the response to theme PD 02 for additional information). The various resource sections of FEIS Chapter 5 discuss mitigation measures for the NorthMet Project. See the response to theme FIN 05 for more details regarding financial assurance. Additional details on the cost estimates, time frames, contingency plan amounts for unforeseen challenges, and calculations that would be required for the project would be addressed during permitting. FEIS Chapter 3 indicates that the Tailings Basin and the Category 1 Stockpile would have water containment systems, and that wastewater would be routed to the WWTP or WWTF, respectively, to be treated. FEIS Section 5.2.11.2.2 discusses the potential for some light pollution due to 24-hour mine operations, although lighting would be directed downward. PolyMet does not propose any further specific mitigation measures for light effects.

FEIS Section 5.2.13.2.3 indicates that if the NorthMet Project Proposed Action had a release of a CERCLA hazardous substance, it would be required to comply with the notification requirements of EPCRA and CERCLA, specifically 40 CFR 355.60, 40 CFR 302, and the Emergency Notification Procedures in Minnesota as required by Title III of the Superfund Amendments and Reauthorization Act (USEPA 40 CFR 300-399).

Theme PD 02

Theme Statement

The SDEIS does not comply with Minnesota state rules regarding mine closure (i.e., *Minnesota Rules* 6132.3200, 6132.4800, 6132.1300, 6132.1200, and 6132.1100). Perpetual mechanical water treatment is not allowed; passive treatment should be well defined and proven before approved. Waste rock stockpiles should have liners.

Thematic Response

There is a crucial distinction in the state's Non-Ferrous Rules between goals (*Minnesota Rules 6132.320*0, Subpart 1) and requirements (*Minnesota Rules* 6132.3200, Subpart 2). Subpart 1 describes the "Goal" of closure and post-closure maintenance. The goals in the Non-Ferrous Rules (specifically *Minnesota Rules* 6132.2000 through 3200, Subpart 1) are aspirational targets for reclamation, and are not specific requirements that obligate permittees (see *Minnesota Rules* 6132.0100, Subpart 8).

Minnesota Rules 6132.3200, Subpart 2 contains the legal "requirements" with which mine permit holders must comply. The Non-Ferrous Rules address the issue of reclamation by creating "reclamation standards" for thirteen different aspects of any mining project, including siting, buffers, storage pile design, management of reactive mine waste, and closure and post-closure maintenance. The Non-Ferrous Rules (Subpart 2) do not contain a specific requirement that mines must show how they would be maintenance-free before receiving a mine permit.

The Non-Ferrous Rules explicitly allow maintenance after closure, which is known as post-closure maintenance (*Minnesota Rules* 6132.3200, Subpart 2.E.6). While closure is defined in the Rules to mean the process of terminating and completing final steps in reclaiming any specific portion of a mining operation, post-closure maintenance includes those activities that are required to sustain reclamation after closure (*Minnesota Rules* 6132.0100).

In addition to setting out the requirements for mining and reclamation, the Non-Ferrous Rules mandate that the permittee provide financial assurance sufficient to perform reclamation activities, including closure and post-closure maintenance, should the permittee be unable to do so (*Minnesota Rules* 6132.1200, Subpart1). Financial assurance may also be required where corrective action is needed during the life of the mine.

Because mine closure is part of every reclamation plan, financial assurance must be provided to cover the anticipated costs of the cessation of use and stabilizing the site. The nature of post-closure maintenance activities and the associated costs are likely to change over the course of active mining. Thus, the financial assurance package would be adjusted during the annual updates of the reclamation plan (*Minnesota Rules* 6132.1300).

The FEIS includes available details regarding long-term water treatment and Minnesota state rules. Liners would be installed for stockpiles or areas where there is a potential to generate acid and metal leachate. The Category 1 Stockpile and Tailings Basin would have containment systems to collect seepage, which would be pumped to the WWTF and WWTP, respectively.

The two liner layers on the Hydrometallurgical Residue Facility would be separated by a leakage collection system, which is designed to collect any potential leakage. Each liner layer would consist of a geomembrane layer above a geosynthetic clay layer. A drainage collection system would also be installed during reclamation to collect drainage above the upper liner. The cap would consist of a geotextile fabric, overlain by a clay barrier layer, and a 40-mil low-density polyethylene layer. This would be covered with additional LTVSMC coarse tailings or common borrow and cover soils to sustain a vegetated cover. The FEIS includes available details from the updated Residue Management Plan.

Theme PD 03

Theme Statement

The SDEIS relies on inadequate detail and unrealistic assumptions about how water resources would be managed for the NorthMet Project. In particular, there is very little detail on the reverse osmosis (RO) process, and the SDEIS makes the unrealistic assumption that the proposed wastewater treatment systems will be effective for centuries after the mine closes. Due to this deficiency, the project should not proceed. The FEIS should provide more detail regarding the RO process and confidence in being able to treat water from this project to suitable levels.

Thematic Response

FEIS Section 5.2.2 explains that during reclamation, water from the West Pit and Category 1 Stockpile would be treated at the WWTF, which would be upgraded to include an RO treatment unit. Treatment at the RO unit would result in an effluent that meets all applicable water quality standards. The WWTP would also include an RO unit that would achieve a sulfate concentration of 10 mg/L in effluent. The WWTP RO system would treat captured Tailings Basin seepage during operations and closure, and tailings pond water during closure. PolyMet has conducted pilot scale testing of RO treatment technology, and the results from this testing showed that this technology would treat water to meet all required water quality standards (see FEIS Section 3.2.2.1.10). Both WWTF and WWTP systems would continue operating until monitoring and pilot-testing results indicate that a transition could be made to approved non-mechanical systems. Provisions of the financial assurance package, which is part of the Permit to Mine, would require that funds be available if the company is unable to meet its obligations for the ongoing maintenance of all equipment, as well as replacement of all equipment as often as necessary.

Theme PD 04

Theme Statement

The FEIS should provide sufficient detail to fully describe how water runoff will be contained and managed on site, including details on:

- The effectiveness of the covers;
- The west equalization basin; and
- Stormwater control.

Thematic Response

FEIS Sections 3.2.2.3.10 and 3.2.2.3.11 describes that direct precipitation, stormwater run-on, and water collected by the Tailings Basin seepage capture systems would be directed to the Tailings Basin. The Tailings Basin would have a water containment system around the northern, eastern, and western dams to intercept seepage and pump it back to the Tailings Basin. Excess Tailings Basin pond water would be pumped to the WWTP for treatment. FEIS Sections 3.2.2.1.7 and 3.2.2.1.8 state that the Category 1 Stockpile would have a cover system in closure and water containment system surrounding it to collect surface runoff (non-contact stormwater) and drainage that would be pumped to the WWTF for treatment. FEIS Section 3.2.2.1.8 also discusses stormwater controls at the Mine Site, which would include a system of dikes and ditches to manage and control non-contact stormwater from flowing off-site. Stormwater would be directed to sedimentation ponds. Contact stormwater from the Category 2/3 or 4 stockpiles or the Ore Surge Pile would be stored in the West Equalization Basin at the WWTF for treatment.

FEIS Section 3.1.1.3 states, "Water control systems would be constructed to capture water that has contacted surfaces disturbed by mining operations, as well as water collected on stockpile liners (i.e., process water). Process water would be treated at a treatment facility located at the Mine Site and either pumped via a Central Pumping Station to the Plant Site for discharge to the Tailings Basin, or used to supplement flooding of the East Pit after year 11."

The effectiveness of the containment systems are taken into account in the water quality modeling that has been accomplished for the NorthMet Project. The results of the water quality modeling are addressed in FEIS Section 5.2.2.

Theme PD 05

Theme Statement

The description of the Proposed Action in the SDEIS does not identify all of the necessary elements of a water monitoring system.

Thematic Response

FEIS Sections 3.2.2.1.10 and 5.2.2.3.1 state that surface water and groundwater would be monitored as required by relevant permits. The water monitoring program is required under NPDES/SDS regulations, and would be detailed and finalized in the NPDES/SDS permitting process. FEIS Section 5.2.2.3.6 provides an overview of the proposed water monitoring program.

Theme PD 06

Theme Statement

The FEIS should provide more information about future non-mechanical treatment systems, and should demonstrate that non-mechanical treatments are effective in treating wastewater after closure of the mine.

Thematic Response

The NorthMet Project Proposed Action relies on mechanical treatment for as long as necessary. FEIS Chapter 3 states that PolyMet has committed to conducting pilot and other feasibility studies on the use of non-mechanical treatment as an adaptive management measure if proven effective and cost efficient. The possible future use of non-mechanical treatment is stated as a long-term goal, but the details of how such systems would operate would be determined once operations begin and site specific data could be used for pilot/feasibility studies, and if eventually proposed would be addresses in future permitting.

The WWTF would continue to treat water until water quality monitoring demonstrates that effluent would achieve water quality criteria under non-mechanical treatment. Similarly, the WWTP would continue to treat Tailings Basin seepage until non-mechanical treatment would be demonstrably appropriate. FEIS Section 5.2.2.3.5 lists some non-mechanical systems that may be used, including constructed wetlands, PRBs, PSBs, and/or other technologies to still be identified. The Adaptive Water Management Plan (PolyMet 2015d, as cited in the FEIS) describes in more detail various non-mechanical treatment systems that could be utilized with details about each design and the degree of use of each design in industry.

Theme PD 07

Theme Statement

The Proposed Action calls for Tailings Basin water containment technologies, such as the slurry walls, berms, and trenches, which are not proven to work for the type of mining proposed in the SDEIS. The FEIS should describe how these water containment technologies, as described in documents such as the USACE EM 1110-2-1901 standard, will decrease water pollution rates.

Thematic Response

USACE EM 1110-2-1901 is an Engineer Manual from 1986 titled "Seepage Analysis and Control for Dams." Design criteria for the Tailings Basin are based on well-established geotechnical design standards with significant precedent in Minnesota, in the greater United States, and worldwide. The effects of the containment system on Tailings Basin stability have also previously been analyzed, and the analysis results are on file with MDNR. The water containment system is designed to avoid hydrostatic pressure, which would transfer back into the Tailings Basin dams, potentially increasing the phreatic surface elevation within the dams. Rather, the system as preliminarily designed would the capability to lower the hydrostatic pressure on the upstream (Tailings Basin) side of the containment system cutoff wall, thereby potentially lowering rather than raising the hydrostatic pressure at the Tailings Basin dams.

The type of mining proposed does not directly affect the design, construction, and operation of proposed groundwater containment systems for the NorthMet Project. Rather, key design considerations for the containment systems include but are not limited to the local geologic and hydrogeologic characteristics of the site, the depth to bedrock or other confining unit from the ground surface, the presence and prevalence of cobbles and boulders in the glacial till, the ground surface topography along and adjacent to the containment system alignment, the soil types to be encountered along the alignment, and the constituents in the groundwater to be contained. The proposed containment system technology is not new nor unique; the slurry cutoff wall and collection trench approach has been used for many decades, beginning initially as a means to facilitate construction of deep foundations in locations of shallow groundwater and difficult soil conditions, and subsequently expanding to other uses such as the containment of contaminated groundwater emanating from unlined waste disposal facilities (e.g., landfills, stockpiles, etc.).

Numerous scholarly papers have been written about the use of groundwater containment systems, and a number of contractors are well-experienced and proficient in containment system construction. The groundwater collection component of the system and the hydraulic barrier (cutoff wall) work in tandem to control the direction of groundwater flow and the amount of groundwater collected. Maintenance of a lower hydraulic head on the upgradient side of the cutoff wall than on the downgradient side of the cutoff effectively captures any seepage that would otherwise leave the site, while limiting the effect that the system has on groundwater conditions downgradient from (away from) the system. This barrier to flow thereby minimizes the potential for water quality effects on the downgradient side of the containment system.

Theme PD 08

Theme Statement

The SDEIS makes unsupported assumptions about the ability of the Tailings Basin to contain contaminants seeping into the surrounding watershed for centuries to come. The assumptions are based on faulty modeling inputs and overly optimistic environmental analyses that lead to faulty basin design considerations.

Thematic Response

The environmental review process is an objective review by regulatory agencies of the potential impacts to all resources. See the response to theme PD 07, which addresses the Tailings Basin containment technologies and how the cutoff wall and containment system would capture seepage. The north, west, and east seepage containment systems would capture 100 percent of surface seepage under expected conditions, and 90 percent, 90 percent, and 100 percent, respectively, of groundwater seepage. The Tailings Basin South Seepage Management System would capture 100 percent of surface water (Barr 2015e, as cited in the FEIS).

Theme PD 09

Theme Statement

The SDEIS should include a full Reclamation Plan for the Tailings Basin that provides details about goals, methods, financial assurance, reclamation techniques that have been successfully demonstrated, and the timing of activities. The Reclamation Plan must address over-steepening of the Tailings Basin banks and associated seepage.

Thematic Response

A detailed Reclamation Plan is required under the Permit to Mine. The FEIS includes details from the Reclamation Plan (PolyMet 2015g, as cited in the FEIS), which has been updated since the SDEIS. FEIS Section 3.2.2.3.12 describes how the NorthMet Project Plant Site facilities would be operated to allow for progressive or concurrent reclamation during operations, where possible. PolyMet would also submit an annual contingency reclamation plan per *Minnesota Rules* 6132.1300, Subpart 4, to identify activities that would be implemented if operations were to cease in that upcoming year. After mining ceases, PolyMet would finish reclamation activities under the Reclamation Plan, which would be part of the Permit to Mine. Reclaimed areas would be monitored and maintained as needed in the spring and fall or as required by the Permit to

Mine. Areas damaged by erosion or that lost vegetation would be identified, and plans to repair or reseed would be developed and implemented. The goals and methods for reclamation on various Plant Site facilities and areas are listed in FEIS Section 3.2.2.3.12. In addition, FEIS Section 3.2.2.4 describes that financial assurance, covering the costs of reclamation should the mine close for any reason, would be required before a Permit to Mine would be issued.

Theme PD 10

Theme Statement

The SDEIS does not provide enough information on the existing condition of the former LTVSMC Tailings Basin, which would be reused in the Proposed Action. If the existing basin is already leaking, how will PolyMet control seepage from the basin?

Thematic Response

FEIS Section 3.2.2 cites the Reclamation Plan's (PolyMet 2015g, as cited in the FEIS) discussion the remediation of AOCs and ongoing mitigation of water quality at the Tailings Basin. Several Tailings Basin surface seeps and discharges are currently being mitigated via a Consent Decree. The Reclamation Plan states that Cliffs Erie is currently executing the MDNR-approved Closure Plan for legacy components. Under the NorthMet Project Proposed Action, PolyMet would install a water containment system around the northern, western, and eastern Tailings Basin dams to intercept seepage emerging near the toe, which is where several legacy seeps exist as well. PolyMet would monitor, maintain, and improve, if necessary, the legacy components that remain, such as the Tailings Basin South Surface Seepage Management System along the south Tailings Basin dam. PolyMet would be required to address legacy contamination and would provide financial assurance for the legacy components under a Permit to Mine application.

Theme PD 11

Theme Statement

The Proposed Action's designs do not address overflow concerns at the Tailings Basin due to heavy rain events or other catastrophic events. The SDEIS does not provide contingency plans, failure analyses, and costs to protect the land and watershed from contaminated water.

Thematic Response

FEIS Section 3.2.2.3.10 discusses the emergency overflow channel at the Tailings Basin, which would be designed as a backup means to control the pond elevation during a PMP event. The Tailings Basin pond is designed to hold the PMP event, which is a catastrophic event consisting of 38-inch storm event within a 72-hour period.

The Flotation Tailings Management Plan (PolyMet 2014k, as cited in the FEIS) and Rock and Overburden Management Plan (PolyMet 2015h, as cited in the FEIS) include draft Contingency Action Plans. The purpose of these plans is to anticipate or envision the failures that could occur at these facilities, and to identify early warning signs of potential future failures and appropriate response actions. These plans would be further developed as project development continued, with updated Contingency Action Plans included in future regulatory agency submittals in support of environmental review and permitting.

In addition to setting out the requirements for mining and reclamation, the Minnesota Non-Ferrous Rules mandate that the permittee provide financial assurance sufficient to perform reclamation activities should the permittee be unable to do so. *Minnesota Rules* 6132.1200, Subpart 1 requires financial assurance so that funds are available if the company is unable to meet its obligations for potential corrective actions.

Theme PD 12

Theme Statement

The SDEIS wrongfully assumes the east side of the Tailings Basin would not have groundwater seepage due to bedrock. This assumption forms the basis for the inaccurate models used to predict zero water flow from the basin.

Thematic Response

The water quality modeling in the FEIS has been updated to include the potential for water to seep from the east side of the Tailings Basin. FEIS Section 3.2.2.3.10 states that a containment system would be constructed around a portion of the east side of the Tailings Basin for seepage collection.

Theme PD 13

Theme Statement

The SDEIS does not provide enough information concerning the hydrology of the south water containment system of the Tailings Basin. Specifically, the SDEIS does not:

- Describe the placement of berms and trenches to cut off water seeping from the basin;
- Provide water seepage monitoring data for the area; and
- Describe the hydrogeological features of the area which can affect water containment.

Thematic Response

The Water Management Plan-Plant Site (PolyMet 2015i, as cited in the FEIS) includes the detailed design drawings of the South Surface Seepage Management System, which was installed as part of Cliffs Erie's Consent Decree to capture seepage along the south side of the Tailings Basin. This system is being monitored and evaluated for effectiveness under the Consent Decree. The collected monitoring data is being submitted to the MPCA. FEIS Section 3.2.2.3.10 discusses surface seepage out of the south side of the Tailings Basin, and PolyMet's commitment to upgrade the south side capture efficiency to 100% in the event the Cliffs Erie improvements do not attain 100% capture.

Theme PD 14

Theme Statement

The SDEIS does not provide an accurate measure of how much raw water will be needed to operate the Tailings Basin.

Thematic Response

FEIS Section 3.2.2.3.4 describes the water needs of the NorthMet Project Proposed Action. Project water needs are for the milling and flotation circuits, which would be supplied from return water from the Tailings Basin. Water in the Tailings Basin would come from precipitation, the Mine Site, and the Seepage Capture Systems. Additional raw water needs would come from Colby Lake as necessary, and the anticipated pumping rate from Colby Lake would vary between 260 and 1,760 gallons per minute, with an average of 760 gallons per minute (FEIS Section 3.2.2.3.4).

Theme PD 15

Theme Statement

The FEIS should provide additional detail and clarity regarding waste rock management including:

- Descriptions of waste rock by type (e.g., why separate Category 2 and 3 waste rock material if it would be combined anyway);
- Consistent characterization of the acid-generating potential of the rock stockpiles;
- Separate management of the overburden types based on their use;
- Clarification on how long the temporary stockpiles would be in place; and
- Containment of water from the stockpiles and mine pits.

Thematic Response

FEIS Section 3.2.2.1.7 includes available details regarding waste rock management and characterization, overburden management, and temporary stockpile timeframes. FEIS Section 3.2.2.1.8 discusses water containment for the stockpiles and mine pits. The FEIS also references documents such as the Waste Characterization Data Package (PolyMet 2015q, as cited in the FEIS) and the Rock and Overburden Management Plan (PolyMet 2015h, as cited in the FEIS), which contain additional details regarding waste rock and overburden management.

Theme PD 16

Theme Statement

The FEIS should provide additional detail and clarity regarding management of the closure cover for the Category 1 Stockpile, including vegetation control and effectiveness of the cutoff wall.

Thematic Response

FEIS Section 3.2.2.1.8 includes available details regarding the cutoff wall effectiveness, based on PolyMet's updated Project Description document (PolyMet 2014b, as cited in the FEIS) and Reclamation Plan (PolyMet 2015g, as cited in the FEIS). FEIS Section 3.2.2.1.10 states that the reclaimed Category 1 Stockpile would be monitored and maintained as needed in the spring and fall or as required by the Permit to Mine. Any areas damaged by erosion or that lost vegetation would be identified, and plans to repair or reseed would be developed and implemented. Long-term maintenance of the Category 1 Stockpile would also include removal of woody species and trees from the cover system. The Reclamation Plan, required as part of the Permit to Mine, contains additional details on the Category 1 Stockpile cover system.

Theme PD 17

Theme Statement

The FEIS should be revised to provide a reasonable range of probabilities for containment failures at the Hydrometallurgical Residue Facility. Performance (leakage) and life expectancy of the liners and drainage systems and cap are concerns that need more detail. In addition, the Hydrometallurgical Residue Facility should be classified as a hazardous waste landfill.

Thematic Response

The Hydrometallurgical Residue Facility would be constructed over the LTVSMC emergency basin. The two liner layers on the Hydrometallurgical Residue Facility would be separated by a leakage collection system, which is designed to collect any potential leakage from the bottom of the cell. Each liner layer would consist of a geomembrane layer above a geosynthetic clay layer. A drainage collection system would also be installed during reclamation to collect drainage above the upper liner. The cap would consist of a geotextile fabric, overlain by a clay barrier layer, and a 40-mil low-density polyethylene layer. This would be covered with additional LTVSMC coarse tailings or common borrow and cover soils to sustain a vegetated cover. During reclamation and long-term closure, leakage would be routed and cycled through the Plant Site WWTP. The FEIS includes available details from the updated Residue Management Plan (PolyMet 2014r, as cited in the FEIS).

The liner system components have been selected specifically to perform well, given the characteristics of the residue, which consists primarily of gypsum. The liner system components selected for the Hydrometallurgical Residue Facility are routinely used for similar facilities in other industries and have demonstrated the expected levels of performance. The design produces a liner system with virtually no leakage due to the system's ability to maintain a very low hydraulic head on the composite liner portion of the overall liner system.

The Residue Management Plan presents the planned Hydrometallurgical Residue Facility monitoring and maintenance plan. Additional monitoring and maintenance requirements would be outlined by the responsible regulatory agency as part of facility permitting.

Two submittals titled "PolyMet Information on HRF Residues" were provided to the Co-lead Agencies on August 5, 2014. The documentation summarized the results of two rounds of testing, conducted in 2005 and 2009, on the residue that is to be discharged to the Hydrometallurgical Residue Facility. It also reviewed the testing results against the regulations under RCRA. Mining wastes associated with extraction, beneficiation, and processing of ores and minerals are typically excluded from the RCRA definition of hazardous waste (40 CFR 261.4(b)(7)). PolyMet has conducted environmental testing to compare the properties of the hydrometallurgical residue with the RCRA hazardous waste thresholds. Comparison of the results from this testing with the RCRA hazardous waste thresholds shows that the hydrometallurgical residue does not have any toxicity characteristics of a hazardous waste. The MPCA concurs with this assessment.

Theme PD 18

Theme Statement

The FEIS should disclose more details about the operation of the Hydrometallurgical Residue Facility, including:

- The extraction methods used to recover metal concentrates at the facility;
- The chemical composition and pH of the materials that would be disposed of in the facility; and
- Monitoring for leakage.

Thematic Response

FEIS Sections 3.2.2.3.6 and 3.2.2.3.7 discuss the operation of the Hydrometallurgical Residue Facility, including the autoclave leaching and solution purification steps to extract and isolate platinum group, precious metals, and base metals. Calcium in the form of either limestone or lime would be added to neutralize solutions from the upstream process. FEIS Section 3.2.2.3.10 states that the Hydrometallurgical Residue Facility would be double-lined to minimize release of residue leachate, and any collected leakage would be pumped back to the Hydrometallurgical Residue Facility pond. The Residue Management Plan (PolyMet 2014r, as cited in the FEIS) presents the planned Hydrometallurgical Residue Facility monitoring and maintenance plan. Additional monitoring and maintenance requirements would be outlined by the responsible regulatory agency as part of facility permitting.

Theme PD 19

Theme Statement

The SDEIS lacks sufficient detail regarding construction quality assurance, as well as the suitability of the proposed location of the Hydrometallurgical Residue Facility (as it relates to effects on critical ecosystems and water resources).

Thematic Response

FEIS Section 5.2.14.2.3 discusses the design and construction of the Hydrometallurgical Residue Facility, and the Geotechnical Data Package (PolyMet 2014c, as cited in the FEIS) indicates the design would meet all factors of safety as required. The Hydrometallurgical Residue Facility would be constructed over the LTVSMC emergency basin. This site is known to have suitable subsurface conditions and would minimize impacts to ecosystems and water resources as compared to a new site, since the existing site is already disturbed. During operations, the double liner system for the Hydrometallurgical Residue Facility would minimize release of residue leachate, and any collected leakage would be pumped back to the Hydrometallurgical Residue Facility pond. During reclamation and long-term closure, leakage would be routed and cycled through the WWTP. The FEIS includes available details from the updated Hydrometallurgical Residue Management Plan (PolyMet 2014r, as cited in the FEIS).

Rigorous construction quality assurance procedures for lined facilities are standard in Minnesota, and PolyMet would propose and be required via facility permitting to implement a rigorous liner system construction quality assurance/quality control program.

Site-specific and material-specific testing as deemed necessary by the facility designer and the responsible regulatory agency would be performed as part of final design and/or construction and as part of the construction quality assurance/quality control program for the Hydrometallurgical Residue Facility.

Theme PD 20

Theme Statement

The FEIS should disclose more details about the closure of the Hydrometallurgical Residue Facility, including:

- The dewatering process at closure (how would it work and where would the water be taken?); and
- Long term closure monitoring and maintenance requirements, including vegetation control and inspection for plugged inlet structures and piping systems (would this be perpetual?).

Thematic Response

FEIS Section 3.2.2.3.12 includes available details regarding the closure of the Hydrometallurgical Residue Facility, based on the updated Project Description (PolyMet 2014b, as cited in the FEIS) and Reclamation Plan (PolyMet 2015g, as cited in the FEIS) documents. At closure, the ponded water would be pumped to the WWTP for treatment. The area would then be graded, equipped with a cover system, and re-vegetated. The final cover would be inspected and maintained by mowing once per year or as needed, and repairs to the cover would be made as necessary. Woody species or trees would be removed from the cover system during mowing. A rip-rapped drainage channel or plug-resistant inlet and piping system for surface water runoff control would be installed, and inspections would occur annually or as needed.

Theme PD 21

Theme Statement

The SDEIS lacks details on the hydrometallurgical processing of metal ores at the Plant Site. Specifically, it does not adequately provide details for how the copper/gold/PGE recovery will produce sulfide precipitates from the hydrometallurgical processes.

Thematic Response

FEIS Sections 3.2.2.3.6 and 3.2.2.3.7 discuss the operation of the Hydrometallurgical Residue Facility, including the autoclave leaching and solution purification steps to extract and isolate PGE and precious metal sulfide precipitates, and base metals.

Theme PD 22

Theme Statement

The SDEIS fails to provide impact analysis and contingency plans that address climate change, extreme precipitation, other weather events, or other failures and mishaps that typically occur in mining operations and closure. The FEIS should disclose the effects suggested by failure analyses, contingency plans, and adaptive management plans.

Thematic Response

The FEIS includes available details regarding contingency plans for unforeseen challenges or failures. Stormwater ponds are designed for the 100-year, 24-hour storm event plus one foot of freeboard. All process water ponds, with the exception of the OSLA pond, were designed for the 100-year, 24-hour storm event plus three feet of freeboard. The OSLA pond was designed for the 25-year, 24-hour storm event plus three feet of freeboard. Additionally, all process water systems with the exception of the Rail Transfer Hopper pond, would be able to manage runoff from these storm events without their pumps running, in the event of a power outage or at full capacity at the WWTF. Due to the design of the Tailings Basin for the PMP event, the potential for overflows is very low. The PMP is defined as "the theoretically greatest depth of precipitation for a given duration that is physically possible over a particular drainage area for a certain time of the year," (Schreiner and Riedel 1978). Most if not all tailings basins on the Iron Range are designed for some level of PMP event. The Tailings Basin has been designed to hold the 72-hour PMP event, which is approximately 38 inches, without overtopping. The PMP does not have an assigned return period, but it is usually assumed by hydrologists to be on the order of thousands of years.

The Adaptive Water Management Plan (PolyMet 2015d, as cited in the FEIS) is currently a publicly available document, and would be referenced and available as part of the FEIS and Permit to Mine. See CEQ, Appropriate Use of Mitigation and Monitoring and Clarifying the Appropriate Use of Mitigated Findings of No Significant Impact (Jan. 14, 2011) for more information about the use of adaptive management.

Contingency mitigation is part of the company's management plans. If monitoring or the refined model estimates show that with adaptive engineering controls water quantity or quality at compliance points would not meet compliance parameters, contingency mitigations would be available (and listed in the various management plans for the Project) to address specific situations.

Theme PD 23

Theme Statement

PolyMet has no mining experience, and aspects of the Proposed Action are untested or have otherwise failed elsewhere. What qualifications does PolyMet have to design, model, and manage the Proposed Action as outlined in the SDEIS?

Thematic Response

Regulatory agencies conduct the environmental review process to ensure impacts to the environment are minimized. Following environmental review, regulatory agencies review design plans, and draft permits that contain conditions that ensure compliance with all applicable state and federal regulations that protect the environment. The preliminary design work has been completed by experienced and licensed professionals. Detailed plans and specifications would be prepared by licensed professionals and reviewed by permitting agencies as part of the permitting process.

Theme PD 24

Theme Statement

The SDEIS does not indicate which parties will be responsible for implementing and monitoring the proposed mitigation measures and plans, nor the extent of public review of the final design during permitting.

Thematic Response

PolyMet is responsible for implementing and monitoring the proposed mitigation plans. The regulatory agencies would review monitoring results and annual reports to ensure compliance. The FEIS includes available details regarding mitigation measures in each resource section of Chapter 5. Final decisions on the mitigation measures would be made during permitting. Public review opportunities are outlined as part of each permit's existing process.

Theme PD 25

Theme Statement

The long-term financial assurance details in the SDEIS are insufficient for the Proposed Action. Also, the financial plans do not account for capital replacement costs for the mine. The SDEIS also does not address how the financial and economic benefits of the mining project will be distributed.

Thematic Response

FEIS Section 3.2.2.4 includes available details regarding financial assurance. Additional details on the cost estimates and calculations that would be required for the project would be addressed during permitting. Specific infrastructure timelines and life expectancies of equipment would be accounted for during permitting as well. Table 3.2-15 provides financial assurance cost estimates for various years of closure, as well as for monitoring and mitigation costs. FEIS Section 3.2.2.4.1 discusses the activities that would be considered in cost estimates, and states that cost estimates would be updated annually under the Permit to Mine. *Minnesota Rules* 6132.1200, Subpart 3, stated that cost estimates shall be annually adjusted using current dollar value at the time of the estimate. The liner and cover systems selected for waste containment are selected on the basis of numerous factors discussed in the Rock and Overburden Management Plan (PolyMet 2015h, as cited in the FEIS) and FEIS Sections 3.2.2.1.8 and 3.2.2.3.10. The WWTP and WWTF replacement costs would be included in long-term financial assurance estimates. The FEIS discusses economic benefits to local communities in FEIS Section 5.2.10.

Theme PD 26

Theme Statement

Historically, mining in sulfide-bearing rock has always led to water contamination. This is particularly concerning in the water-rich environment of northeastern Minnesota. The FEIS should describe how the Proposed Action differs from previous mines with sulfide-bearing rock (e.g., Ladysmith Mine in Wisconsin, Eagle Mine in Michigan, Talvivaara Mine in Finland) and how those differences would avoid water contamination.

Thematic Response

NEPA/MEPA regulations do not require discussion or comparisons to other Copper/PGE mine projects, as it is outside the scope of the project (see *Minnesota Statutes* 116D.04 and 40 CFR 1500). FEIS Section 5.2.2 discusses how the NorthMet Project would address water contamination and/or comply with water standards.

Theme PD 27

Theme Statement

The SDEIS incorrectly makes the comparison between taconite mining and sulfide mining. Sulfide mining would have a substantially greater impact on the environment than taconite mining historically has.

Thematic Response

These comments generally faulted the SDEIS because it erroneously compared taconite mining and sulfide mining, which would be more environmentally damaging than the historical mining in the region. Because no specific information was provided, no changes were made to the EIS.

Theme PD 28

Theme Statement

The SDEIS shows that the Proposed Action has been designed in a way that is environmentally responsible and will minimally impact the environment. The Proposed Action would accomplish these goals by reusing a former mining facility and controlling its existing pollution. It would be managed appropriately by regulators.

Thematic Response

These comments generally supported the NorthMet Mining Proposed Action. Because no specific information was provided, no changes were made to the EIS.

Theme PD 29

Theme Statement

The SDEIS relies on a number of improper and unsupported assumptions in the project design, as well as environmental models that minimize the threats of the Proposed Action on human health and the environment. The FEIS should disclose, with objective data, accurate environmental effects, especially with regards to water.

Thematic Response

FEIS Chapter 5 discusses effects that are known or predicted to occur, using several different types of models. The environmental review process is an objective review by regulatory agencies of the potential impacts.

Theme PD 30

Theme Statement

The SDEIS is misleading because it does not disclose the full extent of the project. The FEIS should provide additional detail about:

- The Proposed Mine's full operating capacities and opportunity to expand (e.g., the full size of the ore body and the capacity of the Plant Site);
- The definition of ore and the volume and sulfur content of waste rock;
- The geology of the mine pits;
- The volume of material that would be mined, processed, and sold;
- Siting, construction, and operation of the mine pits (e.g., how open pit mining works) and related facilities; and
- The full environmental footprint.

Thematic Response

The FEIS analyzes the NorthMet Project as planned and proposed by PolyMet. If, in the future, there is a proposed expansion of the Project's footprint or processing rate, or a substantive change in operations, the requisite additional environmental review would be performed. No such changes are reasonably foreseeable. FEIS Section 3.2.2.1 discusses the geology of the NorthMet Deposit and mine pits, the total volume of ore and waste rock that would be excavated, the sulfur content of the various categories of waste rock, and the process of siting, construction, and operation at the mine pits (e.g., Figure 3.2-10, Tables 3.2-4 and 3.2-8). FEIS Section 3.2.2.3 discusses the siting, construction, operation, and capacity of the Plant Site.

Theme PD 31

Theme Statement

The FEIS should provide additional detail and clarity regarding the description of the geologic formations (e.g., where is the Virginia Formation and the Duluth Complex located?). The assumption that unsaturated overburden would not be reactive is misleading.

Thematic Response

The FEIS references documents such as the Rock and Overburden Management Plan (PolyMet 2015h, as cited in the FEIS) and the Mine Plan (PolyMet 2014q, as cited in the FEIS), which contain more details regarding site geology and overburden characteristics. FEIS Section 3.2.2.1 discusses the geology of the Duluth Complex, Virginia Formation, and mine pits (see Figure 3.2-10). This section also discusses the unsaturated overburden and explains that it has been above the natural water table and exposed to air long enough for chemical reactions to have already taken place.

Theme PD 32

Theme Statement

Technologies proposed for the NorthMet Project are devised by the mining industry and will not solve the issue of hazardous wastes and air pollution generated by activities associated with the Proposed Action. The mine should be put on hold until proven technology is available.

Thematic Response

FEIS Section 5.2.13 provides applicable hazardous materials management regulation references/citations; hazardous material management plan requirements (transportation, storage, use, and disposal); emergency planning and community right-to-know recordkeeping and reporting requirements; and hazardous material spill response management and mitigation measures. The EIS is not meant to replace compliance planning, nor is it meant to provide explicit detail of spill response plans, hazardous material reduction plans, hazardous material or waste management plans and contingency plans. PolyMet would be required to dispose of all waste in accordance with all applicable state and federal laws and regulations.

Theme PD 33

Theme Statement

The FEIS should consider the environmental effects of metal smelting and downstream use of the metal concentrates.

Thematic Response

The NorthMet Project Proposed Action would utilize a beneficiation and hydrometallurgical processing technology rather than smelting. Copper smelting at a specific location is not a reasonably foreseeable effect of the NorthMet Project Proposed Action. Accordingly, these effects are not included in the FEIS. In addition, any downstream smelting processes would be the subject of a separate environmental review process, and would be subject to compliance with applicable water quality and air quality standards.

Theme PD 34

Theme Statement

The addition of limestone to sulfur bearing rock should be considered as a management strategy. The SDEIS should consider the potential benefits and ecological effects of using limestone.

Thematic Response

FEIS Section 3.2.2.1.10 discusses that lime could be added to the East Pit during waste rock backfilling in order to maintain circumneutral pH in the pit pore water. The determination of whether to add lime, and the details of such addition would be determined during permitting.

Theme PD 35

Theme Statement

The FEIS should include a full Reclamation Plan for the waste rock pits that provides details about goals, methods, financial assurance, reclamation techniques that have been successfully demonstrated, and timing of activities. The FEIS should also include:

- A characterization of waste disposed of in the East Pit;
- An evaluation of abandoned pipelines;
- A tracking system for hazardous materials to ensure appropriate disposal and compliance with laws; and
- A description of the water balance desired for the pits post-closure.

Thematic Response

FEIS Section 3.2.2.1.10 and the Reclamation Plan referenced in the FEIS describe how the NorthMet Project Mine Site facilities would be operated to allow for progressive or concurrent reclamation during operations. Further details would be added to the Reclamation Plan during the permitting process. After mining ceases, PolyMet would finish reclamation activities under the Reclamation Plan, part of the Permit to Mine. After mining in each mine pit ceases, the walls and overburden portions would be sloped and graded in accordance with *Minnesota Rules* 6132.2300, and then vegetated to conform to *Minnesota Rules* 6132.2700. Category 2/3 and 4 waste rock would be placed into the East Pit beginning in year 11, and the combined East Central Pit would be completely backfilled after year 20. FEIS Table 3.2-8 defines the waste rock characterization properties.

Pipelines and various other dewatering systems not used in reclamation would be removed, and the areas graded and vegetated.

See the response to theme PD 32 for more information about hazardous materials.

During backfilling, the pit would be flooded concurrently to limit the oxidation potential of waste rock. A wetland would be constructed over the backfilled combined East Central Pit, and water depth would be maintained by a gravity overflow structure to the West Pit. The West Pit would be sloped as well, and then allowed to fill naturally, and supplemented with treated water.

See the response to theme WR 181 for more information about the water balance and mechanisms of consumptive use.

Theme PD 36

Theme Statement

The SDEIS does not adequately address the design or the social and environmental effects of transportation and end use of materials, including:

- Dust and spillage of ore and other materials along the Transportation Corridor;
- Construction and reclamation plans for all roads;
- Pipeline construction materials used to move sulfate water between the Mine Site and Plant Site;
- The presence of project features within and out of the Transportation and Utility Corridor; and
- Probabilities and consequences of spills and accidents during transportation.

Thematic Response

The Project Description document states that monitoring and mitigation activities (including surface water quality sampling in the streams traversed by the rail line) would be developed in the permitting process. FEIS Section 3.2.2.1.10 states that roads not used during reclamation would be demolished, the asphalt from paced surfaces removed, and disturbed areas reclaimed and vegetated according to *Minnesota Rules* 6132.2700. Any roads, including mine pit access roads (*Minnesota Rules* 6132.3200), that may develop into unofficial off-road vehicle trails would require a variance from MDNR reclamation rules to allow a 15-ft-wide unpaved, unvegetated track down the centerline of the road. FEIS Section 5.2.13 discusses the probabilities and consequences of spills or accidents during transportation. The FEIS includes available information from the updated Project Description document. The downstream use of the metal concentrates is outside the scope of the FEIS.

Theme PD 37

Theme Statement

The FEIS should address the potential effects of transporting copper and nickel concentrates to the metal smelters. The FEIS should also consider alternative methods for the transportation of copper and nickel concentrates leaving the site.

Thematic Response

FEIS Section 3.2.2.3.9 describes the transport of concentrate products using sealed bulk bags, sealed containers, or covered solid-bottom rail cars. The off-site transport and use of the metal concentrates is outside the scope of the FEIS. Any downstream smelting processes would be the subject of a separate environmental review process, and would be subject to compliance with applicable water quality and air quality standards.

Theme PD 38

Theme Statement

The maps in the SDEIS are incorrect, including the map for the One Hundred Mile Swamp. The errors mislead the public into thinking that the Proposed Project will not affect surrounding water resources, including the BWCAW.

Thematic Response

A National Atlas shows a single wetland complex (referred to as 100-mile swamp) as straddling the major watershed divide separating the Superior Basin from the Rainy River Basin. This appears to indicate that this wetland complex creates a conduit for water originating from the Mine Site to reach the Dunka River, and ultimately, the BWCAW. However, wetlands are delineated using many factors in addition to hydrology; the delineation of 100-mile swamp as continuous across this boundary does not equate to a hydrologic connection. There are two hydrologic barriers between the Mine Site and the Rainy River Basin, including:

- High ground north of the Partridge River creates a watershed divide separating the Superior and Rainy River Basins, and prevents surface water from passing between the two. This major watershed divide is included in the National Atlas, as well as USGS and MDNR data sets. This divide is accurately presented in the FEIS Figures 4.2.2-1 and 5.2.2-22.
- Yelp Creek and the Partridge River encircle the north, east, and south sides of the Mine Site. These streams create a hydrologic "sink" for sources of water originating at the Mine Site. Surface runoff or groundwater seepage leaving the Mine Site would follow a gradient into Yelp Creek or the Partridge River, as opposed to continuing uphill towards the watershed divide (see FEIS Figure 5.2.2-4). Yelp Creek and the Partridge River extend further west (i.e., more fully encompassing the Mine Site) than is shown on the map in question.

Theme PD 39

Theme Statement

The FEIS should identify Project energy requirements, and should consider implementing solutions to reduce energy consumption during the life of the mining project. Energy efficient solutions such as making use of renewable energy sources instead of using coal and implementing energy efficient construction standards would demonstrate a commitment to the environment.

Thematic Response

The FEIS considers effects from the Land Exchange and the NorthMet Project Proposed Action, which is a proposed mining and mineral processing project. The NorthMet Project would consume electricity. In Minnesota, designated electric utilities are the default service providers. The primary policy mechanism to encourage renewable energy in Minnesota is through the renewable energy standard and the solar-specific standard for electric utilities in *Minnesota Statutes* 216B.1691.

The FEIS Tables 5.2.7-8 and 5.2.7-9 list indirect GHG emissions due to (offsite) electricity generation required for the project. FEIS Section 5.2.7.4.1 also describes that a hydrometallurgical process reduces energy demand by 50 percent over a pyrometallurgical process, and that the select processing motors would be premium efficiency motors, which would also help minimize electricity use. Since the SDEIS, PolyMet modified the NorthMet Project Proposed Action to include a SAG mill, which would be much more efficient and use less energy than the existing rod mill and ball mill circuit originally proposed.

A.5.18 Issue: Permitting and Regulatory Considerations (PER)

Theme PER 01

Theme Statement

The permit process should allow for public access to information, review, and input (e.g., hearings, and/or a vote), and should have an objective third party consultant to evaluate applications and process, including the Permit to Mine and AWMP.

Thematic Response

Under the State of Minnesota Data Practices Act, all public government data collected, created, received, maintained, or disseminated during the permit process is accessible to the public, including, but not limited to, permit applications and draft permits. The public review and input process varies depending upon the permit and is controlled by state statute and/or rule.

The Freedom of Information Act (FOIA) gives the public the right to access information from the federal government. Under the FOIA, federal agencies must disclose any information that is requested, unless that information is protected from public disclosure. Not all records can be released under the FOIA, and there are nine categories of exemptions. For example, Exemption 5 covers information that concerns communications within or between agencies which are protected by legal privileges that include, but are not limited to: attorney-work product privilege, attorney-client privilege, deliberative process privilege, and presidential communications privilege.

Theme PER 02

Theme Statement

PolyMet is an untested company with no experience in mine development, mine operations, or financial assurance. The MN DNR should not allow a company to undertake such a huge mining operation without a record showing that they are a qualified company to safely operate the proposed NorthMet mine. The parent company of PolyMet (PolyMet, Canada) and major investor (Glencore Xstrata) should be held responsible for and be part of the Permit to Mine and Financial Assurance. Even so, Glencore Xstrata is not from the United States and does not have a trustworthy environmental record.

Thematic Response

FEIS Section 3.2.2.4 includes available details regarding financial assurance. PolyMet, the project proponent, and not its shareholders, would be responsible for the Permit to Mine and financial assurance. *Minnesota Rules* 6132.1200, Subpart 5 states that financial assurance criteria require that funds must not be dischargeable through bankruptcy and are fully binding and enforceable under state and federal law. Final details on the financial assurance requirements for the NorthMet Project Proposed Action, as well as who would be responsible for it would be addressed during permitting.

Theme PER 03

Theme Statement

The NorthMet Project is a high risk project and has inherently high costs associated with planned and unplanned environmental mitigation needs, such as long-term, post-closure water treatment. Permits for the project should include financial assurance adequate to cover unplanned events, reclamation, monitoring, contingency mitigation, and long-term closure activities to protect the state from financial cost. PolyMet should also be held to harsh financial and legal penalties for failure to comply.

Thematic Response

FEIS Section 3.2.2.4 includes available details regarding financial assurance. *Minnesota Rules* 6132.1200 outlines financial assurance requirements, and Subpart 5 specifically states that financial assurance funds must not be dischargeable through bankruptcy and are fully binding and enforceable under state and federal law. Final details on the financial assurance requirements for the NorthMet Project Proposed Action, as well as who would be responsible for it would be addressed during permitting.

Theme PER 04

Theme Statement

The NorthMet Project would not meet the Permit to Mine requirement for the mine to be maintenance free at closure (*Minnesota Rules* 6132.3200), especially because the 200 and 500 year timeframes for potential water effects are tantamount to “perpetual” water treatment. In addition, other long-term monitoring and maintenance requirements included as part of the Proposed Action are unrealistic and not practicable.

Thematic Response

Minnesota Rules 6132.3200, Closure and Postclosure Maintenance, identifies several goals for non-ferrous mining areas, including the goal that sites be closed so that they are maintenance-free. A maintenance-free site is the goal of the Minnesota Department of Natural Resources (MDNR) for the NorthMet Project Proposed Action, as it is for every mining site. The NorthMet Project Proposed Action includes piloting a non-mechanical treatment system to achieve this goal. PolyMet would include funds in its reclamation cost estimate and financial assurance package to fund mechanical water treatment for as long as necessary, but the Permit to Mine would require PolyMet to present a plan for eventual transition from mechanical water treatment to non-mechanical treatment. PolyMet cannot be released from its responsibilities, including financial assurance requirements, until there is no longer a need for closure/post-closure treatment/maintenance. Financial assurance is a component of any Permit to Mine, to ensure that necessary maintenance can be provided for as long as it necessary.

Theme PER 05

Theme Statement

If contaminants traveling through groundwater contribute to the pollution of surface water, USEPA and the federal courts require an NPDES permit for the discharge.

Thematic Response

The EIS considers that permitting for the NorthMet Project Proposed Action, if approved, would require monitoring that would likely include water levels and water quality in groundwater and potentially affected waters of the U.S., including wetlands and tributaries. The goal of this monitoring is to anticipate or predict the potential for an NPDES discharge so that the NPDES discharge can either be eliminated, or alternatively permitted with NPDES permit coverage prior to its occurrence. See FEIS Section 5.2.2.3.6 for more information on groundwater and wetland monitoring and possible future mitigations.

The FEIS states that an NPDES permit would be required for any point source water discharge that adds pollutants to waters of the U.S. The Final EIS correctly identifies the waters of the US.

Theme PER 06

Theme Statement

The permitting agencies have a poor track record for enforcement and holding mining companies accountable for compliance with permit conditions. Known AMD sites in Minnesota (Dunka Mine and LTV) have legacy pollution. The FEIS and permits should include assurances that PolyMet would be able to meet, and would be strictly held to conditions (if approved) with harsh penalties for violation. Permitting agencies should retain the right to update the permit conditions, including monitoring, to reflect best practice and/or more stringent environmental standards, should conditions or standards change (e.g. for mercury). Facility shutdown should be an option. Variances should not be granted.

Thematic Response

If state permits are issued, the MDNR and MPCA would retain the right to re-open and amend the permit as necessary to ensure compliance with state and federal rules. In addition, MPCA's water quality permits last five years, and must go through a formal (and public) reissuance process thereafter. If a permit is reissued or re-opened, contemporary standards would be incorporated into the revised permit. The MPCA and MDNR retain any and all enforcement powers allowed under state law. State and federal rules allow for a permittee, under certain circumstances, to apply for a water quality variance, and the MPCA cannot unilaterally terminate that right. The application for a variance would be evaluated against the criteria in state and federal rules to determine whether the variance can be granted.

Theme PER 07

Theme Statement

Permitting of the NorthMet mine would create a precedent for other sulfide mines in the vicinity of the BWCAW that would have significant cumulative consequences.

Thematic Response

An Environmental Impact Statement (EIS) would be required for any proposed new mine in the vicinity of the BWCAW, and a cumulative effects analysis would be part of such an EIS. In addition, each new project or facility would be subject to its own separate and independent permitting process.

Theme PER 08

Theme Statement

The NorthMet project and Land Exchange are inconsistent with fiduciary obligations owed by the United States government under treaties with Indian tribes. Treaty usufructuary rights to hunt and gather unpolluted fish, wildlife, medicinal plants and wild rice should be honored.

Thematic Response

The Agency's obligation is to ensure that Band members have ample opportunity to exercise their treaty-reserved usufructuary rights; that federal lands are managed to maintain both the diversity and abundance of natural resources; and that the Bands' usufructuary rights to treaty resources are not impaired. The Land Exchange Proposed Action was analyzed to understand the potential effect posed to usufructuary rights. The Co-lead Agencies have consulted, and continue to consult with the Bois Forte Band of Chippewa, the Grand Portage Band of Lake Superior Chippewa, and the Fond du Lac Band of Lake Superior Chippewa, the three principle Bands that retain usufructuary rights in the proposed project area. In addition, the Co-lead Agencies have consulted with the Great Lakes Indian Fish and Wildlife Commission and the 1854 Treaty Authority, the principal natural resource agencies representing the aforementioned Bands Through consultation, the Co-lead Agencies understand that the Bands' principle interest with regards to the Land Exchange Proposed Action are the following: to retain or increase the amount of public land within the 1854 Treaty Ceded Territory, shoreline wetlands, culturally important natural resources used in exercising treaty rights of hunting, fishing and gathering, cultural or religious properties, and access to culturally important natural resources and cultural or religious properties. The Co-lead Agencies have a fiduciary obligation to understand and consider the effects that the Land Exchange Proposed Action would have on Band members exercising their treaty rights in the 1854 Ceded Territory. While the Land Exchange Proposed Action would remove certain lands from federal ownership, this loss is potentially offset by incoming private lands that would become part of the federal estate within the 1854 Ceded territory. Outside of the Land Exchange Proposed Action, the Co-lead Agencies have also analyzed the potential effects posed by the Proposed Connected Actions. The potential affects posed to natural resources and cultural resources of importance to the Bands have been disclosed and would be considered during the Co-lead Agency decision process.

Theme PER 09

Theme Statement

The SDEIS did not include sufficient information to inform related water permits. For example:

- The SDEIS is not clear where compliance points would be—property boundaries are not sufficient;
- The FEIS must disclose the predicted quality of groundwater below each of the mine features and Tailings Basin, as well as other seepage locations;
- Baseline water quality along the Transportation and Utility Corridor should be monitored for permitting. It is not clear if there will be mixing zones, or how groundwater entering surface water would be held in compliance; and
- The FEIS should include the narrative state standards, which are more difficult and complex than simple numeric goals, and should address issues related to nondegradation and/or antidegradation.

Thematic Response

The MPCA worked closely with the MDNR during the preparation of the FEIS to ensure that this document fully informs the subsequent water quality permitting process. The impact analysis performed as part of the FEIS to estimate potential impacts to water resources would be used to inform any future permitting process with respect to the location of surface and groundwater compliance points, monitoring requirements, and compliance limits consistent with state and federal requirements. All applicable state water quality standards and permitting requirements, including nondegradation, would be addressed as part of any water quality permitting process.

Theme PER 10

Theme Statement

The FEIS should include more detail on how the project would comply with the wild rice standard, given the existing high levels of sulfate in Embarrass and Partridge Rivers. How would PolyMet meet a (potential future) revised standard? How would PolyMet comply with non-mechanical treatment in the long term?

Thematic Response

The FEIS includes descriptions of the Wastewater Treatment Plant (WWTP) at the Plant Site and the Wastewater Treatment Facility (WWTF) at the Mine Site, both of which would be capable of discharging treated wastewater at concentrations at or below 10 mg/L (the wild rice sulfate water quality standard), as demonstrated by pilot-testing already conducted. More detailed information on these treatment systems would be available as part of any future permitting process. Future changes to the wild rice sulfate standard, if any, are speculative and outside the scope of the FEIS. However, should a more stringent standard be developed in the future, operation of the reverse osmosis (RO) treatment systems can be adjusted to meet a more stringent effluent limit. Non-mechanical treatment effectiveness in decreasing the concentration of sulfate and other parameters to required levels would need to be proven through bench- and pilot-testing before it could be permitted to replace the currently proposed mechanical systems.

Theme PER 11

Theme Statement

Increased mercury cannot be allowed in the Embarrass River, regardless of a projected mercury decrease in the Partridge River. Quantification of methylmercury, bioaccumulation and compliance with the downstream Fond du Lac Band of Lake Superior Chippewa's water quality standard for mercury should be considered as part of the EIS before permitting proceeds.

Thematic Response

The FEIS has evaluated mercury concentrations from the Plant Site WWTP and Mine Site WWTF, and has concluded that effluent from both facilities can meet the applicable mercury water quality standard of 1.3 ng/L. The MPCA has provided guidance to the Co-lead Agencies that a discharge to a water body impaired for fish tissue mercury is not prohibited, provided that the discharge can meet the applicable water quality standard without benefit of mixing or dilution (i.e., does not cause or contribute to the impairment). In preparing the FEIS, the Co-lead Agencies concluded that a quantification of methylmercury and its subsequent bioaccumulation cannot be made, given the limitations of today's scientific understanding of the complex processes contributing to methylation of mercury in the environment and introduction into fish tissue. The analysis in the FEIS acknowledges this scientific uncertainty. The FEIS has evaluated potential changes in mercury concentrations in the St. Louis River near the Fond du Lac Band's northern reservation boundary and concluded that mercury concentrations in the St. Louis River at the reservation boundary are not predicted to change from current levels as a result of the Proposed Connected Actions.

Theme PER 12

Theme Statement

The Hydrometallurgical Residue Facility should be classified as a hazardous waste facility, and as such should meet the respective rules for hazardous waste facilities (i.e., the current location is not suitable).

Thematic Response

Minnesota Rules 7045.0120, Subpart 1.1 provides exemption to waste from extraction, beneficiation, and processing of ores and minerals in regard to storage, labeling, transportation, treatment, processing and disposal. Even if that were not the case, actual testing of hydrometallurgical residues obtained from pilot-testing indicates that these residues do not exceed RCRA hazardous waste thresholds. For more details, see the response to theme HAZ 02.

Theme PER 13

Theme Statement

Under what conditions and when would PolyMet be able to request release from the Permit to Mine?

Thematic Response

PolyMet would need to complete all requirements of the Permit to Mine to the satisfaction of the MDNR, which would include all financial assurance and closure requirements. *Minnesota Rules* 6132.4800, Request for Release From Permit, outlines requirements/conditions for a permittee requesting release from a Permit to Mine.

Theme PER 14

Theme Statement

Has the USEPA reviewed the contents and potential effects of this SDEIS under the Clean Water Act?

Thematic Response

The USEPA, as a Cooperating Agency, reviewed and provided written comments on the SDEIS. The USEPA comment letter is included as part of the FEIS in Appendix A.

Theme PER 15

Theme Statement

Proposed wetland fill at the Plant Site is likely to result in water quality standard violations.

Thematic Response

Water levels in wetlands adjacent to proposed facilities could go up or down as a result of proposed wetland fill, but the proposed wetland fill would unlikely have an effect on the water quality of wetlands. At the Plant Site, the seepage collection system would intercept approximately 90 percent of groundwater and 100 percent of surface water. That intercepted water would be replaced by treated water from the WWTP, which would be discharged outside the containment structure into wetlands to maintain their hydrology. It is expected that water quality permits would require monitoring of potentially affected surface waters near the Tailings Basin.

Theme PER 16

Theme Statement

There should be no change to existing allowable limits for water quality.

Thematic Response

The MPCA would apply all applicable water quality standards as they appear in state and federal rules at the time of permitting. The incorporation of any changes to water quality standards is a separate public process, and is not part of the evaluation in this FEIS.

Theme PER 17

Theme Statement

The agencies should require detailed monitoring of the water levels in the shallow aquifers.

Thematic Response

The MPCA, MDNR, USACE would assess the need to require ongoing monitoring of water levels in the shallow aquifer during their respective permitting processes.

Theme PER 18

Theme Statement

What level of runoff into adjacent rivers and lakes will be deemed acceptable, and what impact will that runoff have on fish, birds, and wildlife in the region?

Thematic Response

All runoff that contacts mine waste or mining disturbed areas is proposed to be captured and treated to meet applicable effluent limitations before it is discharged into the environment. Non-contact stormwater would be managed through best management practices as determined through the stormwater pollution prevention plan required by the MPCA's water quality permit.

Theme PER 19

Theme Statement

Who would be responsible for non-mechanical treatment pilot testing?

Thematic Response

The permittee would be responsible for pilot-testing of non-mechanical treatment systems. The permittee would need to demonstrate to the satisfaction of the permitting agencies (MPCA and MDNR) that the non-mechanical treatment systems would be able to meet required performance levels before they can be permitted to replace either of the mechanical systems (i.e., the WWTP or WWTF) that are part of the NorthMet Project Proposed Action.

Theme PER 20

Theme Statement

The process has taken too long. The decision to grant the permits (or not) should be made in a timely manner.

Thematic Response

These comments discuss the timing of the environmental review and permitting processes. Since no specific information was provided, no changes were made to the EIS.

Theme PER 21

Theme Statement

Tailings dam safety reports should be completed more frequently than every five years.

Thematic Response

Tailings Basin dams would be monitored and managed in accordance with the Dam Safety Permit. Examples of the monitoring and management measures that may be required under the permit are provided in FEIS Section 3.2.14.2. Exact requirements, including the frequency of reporting, would be established during permitting.

Theme PER 22

Theme Statement

Does the sulfate standard drive the whole seepage treatment plan? What dilution factor is valid for the St Louis River between the Embarrass River and the Partridge River?

Thematic Response

The sulfate standard of 10 mg/L, applicable to waters used for production of wild rice during periods when the rice may be susceptible to damage by high sulfate levels, is an important standard that informed PolyMet's treatment plan; however, it was not the only water quality parameter important to the design and selection of engineering controls. Efficient removal of metals and "salty" parameters were also important considerations. The modeling performed for the FEIS considered effluent concentrations, watershed runoff, and contributions from stream flow and groundwater in estimating sulfate concentrations in surface water. The FEIS would inform permit decisions. If a permit is issued, the permit would be protective of all applicable beneficial uses.

Theme PER 23

Theme Statement

The SDEIS fails to study the project in the context of other sulfide copper/nickel mines, their history of impacts and regulatory compliance, including companies who are PolyMet investors. If permits are issued, will there be a constant battle to enforce regulations, will variances be sought?

Thematic Response

As required, the FEIS evaluates the potential environmental effects associated with the NorthMet Project Proposed Action. The original scoping of the EIS was informed by the available general body of knowledge related to non-ferrous mining. State and federal rules allow for a permittee, under certain circumstances, to apply for a water quality variance; however, variances are considered rarely and on only a case-by-case basis. Any such action by the MPCA would require MPCA Citizens Board approval. Enforcement of regulations is an important component of any permit program, and available state tools have been shown to be effective in resolving non-compliance.

Theme PER 24

Theme Statement

PolyMet should fund an independent group to monitor the project on a full time basis in perpetuity. This entity should have the power to curtail or shut down operations and direct punitive measures as necessary.

Thematic Response

State and federal government agencies are the independent entities that have monitoring responsibility and authority. These responsibilities and authorities are embodied in law and policy, which are a reflection of the public interest.

Theme PER 25

Theme Statement

The State should institute a permanent or temporary moratorium on hard rock sulfide mining. If temporary, then a moratorium on the project should be in place until the reverse osmosis water treatment technology has been successfully installed at another comparable mine.

Thematic Response

To date, the Minnesota state legislature has enacted no moratoria on hard rock sulfide mining or wastewater treatment technologies. Such actions would require legislative approval, and would be enacted through a public process.

Theme PER 26

Theme Statement

The project violates the Weeks Act, Clean Water Act, Clean Air Act and/or National Land Management Policy.

Thematic Response

If permitted, the NorthMet Project Proposed Action would be required to comply with all applicable state and federal regulations and policies.

Theme PER 27

Theme Statement

The proposed project threatens Lake Superior, which is protected by international agreements, such as the International Boundary Waters Treaty of 1909, the Great Lakes Charter of 1985, the Great Lakes Charter Annex of 2001, the Great Lakes Compact of 2005, and the Lakewide Management Plan.

Thematic Response

If permitted, the NorthMet Project Proposed Action would be required to comply with all applicable state and federal regulations and policies.

Theme PER 28

Theme Statement

DNR should require that sulfide in backfilled waste rock never oxidizes.

Thematic Response

The NorthMet Project Proposed Action is designed so that waste rock backfilled into the East Pit would remain permanently submerged under water. The rate at which sulfide minerals could oxidize in submerged waste rock (and pit wall rock) was considered explicitly in the Impact Assessment Planning (IAP) process undertaken by the Co-lead Agencies for the NorthMet Project Proposed Action. Specifically, the IAP geochemistry group considered the question of whether "Flooded wall rock and backfilled waste rock may still encounter some oxygen that is dissolved in the water, which would release some metals and sulfate" (MDNR et al., as cited in the FEIS). The IAP geochemistry group concluded that "The effect is too small to warrant incorporation into the pit lake water quality model." Justification for this conclusion is supported by an analysis presented in a 2008 memo by SRK Consulting, which estimated that, even in the top meter of waste rock, the rate of sulfide oxidation would be less than 1/800th as fast underwater relative to rock exposed to the air (Day 2008, Section 6.1).

Theme PER 29

Theme Statement

The Minnesota Department of Health (MDH) recommends groundwater evaluation criteria be used for specific contaminants.

Thematic Response

Minnesota's water quality permitting agency, the MPCA, would use the water quality evaluations in the FEIS to inform permitting. For any water quality permit drafted for the NorthMet Project Proposed Action discharges, the specific permit requirements, including compliance limits for groundwater, would be determined through well-established water quality permitting practices reflecting state and federal water quality regulations and associated guidance.

Theme PER 30

Theme Statement

Does Minnesota's regulatory process include water quality monitoring for mining to prevent water pollution from exceeding standards or reduce pollution that exceeds standards?

Thematic Response

PolyMet would be required to comply with all terms and conditions of any water quality permit issued for the Project. These terms and conditions are based on established state and federal water quality regulations, including applicable water quality standards. The permit would include required performance, effluent, and other compliance monitoring to ensure compliance with permit conditions.

Theme PER 31

Theme Statement

The permitting agencies should use previous negative experiences to improve permits for the NorthMet mine to make sure that mistakes are not repeated.

Thematic Response

Permitting agencies would rely upon information presented in the FEIS, any additional information included in permit applications, and their own experience and knowledge in their respective permitting programs in preparing permits that are consistent with applicable state and federal permitting regulations.

Theme PER 32

Theme Statement

How would the Air Quality permit for the NorthMet project comply with the State's established greenhouse gas reduction goals?

Thematic Response

The issues raised by this comment would be part of any future air permit review and approval process. The permitting process would result in permit requirements that are consistent with Minnesota's greenhouse gas reduction goals.

Theme PER 33

Theme Statement

Minnesota law prohibits degrading water quality below the original level, even if the original level exceeds the standard for modified or polluted waters.

Thematic Response

These comments provide general information regarding the degradation of water quality. No changes were made to the EIS as a result of these comments.

Theme PER 34

Theme Statement

The SDEIS has shown that the project will have state and federal regulatory oversight. The SDEIS also has shown that Polymet can comply with Minnesota's tough environmental management requirements, and should thus be able to proceed through permitting and approvals.

Thematic Response

These comments generally supported the NorthMet Mining project. Because no specific information was provided, no changes to the EIS were made.

Theme PER 35

Theme Statement

The SDEIS does not show that the NorthMet Project would be compliant with federal, state, and provincial environmental laws, including MERA. Economic considerations alone cannot drive environmental decisions. Because the mining companies have poor track records, environmental risks (including reactive mine waste) and potential consequences (including to Lake Superior) are too great, the NorthMet Project should not be permitted. The Minnesota Department of Natural Resources, the U.S. Army Corps of Engineers and the U.S. Forest Service should choose the No Action Alternative and deny the requested permits and Land Exchange.

Thematic Response

These comments stated that the Co-lead Agencies should choose the No Action Alternative and deny the requested permits and Land Exchange. Because no specific information was provided, no changes to the EIS were made.

Theme PER 36

Theme Statement

Were the USFWS, MPCA, and Minnesota Department of Health (MDH) included in EIS process?

Thematic Response

Although not acting as Co-lead agencies, MPCA and MDH have been involved in this EIS process. As discussed in FEIS Section 1.2.3, while not Co-lead or Cooperating Agencies, other federal and state agencies have important roles on the project. The MPCA and MDH are assisting the MDNR pursuant to *Minnesota Rules* 4410.2200. The USFWS has reviewed the Biological Assessment and would provide a Biological Opinion.

Theme PER 37

Theme Statement

Is the P90 threshold a permitting loophole?

Thematic Response

The P90 evaluation criterion was a tool developed for EIS purposes to help interpret the probabilistic distribution of water quality predictions generated by the GoldSim water quality model. Minnesota's water quality permitting agency, the MPCA, would use the water quality evaluations in the FEIS to inform the permitting process. If a water quality permit is drafted for the NorthMet Project Proposed Action discharges, specific effluent limits and other compliance requirements would be determined through well-established water quality permitting practices reflecting state and federal water quality regulations and associated guidance.

Theme PER 38

Theme Statement

Why and how has the permitting process already started (parallel with the EIS process)?

Thematic Response

Pre-application permit discussions have occurred in parallel with the development of the NorthMet EIS so that the NorthMet Project Proposed Action can be modified during the EIS process as necessary to meet anticipated permitting regulatory requirements. The goal of these discussions was to prevent major project modifications during any potential permit drafting process. Establishing a complete NorthMet Project Proposed Action description during the EIS process that anticipates potential permit requirements allowed the public to perform a more meaningful review of the NorthMet Project Proposed Action and gain a clearer understanding of the its potential effects. The extent of the permitting discussions that occurred during the EIS process was permit- and agency-specific; however, these discussions were typically limited to additional information and analyses needed for the permitting processes, permit application content, and the sequence and timing of permitting process steps. Outcomes of these discussions important to the EIS were shared with the Co-lead Agencies. While permit applications may be submitted and permits drafted prior to the end of the EIS process, no permit decisions may be made until the EIS process is complete.

Theme PER 39

Theme Statement

Both state and federal policy support the development of mining projects such as the NorthMet project within the Superior National Forest.

Thematic Response

These comments suggest that state and federal policy support development such as mining projects within the Superior National Forest. Because no specific information was provided, no changes to the EIS were made.

Theme PER 40

Theme Statement

The PolyMet proposal meets none of the MDNR's mission statement "to conserve and manage the state's natural resources, provide recreation opportunities and…provide commercial uses…in a way that creates a sustainable quality of life" and to "manage…and sustain waterways and groundwater resources."

Thematic Response

These comments indicate that PolyMet's proposal would meet no aspect of the MN DNR's mission statement. Because no specific information was provided, no changes were made to the EIS.

Theme PER 41

Theme Statement

Preserving wetlands must be considered crucial to the goal of Minnesota's 25-year effort to "enhance, protect and restore water quality."

Thematic Response

If permitted, the NorthMet Project Proposed Action would be required to comply with all applicable state and federal wetland regulations and policies.

Theme PER 42

Theme Statement

The MDNR has two contradictory mandates that must be fixed—both protect the environment and be required to make the most money from the same land.

Thematic Response

These comments discuss MN DNR's contradictory mandates and that they must be fixed. Since these comments are considered to be outside the scope of the EIS, no changes were made to the EIS.

Theme PER 43

Theme Statement

The MDNR does not have the expertise to properly evaluate the mine's impacts on the resources of Minnesota.

Thematic Response

The Environmental Review process for the NorthMet Project Proposed Action has included both experienced state and federal technical staff and experienced consultants/technical experts.

Theme PER 44

Theme Statement

Minnesota has an excellent reputation and laws to protect the environment, and should not be compared to other countries and areas, or to policies in effect years ago.

Thematic Response

These comments have generally supported Minnesota's good reputation and laws that protect the environment. Because no specific information was provided, no changes were made to the EIS.

Theme PER 45

Theme Statement

By rule, the MDNR is the designated RGU for the NorthMet project. It has never made sense that the DNR should have final decision over property that is currently owned and managed by the USFS for the benefit of all citizens.

Thematic Response

Under MEPA rules, the MDNR is specifically designated as the Responsible Governmental Unit (RGU) for any new mining project. The Proposed Connected Actions include a land exchange of federal lands administered by the United States Forest Service (USFS); therefore, the USFS has been involved with the Proposed Connected Actions as a Co-lead Agency since 2010.

A.5.19 Issue: Socioeconomics (SO)

Theme SO 01

Theme Statement

The proposed economic and employment benefits of the NorthMet Project are small in comparison to the economic cost and the high probability of damage to the environment. The short-term gains (i.e., 20 years of profits and jobs) as a result of the NorthMet Project are not worth the long-term environmental damage and associated costs, which could last 200-500 years.

Thematic Response

FEIS Section 5.2.10.2.2 provides a discussion of the economic effects of the NorthMet Project Proposed Action. Construction, operations, and closure would provide new jobs, substantial new earnings, and indirect contributions to public finances. Environmental impacts would be managed through engineering controls, monitoring, mitigation and adaptive mitigation under permits, and the proposed would be responsible for associated costs as well as financial assurance. See FEIS Section 5.2.2 for detailed discussion on water impacts that would require long-term management. Impacts on air quality are addressed in FEIS Section 5.2.7 and other environmental impacts are disclosed throughout FEIS Chapter 5 and 6. Financial assurance is discussed in FEIS Section 3.2.2.4; however, specific details and costs would be determined during permitting.

Theme SO 02

Theme Statement

Northern Minnesota relies on pristine wilderness to support its economy—especially its tourism economy—which the NorthMet Project would put at risk.

Thematic Response

The NorthMet Project Proposed Action would take place in an area that has experienced mining previously; for more discussion on this see FEIS Section ES-10. As discussed in FEIS Section 5.2.11.2.1, the presence of the NorthMet Project Proposed Action would not substantially affect regional recreation or visual resources, nor would it substantially affect air or water quality or increase noise levels in popular regional recreation lands such as the BWCAW (see FEIS Section 5.2.12). Consequently, there is insufficient evidence to demonstrate that the presence of the

NorthMet Project Proposed Action would affect the tourism industry as a whole; see FEIS Section 5.2.10.2.2 for further discussion.

Theme SO 03

Theme Statement

The Proposed NorthMet Project would have negative effects on the real estate market in northeastern Minnesota, with related secondary effects on the local economy. These effects could include reduction of real estate values and/or impedance of the already slow market recovery.

Thematic Response

The NorthMet Project Proposed Action's effects on the Study Area's housing values are anticipated to be minimal. The most likely result of the operation of the NorthMet Project Proposed Action is a minor increase in housing demand and prices in study area communities, with moderate effects in individual communities closest to the NorthMet Project area. Increased housing prices may or may not be a negative effect; average housing values in the communities closest to the NorthMet Project area are relatively low compared to other Study Area communities. Minor to moderate increases in housing value would likely be seen as a benefit to homeowners, and the opportunity to add newer housing stock (either through rehabilitation of existing units or the construction of new units) to the Study Area would generally improve property values, thus improving local property tax revenues in those communities. For further discussion, see FEIS Section 5.2.10.2.4.

Theme SO 04

Theme Statement

The discussion of potential socioeconomic effects in the SDEIS is inadequate. The FEIS should include further analysis, including a detailed analysis of displaced economic activity, ceded territory effects, and how fluctuating workforce numbers impact infrastructure and services.

Thematic Response

The socioeconomic analysis provided in the FEIS satisfies NEPA and MEPA requirements. Regarding displaced economic activity, FEIS Section 4.2.10.1.2 shows the distribution of employment by industry type in the Study Area, and demonstrates that mining is one of many important industries in the region. FEIS Section 5.2.10.2.2 discusses the relationship of mining to the tourism industry. While the NorthMet Project Proposed Action would have substantial economic impacts on the Study Area, it would only add approximately 1,000 jobs (1 percent of the existing workforce). There is no evidence that the Project would prevent the diversification of, or cause displacement of other economic activities from, the Study Area. The FEIS acknowledges the concern about fluctuating workforce numbers (see FEIS Section 5.2.10.1.4 for further discussion). FEIS Section 5.2.10.1.5 provides further discussion of impacts to infrastructure and other services, while FEIS Section 5.2.10.2.6 and the response to theme SO 09 discuss potential impacts to the ceded territory.

Theme SO 05

Theme Statement

The SDEIS evaluation of the economic effects related to taxes is inadequate. The FEIS should be revised to include the following considerations:

- The State of Minnesota policy of rebating taxes to the mining industry;
- Why the estimates of federal, state, and local taxes differ between the DEIS and SDEIS; and
- More detail on the calculation of estimated taxes paid, given that the copper-nickel mining industry has its own unique tax structure.

Thematic Response

1. Discussion of the State of Minnesota's policy of rebating taxes to the mining industry is not required under NEPA or MEPA.

2. The difference in tax estimates between the DEIS and SDEIS is due to different assumptions in IMPLAN modeling about projected operations. In the original IMPLAN report (2005), the total projected output for a typical year of operations (assumed at the time to be 2009) was half that of the projected output in the 2011 IMPLAN report. The change in output assumptions reflects changes in the NorthMet Project Proposed Action between the DEIS and SDEIS. The IMPLAN model uses the proportion of total tax collection attributed to direct, indirect, and induced output to estimate tax revenue; therefore, when the total projected output increases, so does tax revenue.

3. FEIS Section 4.2.10.1.3 discusses all taxes applicable to mining, and Table 5.2.10-3 lists the estimated annual NorthMet Project taxes paid.

Theme SO 06

Theme Statement

The FEIS should provide additional detail about the economic effects of the Proposed Action, including whether jobs would be held by Minnesota workers, how many will be long term vs. short term, and the degree to which profits would stay in northern Minnesota.

Thematic Response

FEIS Section 5.2.10.2.1 discusses the number of direct and indirect jobs created during construction, operations, and closure of the NorthMet Project Proposed Action. Accurate prediction of the degree to which jobs associated with the NorthMet Project Proposed Action (let alone indirect and induced jobs) would be filled by Minnesota workers is not feasible, given the complexity of the labor market. FEIS Section 5.2.10.2.2 discusses employment, income, the number of long-term versus short-term jobs, as well as the degree to which profits would stay in Minnesota. FEIS Section 5.2.10.2.3 discusses the impacts of the NorthMet Project Proposed Action on public finance.

Theme SO 07

Theme Statement

The SDEIS lacks a cost-benefit analysis. The FEIS should include such an analysis to determine if the benefits of sulfide mining outweigh the risks and known effects from this type of mining. An FEIS cost-benefit analysis should specifically evaluate concerns about financial assurance—i.e., whether the public would eventually need to pay for cleanup and how such costs would affect the cost-benefit equation.

Thematic Response

A cost/benefit analysis is not required under NEPA or MEPA.

Section 102 of NEPA (42 USC 4321 et seq.) requires all Federal agencies, to the fullest extent possible, to do the following: "identify and develop methods and procedures, in consultation with the Council on Environmental Quality...which would insure that presently unquantified environmental amenities and values may be given appropriate consideration in decision-making along with economic and technical considerations."

Neither NEPA nor MEPA require the costs and benefits of a proposed action to be quantified in dollars or any other common metric; moreover, it is not possible to quantify and assign a value to all benefits and costs associated with the NorthMet Project Proposed Action. The FEIS focuses on the benefits and costs of such magnitude or importance that their inclusion in the analysis can inform the decision-making process.

The FEIS fulfills NEPA and MEPA requirements in adequately addressing benefits and costs. Financial assurance is discussed in FEIS Section 3.2.2.4.

Theme SO 08

Theme Statement

The IMPLAN modeling is inadequate. An economic model that includes both inputs and outputs must be a part of the discussion. The IMPLAN model was limited in scope and accounts for the benefits but does not consider the total costs of this project relative to the benefits of jobs and taxes.

Thematic Response

IMPLAN modeling is an accepted means to assess socioeconomic impacts of a project. IMPLAN uses an input-output approach to model the economic effects of changes in baseline conditions. IMPLAN reports direct, indirect, and induced effects (as defined in FEIS Section 5.2.10.1.3) in terms of employment, output (the value of production), and value added (wages, rents, taxes, etc). FEIS Section 5.2.10.1.3 provides further discussion of IMPLAN model methodology, while FEIS Section 5.2.10.2 presents findings of the IMPLAN model. The response to theme SO 07 addresses cost/benefit analysis.

Theme SO 09

Theme Statement

The SDEIS fails to recognize environmental justice effects of pollutants, such as methylmercury and arsenic that may be found in fish, game, wild rice, and water. These pollutants may cause particular harm to tribal members or low-income families who rely on fish, game, and wild rice for subsistence. Cumulative effects of the project on environmental justice should be analyzed.

Thematic Response

The NorthMet Project Proposed Action are within the 1854 Ceded Territory. FEIS Section 4.2.10.1.6, as well as Table 4.2.9-1 in FEIS Section 4.2.9 summarize available information about subsistence patterns and resources within the 1854 Ceded Territory. Construction of the NorthMet Project Proposed Action would make the Mine Site unavailable for subsistence use. The degree to which construction of the NorthMet Project Proposed Action would affect individual subsistence resources (i.e., fish, game, and plant species) outside of the Mine Site, Transportation and Utility Corridor, and Plant Site is discussed in FEIS Section 5.2.9 (Cultural Resources).

FEIS Section 5.2.10.2.6 discusses consumption of fish. Increased mercury concentrations and associated increases in mercury bioaccumulation in fish tissue could constitute an EJ impact for Band members and other subsistence consumers of fish.

Theme SO 10

Theme Statement

PolyMet should be allowed to move forward with the NorthMet Project. The project will create jobs that will support families and provide economic vitality to the region, as well as produce metals that the world needs. Mining can coexist with a natural resources-based tourism industry.

Thematic Response

These comments generally supported the NorthMet Mining project for its economic benefits. Because no specific information was provided, no changes were made to the EIS.

A.5.20 Issue: Vegetation (VEG)

Theme VEG 01

Theme Statement

The FEIS should provide additional species-level analysis of direct, indirect, and cumulative effects on Endangered, Threatened, and Special Concern (ETSC) species, Regional Forester Sensitive Species (RFSS), Species of Greatest Conservation Need (SGCN), and common vegetation species. The FEIS should incorporate the August 19, 2013, Minnesota ETSC species status list, along with any federal status changes. The FEIS should also include acceptable mitigation measures, such as sensitive species being moved to suitable adjacent habitats. Other measures that address the area, biodiversity, and procedures should be proposed and evaluated.

Species of concern include the floating marsh marigold, neat spike-rush, and bog rush. Disrupting one of the 12 currently existing floating marsh marigold populations in Minnesota will increase the pressure on the remaining populations; the floating marsh marigold should be examined for genetic uniqueness and protected.

Thematic Response

The FEIS vegetation sections were updated to include the new state ETSC status listings from August 19, 2013, as well as any new federal status listing changes. FEIS Section 5.2.4.2 includes a listing of MDNR-acceptable potential mitigation measures. These mitigation measures would be decided upon at the time of permitting. The MDNR generally does not consider transplantation of sensitive species to be an acceptable mitigation measure for several reasons: transplantation moves the species into an artificial habitat, transplantation may have unanticipated effects on other organisms at the new site, and it would be necessary to establish the species and monitor it for several years to determine if it could persist. Additional discussion was added to the FEIS regarding floating marsh marigold; specifically, FEIS Section 5.2.4 clarifies the impact on the statewide population, using updated statewide NHIS data. Additional populations have been added to the NHIS database since the SDEIS. There are 15 known populations, several of which have hundreds to thousands of individuals. Of the 13 colonies within the Mine Site, three would be directly affected by the NorthMet Project Proposed Action, as stated in FEIS Table 5.2.4-3. These affected colonies represent a small percentage of total individuals within the state (using available data, approximately less than 1%).

Theme VEG 02

Theme Statement

The NorthMet Project and Land Exchange would result in a large decrease of or impact to Minnesota Biological Survey Sites of Biodiversity Significance and imperiled or vulnerable native plant communities. These effects should be mapped in the FEIS and more thoroughly evaluated in terms of biodiversity rankings and biodiversity areas. The SDEIS contains insufficient information on mitigation measures for these areas. Areas of concern that should be further analyzed include the Rich Black Spruce Swamp, the One Hundred Mile Swamp, Superior National Forest, the St. Louis River Watershed, wetlands classified by the USEPA as a likely Aquatic Resource of National Importance, the Laurentian Uplands subsection, the MDNR Headwaters Site, the Sand Lake Peatlands Scientific and Natural Area, and the USFS Big Lake candidate Research Natural Area. Communities of concern include the black spruce and jack pine woodland.

Thematic Response

FEIS Sections 4.2.4 and 4.3.4 discuss and provide maps of MBS Sites (Figures 4.2.4-1, 4.2.4-2, 4.2.4-5, 4.3.4-1, and 4.3.4-2) to provide clarity on the location and extent. FEIS Sections 5.2.4 and 5.3.4 include information about the impacts to MBS sites and native plant communities. The WCA rules (including those parts applicable to mining projects under *Minnesota Rules* 8420.0930) include a special consideration for wetlands that are rare natural communities (*Minnesota Rules* 8420.0515, Subpart 3).

Minnesota Rules 6132.2700 require that a project site be reclaimed once mining has ceased. The goals of such reclamation are to "control erosion, to screen mining areas from non-compatible uses, and to provide for subsequent land uses such as wildlife habitat or timber production." The rules also include requirements about the characteristics and planting schedule for vegetation used in reclamation. FEIS Sections 3.2.2 and 5.2.4 describe mine reclamation activities that would be completed as part of the NorthMet Project Proposed Action, some of which may allow such MBS sites to re-establish. The Permit to Mine would address special consideration of wetlands that include rare natural communities. Additional information on rare natural communities would be included in the wetland permit application as part of the Permit to Mine process for further refinement of site-specific conditions.

There are no SNAs or RNAs located on the Mine Site, Transportation and Utility Corridor, or Plant Site.

Theme VEG 03

Theme Statement

A large expanse of high-quality mature forest, peatland, floodplain, wetland, and other habitat would be removed, impacted, or fragmented and its biodiversity role could never be successfully restored on site or elsewhere. These effects will be exacerbated by climate change, especially for vulnerable species. The FEIS should assess costs of replacing these lost functions. Potential effects of the removal of this forest—especially in the context of the Forest Plan—should be assessed in more detail, including effects on timber management/harvest.

Thematic Response

The FEIS vegetation sections include discussion of the NorthMet Project Proposed Action's effects on habitat types. In addition, FEIS Sections 5.2.4 and 5.3.4 also discuss the Forest Plan as it relates to timber management. As described in FEIS Section 4.2.4.2.1 timber-harvesting activities have occurred across the upland forest areas of the Mine Site for the last 20-60 years. The oldest forest areas at the Mine Site include 40 to 80-year-old trees.

The WCA rules (including those parts applicable to mining projects under *Minnesota Rules* 8420.0930) include a special consideration for wetlands that are rare natural communities (*Minnesota Rules* 8420.0515, Subpart 3). *Minnesota Rules* 6132.2700 does require that a project site be reclaimed once mining has ceased. The goals of such reclamation are to "control erosion, to screen mining areas from non-compatible uses, and to provide for subsequent land uses such as wildlife habitat or timber production." The rules also include requirements about the characteristics and planting schedule for vegetation used in reclamation. The Permit to Mine would address special consideration of wetlands that include rare natural communities. Additional information on rare natural communities would be included in the wetland permit application as part of the Permit to Mine process for further refinement of site-specific conditions.

FEIS Section 5.2.3 discusses the wetland types that would be restored on- and off-site as mitigation for effects from the NorthMet Project Proposed Action. These types include forested and shrub swamps, coniferous bogs, etc. The responses to themes WET 05 and WET 14 also discuss effects to wetlands/peatlands, loss of wetland functions, and mitigation for wetland effects.

Theme VEG 04

Theme Statement

The FEIS should more accurately describe wild rice waters. The FEIS should also evaluate effects on wild rice stands (especially from water pollution due to sulfides, sulfates, acid mine drainage, asbestos, arsenic, mercury, iron, copper sulfate, sulfur, sulfuric acid, and hydrogen sulfide as converted by bacteria) downstream of the Project, along with techniques to benefit wild rice. Considering the traditional importance of wild rice and its use for food, adopting a sediment porewater sulfide standard to replace, complement, or work in conjunction with a sulfate standard should be considered. Areas of concern include the One Hundred Mile Swamp and the Embarrass, Partridge, and St. Louis rivers. The FEIS should also clarify access to rice beds on the federal and non-federal lands.

Thematic Response

FEIS Sections 5.2.2 and 5.2.4 includes a description of the NorthMet Project Proposed Action's effects on wild rice beds. The response to themes WR 152, WR 156, and WR 157 discuss wild rice beds and the sulfate standard for wild rice beds. Evaluation of a sediment porewater sulfide standard is outside the scope of this analysis. FEIS Section 5.2.2 states that for MPCA-recommended wild rice beds, the proposed engineering controls would prevent an increase in sulfate concentrations in the Partridge River and would decrease sulfate concentrations in the Embarrass River. The area known as the One Hundred Mile Swamp is not known to support wild rice, and it is not designated as a MPCA Staff-Recommended Wild Rice Bed. Locations of and access to wild rice beds on the federal and non-federal lands are discussed in the FEIS vegetation sections. The Land Exchange would result in an increase in wild rice beds within the federal estate, the FEIS contains additional details about existing public access to Tract 1 wild rice beds via the Pike River. Overall, there would be no increase in wild rice harvest opportunities for the public.

Theme VEG 05

Theme Statement

The reclamation plan should:

- Outline clear re-vegetation goals and timelines;
- Describe woody species control on reclaimed stockpiles;
- Not allow the planting of non-native or invasive plant species;
- Include a noxious weed prevention program;
- Describe soil requirements (pH, fertility, microbial biota, ratios of sand/silt/clay, and nutrient cycles, such as for nitrogen and organic matter); and
- Discuss topsoil management based on soil characterization.

Thematic Response

The FEIS vegetation sections include new details from the updated Reclamation Plan. In particular, invasive species would not be permitted in the seed mix. Some non-native species (e.g., oats, winter wheat) that are commonly used in the state seed mixes to temporarily stabilize soils in order to reduce erosion or dust potential could be planted. The species to be used for reclamation would be finalized during permitting. FEIS Section 3.2.2.1.10 describes how the NorthMet Project area facilities would be operated to allow for progressive reclamation during operations.

After mining ceases, PolyMet would finish reclamation activities under the Reclamation Plan, which is a required portion of the Permit to Mine. *Minnesota Rules* 6132.2700 states that the establishment of vegetation shall begin during the first normal planting period after site features are determined by the Permit to Mine to be no longer scheduled to be disturbed. Reclaimed areas would be monitored and maintained as needed in the Spring and Fall or as required under the Permit to Mine. Areas damaged by erosion or that lost vegetation would be identified, and plans to repair or reseed would be developed and implemented. Long-term maintenance of the only remaining stockpile during closure (i.e., Category 1 Stockpile) would also include removal of deep-rooted woody species and trees from the cover system, according to the Adaptive Water Management Plan. Soil testing to evaluate appropriate fertilizer needs would be completed as available. FEIS Section 3.2.2.1.7 explains that topsoil or overburden would be separated into three types, including unsaturated overburden, saturated overburden, and peat, which is also described in the Rock and Overburden Management Plan. FEIS Section 3.2.2.1.10 further explains that on-site unsaturated overburden and peat would be used as topsoil for the Category 1 Stockpile cover system, while saturated overburden would be used for specific on-site construction applications as approved by MDNR or placed in the combined East Central Pit.

Theme VEG 06

Theme Statement

The FEIS should evaluate and more thoroughly model:

- Pollution (in the form of harmful substances, toxins, leachates, acid mine drainage, heavy metals, manganese, copper, aluminum, aluminum oxide, lead, asbestos, arsenic, dust, sulfates, sulfides, sulfuric acid, mercury, etc.);
- Poor water quality (including from reverse osmosis [RO] effects or due to pH levels) that will impact vegetation in the Project area; and
- Areas of concern including the Arrowhead Region, Lake Superior, the BWCAW, and the St. Louis, Embarrass, and Partridge rivers. The FEIS should provide a more detailed rationale for why effects on these areas are not considered significant, and should more thoroughly discuss the potential effects from bioaccumulation of pollutants within the food web.

Thematic Response

FEIS Sections 5.2.2 and 5.2.7 evaluate water and air modeling results (respectively), and these evaluations inform the analysis of potential effects from harmful pollutants or poor water quality on vegetation species and areas of concern. FEIS Section 5.2.2 states that the NorthMet Project Proposed Action has the potential to affect surface or groundwater hydrology and quality within the Partridge River and Embarrass River watersheds. These watersheds are part of the St. Louis River and Lake Superior watersheds, but are not part of the Hudson Bay basin, and would not affect the BWCAW. As described in FEIS Section 5.2.6, the NorthMet Project Proposed Action is estimated to result in a net decrease in mercury loadings to the Partridge River, but a net increase to the Embarrass River. The responses to theme AIR 04 and AIR 09 discuss the assessment of potentially reactive dust, and the Secondary National Ambient Air Quality Standards that would be protective of vegetation. The response to theme MERC 02 provides additional more information about how mercury bioaccumulation was estimated.

Theme VEG 07

Theme Statement

The analysis of indirect effects to plant species should be expanded (to include dust and other air pollutants such as sulfur dioxide, nitrogen oxide, and greenhouse gases; hydrologic changes; habitat fragmentation; microclimate; loss of fungal associates; erosion; and exotic species). The analysis should vary by each species and location.

Thematic Response

FEIS Section 5.2.4.2 includes an analysis of potential indirect effects to plant species, using available and updated air, water, and wetland modeling results. Potential foreseeable indirect effects analyzed include dust, hydrology effects, and exotic species. PolyMet proposes to implement various dust-control measures such as stabilizing disturbed soils by temporarily establishing vegetation and water spraying during dry periods (consistent with *Minnesota Rules* 6132.2800). As FEIS Section 5.2.7 further describes, fugitive dust control measures would result in 90 percent control at the Mine Site. FEIS Section 5.2.3 explains that vegetation located within zones with a high likelihood of hydrology effects would be more likely to have community changes than those with no or low likelihood of effect. FEIS Section 5.2.4.2.1 describes reclamation objectives, including rapidly establishing a self-sustaining plant community, controlling air emissions, controlling soil erosion, providing wildlife habitat, and minimizing the need for maintenance. The reclamation seeding mix would be determined during permitting, and MDNR would not allow the planting of invasive species.

Theme VEG 08

Theme Statement

The cumulative effects analysis for vegetation:

- Uses an unclear assessment area, data, and approach (past, present, and future);
- Should be expanded to discuss effects to treaty-protected (and state-listed) vegetation resources and access to them;
- Should evaluate the statewide status of each species and how effects on one population would cumulatively affect other populations;
- Should discuss the cumulative effects on resources (wetlands, wildlife, vegetation) and include Sites of Biodiversity Significance, native plant communities, threatened and endangered plant species, and invasive species; and
- Should clarify lack of effects or lack of data.

Thematic Response

The FEIS vegetation sections include an analysis of cumulative effects to vegetation species, treaty-protected resources, MBS sites, and native plant communities. The FEIS uses MDNR Natural Heritage Information System (NHIS) data to analyze the statewide status of each species. Table 6.2-15 summarizes the percentage of statewide populations affected. The NHIS data also clarifies whether there is a lack of data in the cumulative project footprints or an absence of species in surveys conducted on-site. The FEIS has been updated to include the new state ETSC status listings from August 19, 2013, as well as any new federal status listing changes to assess effects to species in the cumulative analysis.

Theme VEG 09

Theme Statement

The FEIS should further describe, define, and explain baseline data on vegetation community types, invasive species, biodiversity, and relative abundance, including monitoring plans. The FEIS should also provide a correlation between Management Indicator Habitat types and Regional Foresters Sensitive Species (RFSS) abundance, along with overall justification for the data used in this analysis.

Thematic Response

FEIS Sections 4.2.4 and 4.3.4 include a discussion of baseline data on vegetation community types, invasive species, biodiversity, and relative abundance. PolyMet and agency documents have also been reviewed for new information. Detailed surveys for Regional Forester Sensitive Species (RFSS) have not been conducted; thus, FEIS Table 4.2.4-5 uses a correlation between RFSS preferred habitat types (Management Indicator Habitat [MIH]) and species abundance.

Theme VEG 10

Theme Statement

The risks to biodiversity and vegetation, and the loss of pristine ecosystems are too great to proceed with the Project as proposed.

Thematic Response

This comment has been received and acknowledged by the Co-lead agencies.

A.5.21 Issue: Wetlands (WET)

Theme WET 01

Theme Statement

The plan for indirect mitigation is inadequate. The SDEIS did not provide upfront mitigation for indirect impacts which should be mitigated upfront. The language on indirect impacts is too vague and does not provide enough assurance that mitigation for indirect impacts would actually occur.

Thematic Response

FEIS Section 5.2.3.3 has been revised to include more information on the monitoring and mitigation plan for the potential indirect wetland effects. The indirect effects analyses performed for the EIS were not performed to characterize impacts but were done to inform where monitoring should take place for those areas that were identified as having a potential for indirect wetland effects. As a result of these analyses performed to determine where monitoring should occur, quantification of wetland types and acres of potential indirect wetland effects were also generated. FEIS Section 5.2.3 provides these quantitative values of potential indirect wetland effects for the six factors. Potential indirect wetland effects from the NorthMet Project Proposed Action were assessed as a result from one of the following six factors: 1) wetland fragmentation; 2) change in wetland hydrology from changes in watershed area; 3) changes in wetland hydrology from groundwater drawdown resulting from open pit mine dewatering; 4) changes in wetland hydrology from groundwater drawdown resulting from operation of the Plant Site, including groundwater seepage containment; 5) changes in stream flow near the Mine Site and Plant Site and associated effects on wetlands abutting the streams; and 6) change in wetland water quality related to atmospheric deposition of dust and rail car spillage associated with Mine Site and Plant Site operations. The assessments provided wetland type and acreage for all six factors; however, only wetland acreages were provided for factor 6 (change in wetland water quality related to atmospheric deposition of dust and rail car spillage associated with Mine Site and Plant Site operations).. The identification of specific mitigation for indirect effects and a monitoring plan is not a requirement for an EIS; however, the FEIS has been updated with additional information on the approach for determining mitigation if the monitoring shows indirect effects are occurring. The monitoring and mitigation for potential indirect effects would be determined during permitting. FEIS Section 5.2.3.3 has been revised to include more information on the monitoring and mitigation plan for the potential indirect wetland effects. The proposed wetland impact, avoidance, minimization, mitigation and monitoring plan presented in the FEIS would be reviewed, modified as required, and approved during permitting; therefore, this information could change during permitting. Please refer to the response to theme FIN 11 for more information on financial assurance.

Theme WET 02

Theme Statement

The USACE has not yet developed a monitoring plan to assess after-the-fact Project indirect impacts to wetlands, but maintains that will be the way to best determine and mitigate indirect wetland impacts. The monitoring plan for indirect impacts should include the following and should be addressed in the FEIS:

- monitoring in all potential indirect impact categories;
- how would the monitoring be performed, including who would perform the monitoring and what is the criteria;
- decision framework as well as the criteria and process for determining when and what additional mitigation would be needed;

- specify the type, location, and compensation ratios that would be required if monitoring determines indirect impacts are occurring; and
- what the adaptive management practices entail.

Thematic Response

FEIS Section 5.2.3.3 has been revised to include more information on the monitoring and mitigation plan for the potential indirect wetland effects. The indirect effects analyses performed for the EIS were not performed to characterize impacts but were done to inform where monitoring should take place for those areas that were identified as having a potential for indirect wetland effects. As a result of these analyses performed to determine where monitoring should occur, quantification of wetland types and acres of potential indirect wetland effects were also generated. FEIS Section 5.2.3 provides these quantitative values of potential indirect wetland effects for the six factors. Potential indirect wetland effects from the NorthMet Project Proposed Action were assessed as a result from one of the following six factors: 1) wetland fragmentation; 2) change in wetland hydrology from changes in watershed area; 3) changes in wetland hydrology from groundwater drawdown resulting from open pit mine dewatering; 4) changes in wetland hydrology from groundwater drawdown resulting from operation of the Plant Site, including groundwater seepage containment; 5) changes in stream flow near the Mine Site and Plant Site and associated effects on wetlands abutting the streams; and 6) change in wetland water quality related to atmospheric deposition of dust and rail car spillage associated with Mine Site and Plant Site operations. The assessments provided wetland type and acreage for all six factors; however, only wetland acreages were provided for factor 6 (change in wetland water quality related to atmospheric deposition of dust and rail car spillage associated with Mine Site and Plant Site operations).. The identification of specific mitigation for indirect effects and a monitoring plan is not a requirement for an EIS; however, the FEIS has been updated with additional information on the approach for determining mitigation if the monitoring shows indirect effects are occurring. The monitoring and mitigation for potential indirect effects would be determined during permitting. FEIS Section 5.2.3.3 has been revised to include more information on the monitoring and mitigation plan for the potential indirect wetland effects. The proposed wetland impact, avoidance, minimization, mitigation, and monitoring plan presented in the FEIS would be reviewed, modified as required, and approved during permitting; therefore, this information could change during permitting. Please refer to the response to theme FIN 11 for more information on financial assurance.

Theme WET 03

Theme Statement

The mitigation for direct impacts is inappropriately sited and would not replace functions within the impacted watershed. In addition, the mitigation sites are too far from the area impacted. The proposed mitigation:

- is outside of the watershed and therefore the type and function of the wetlands will not help water quantity and quality within this watershed;
- is outside of the Ceded Territory;
- is not based on a watershed approach;

- should establish a better plan for replacing wetlands on-site; and
- should consider a larger number of smaller wetlands in the direct area, and should not be dismissed solely on whether the company deems it economically feasible to do so if those mitigations make more sense environmentally.

Thematic Response

FEIS Section 5.2.3.3.2 includes a discussion on the wetland mitigation study limits and the site selection process. The NorthMet Project Proposed Action would be located within the St. Louis River Watershed (#3) (8-digit HUC) within the Great Lakes Basin (4-digit HUC). The Zim Site is located within the same watershed as the NorthMet Project Proposed Action; however, the Aitkin and Hinckley sites are located within the Mississippi River Basin (4-digit HUC) and 8-digit HUC watersheds of Elk-Nokasippi #10 and Snake River #36, respectively. In accordance with the 2008 Final Mitigation Rule, USACE policy, and overall requirements of the CWA, the primary focus of compensatory mitigation is to replace lost wetland functions within the same watershed as the impact site—in this case, the St. Louis River Watershed/Great Lakes Basin. The compensatory wetland mitigation site selection for the NorthMet Project Proposed Action began in 2005 and has gone through a rigorous site selection evaluation. Prior to the 2008 Federal Mitigation Rule, the Aitkin and Hinckley sites were selected, initial approvals by the USACE were received, and substantial investments were made by PolyMet to develop both sites for compensatory mitigation. The USACE guidance prior to the implementation of the 2008 Federal Mitigation Rule was to look for mitigation sites that could provide the following: restoration of historical wetlands, high probability of success, achievement of at least partial in-kind mitigation, and sites that had ditched and/or tiled peatlands to provide for restoration. When the 2008 Final Mitigation Rule went into effect, the USACE informed PolyMet of the priority for siting any future compensatory mitigation within the St. Louis River/ Great Lakes Basin. The Zim Site was subsequently proposed as a third site. The Proponent, along with, in some cases, state and federal agencies, have conducted and are continuing to conduct extensive efforts to find additional suitable sites within in the Great Lakes Basin for wetland mitigation.

The 2008 Federal Mitigation Rule and 2009 USACE St. Paul District Policy specifies a preferential sequence for compensatory mitigation (i.e., use of mitigation banking credits, use of project-specific compensation that is based on a watershed approach, use of project-specific compensation that is on-site and in-kind, and use of project-specific compensation that is off-site and/or out-of-kind), and aims to select mitigation sites as close as possible to the watershed of impact; however, sometimes this cannot be accomplished. The 2009 USACE St. Paul District Policy accepts out-of-watershed mitigation; however, the USACE's preference is for the mitigation to be within the same watershed as a proposed project. The term "watershed approach" is defined in 33 CFR § 332.2 as "an analytical process for making compensatory mitigation decisions that support the sustainability or improvement of aquatic resources in a waters. It involves consideration of watershed needs, and how locations and types of compensatory mitigation projects address those needs…"

Additionally, as described in FEIS Section 5.2.3.3.2, the wetland mitigation planning process relied on the WCA wetland replacement siting rules (*Minnesota Rules* 8420.0522), state compensatory mitigation requirements under state water quality standards (*Minnesota Rules* 7050.0186), and the federal requirements which are discussed above. Additionally, the NorthMet project considered *Minnesota Rules* 7050.0186, which requires compensatory mitigation to be sufficient to ensure replacement of the diminished or lost designated uses of the wetland system that was impacted. In addition, to the extent practicable, the same types of wetlands affected are to be replaced in the same watershed, before or concurrent with the actual alteration of the wetland. The WCA rule also states that wetlands in counties where 80 percent or more of pre-settlement wetlands currently exist (which includes wetlands in St. Louis County), the minimum replacement ratio requirements are as determined by the mitigation location and type ranging from 1:1 to 2.5:1. Moreover, *Minnesota Rules* 8420.0522 indicates the replacement standards for wetlands as regulated under the WCA.

The compensatory mitigation approach by PolyMet followed the St. Paul District Policy in effect at the time the proposed compensation sites were selected, as well as WCA siting rules. Further, the Zim Site was developed in accordance with a watershed approach. In combination, the proposed compensatory mitigation is appropriate for the siting and scale of the effects that would result from the NorthMet Project Proposed Action. As noted above for the project-specific compensation, the following compensatory mitigation siting sequence is required: on-site, in the same 10-digit HUC watershed, in same 8-digit HUC watershed, in same modified 6-digit watershed, in same 4-digit HUC watershed, then statewide.

Initially, no practicable compensation sites were found in the St. Louis River Watershed, but subsequently, the Zim Site was found and incorporated as part of the compensatory mitigation plan. The 2008 Federal Mitigation Rule and 2009 USACE St. Paul District Policy are watershed based, they do not require wetland mitigation sites to stay within the 1854 Ceded Territory; however, the Zim Site is located within the St. Louis Watershed and the 1854 Ceded Territory. The permanent functional loss of wetlands within the St. Louis River Watershed/Great Lakes Basin would be considered by the USACE in its DA permit decision and has been accounted for in the proposed mitigation credits by PolyMet.

The proposed wetland restoration and enhancement performance criteria place a strong emphasis on ensuring that the proposed mitigation strategy provides for the adequate replacement of lost functions. For purposes of compensatory mitigation, the focus is on functions. The 2008 Federal Mitigation Rule specifically eliminated use of the term “values.” An abbreviated MnRAM functional assessment, which was agreed upon by the USACE, was utilized to assess wetland functions for the Mine Site, Transportation and Utility Corridor, and Plant Site. Both the USACE and MDNR require functions to be replaced; however, both agencies use a set of defined ratio requirements to determine the number of acres required to replace functions lost, as there is currently no suitable quantitative functional assessment method in Minnesota. Based on the findings and where impacts occur (e.g., types of wetlands), the mitigation ratios and credits have been increased to take into account the functions lost due to the NorthMet Project Proposed Action. For example, additional compensatory mitigation (i.e., a higher replacement ratio) is proposed to offset loss of bog wetlands, a difficult-to-replace wetland type. All of the wetland mitigation proposed would be restoration with a minimal component of wetland preservation; no creation of wetlands would be part of the off-site mitigation. Furthermore, as previously noted, the mitigation sites would need to meet performance standards in order to be considered successful.

While on-site replacement of wetlands is listed first in the sequencing, on-site conditions may not be the most suitable for successful wetland mitigation. In fact, 33 CFR § 332.3(b) states that compensatory mitigation should be located where it is most likely to successfully replace lost functions and services within the watershed, not specifically on-site. Moreover, the preferred mitigation methodology stated under the 2008 Federal Mitigation Rule begins with the utilization of mitigation banks and in-lieu fee programs within appropriate service areas prior to permittee-responsible mitigation (33 CFR § 332.3(b)(2)-(3)). Following the use of mitigation banks and in-lieu fee programs, the 2008 Federal Mitigation Rule clearly states that permittee-responsible mitigation following a watershed approach (i.e., providing for mitigation in the best suitable location within the proposed impact watershed) should be used (33 CFR § 332.3(b)(4)). Only after mitigation banks, in-lieu fee programs, and permittee-responsible mitigation under a watershed approach have been exhausted or are infeasible should permittee-responsible mitigation through on-site and in-kind mitigation be considered (33 CFR § 332.3(b)(5). Prior to considering permittee-responsible mitigation, PolyMet investigated the potential to purchase wetland mitigation bank credits and/or use an in-lieu fee program; however, as stated in FEIS Section 5.2.3.3.2 of FEIS, there were insufficient credits available to satisfy the mitigation requirements of the NorthMet Project Proposed Action and no in-lieu fee programs are available in Minnesota.

PolyMet considered on-site mitigation first and there is the potential to provide 101.8 acres of wetland restoration on-site during reclamation. The post-closure establishment of the estimated 101.8 acres of on-site wetland is not included in the wetland mitigation credits. The generation of wetland credits from these areas has the potential to be used on a contingency basis, but compensatory credit would not be considered up front due to the post-closure timeframe. The summary of proposed wetland mitigation credits, presented in FEIS Table 5.2.3-17, does not include the on-site wetland restoration.

FEIS Section 5.2.3.3.2 under the off-site mitigation discussion states that mitigation sites were considered for areas meeting all of the required mitigation criteria with at least 100 contiguous acres. That analysis was limited to sites with more than 100 acres of wetland mitigation potential due to anticipated difficulties in planning numerous, small wetland mitigation projects, and the desire to identify opportunities that were feasible. In addition, the NorthMet Project Proposed Action represented an opportunity to restore large wetland systems and provide greater public and ecological benefits than typically available with smaller projects. In addition, smaller mitigation wetlands have a higher likelihood of failure whereas wetlands that are larger in size are more likely to succeed and become self-sustaining. Financial assurance is a key component to compensatory mitigation. Please refer to the response to theme FIN 11 for more information on financial assurance. In addition, when considering potential mitigation location and methodologies, cost is an important factor, although it should not be given greater weight than other factors. However, if in order to establish a successful wetland mitigation area at a site is financially exorbitant as opposed to other similar areas which are more economically feasible, the more economically feasible location is acceptable if all other considerations are equal (e.g., habitat, potential future land uses, environmental suitability, etc.).

Proposed mitigation sites were selected based on availability and the high likelihood of meeting performance criteria. Locations for wetland mitigation projects were evaluated based on a four-tiered priority and are described in detail in FEIS Section 5.2.3.3.2:

- On-site;
- Off-site in the in St. Louis River Watershed (same 8-digit HUC);
- Off-site in the Great Lakes Basin (same 4-digit HUC); and

- Off-site in an adjacent 4-digit HUC, selecting an 8-digit HUC as close as possible to the impacted site.

In summary, on-site establishment of wetlands was considered first. There is the potential to provide 101.8 acres of restoration on-site during reclamation. An initial mitigation study investigation of off-site compensatory mitigation opportunities focused on available areas containing greater than 80 percent of their historic wetland resources as defined by the WCA. That area was selected as the initial study area to comprehensively cover the priority mitigation areas. Available mitigation banking credits that were available for purchase by PolyMet were evaluated in portions of bank service areas and found to be insufficient to satisfy the compensatory mitigation requirements. Subsequently, a GIS analysis was performed to identify potential wetland mitigation sites within the defined study area. PolyMet's primary goal of the analysis was to identify large, potentially drained wetlands located primarily on private or tax-forfeit land within the study area to provide preliminary data for more detailed ground investigations to proceed. To achieve the goal of the mitigation plan, which is to replace lost wetland functions using compensatory wetland types in-kind to the degree practicable, areas where drained wetlands could be restored were preferable over areas where wetlands could be created. The analysis was limited to sites with more than 100 acres of wetland mitigation potential due to the anticipated difficulties in planning numerous, small wetland mitigation projects, and the desire to identify opportunities that were feasible. In addition, the NorthMet Project Proposed Action represented an opportunity to restore large wetland systems and provide greater public and ecological benefit than typically available with smaller projects. The wetland mitigation investigation identified three off-site areas that would provide a total of 1,602.7 acres of wetland compensation and 197.1 acres of upland buffer. Please refer to FEIS Section 5.2.3.3.2 for more information on the mitigation site selection.

For those sites that were feasible, PolyMet has obtained rights to the land and mitigation plans were developed. While the two of the three mitigation sites are located outside the watershed (see FEIS Figure 5.2.3-30), PolyMet has sought out sites that would restore high functioning wetlands. PolyMet has plans, or obtained the rights, to develop three mitigation sites which would provide approximately 1,513.3 wetland mitigation credits off-site.

Theme WET 04

Theme Statement

The mitigation plan and measures are inadequate and the ratios for direct compensatory mitigation should be higher. The FEIS should provide a status update on the development of the final wetland mitigation credits (including type, location, acreages). The FEIS should discuss:

- use of a mitigation ratio of more than 2:1;
- mitigation ratio of a minimum of 2:1 and not reduced below this for the loss of high quality wetlands and difficult to replace forested and bog wetland plant communities;
- since no wetland bank is being developed by PolyMet, no excess wetland mitigation credits would be available. Permittee responsible mitigation sites do not generate credits;
- SDEIS suggests that PolyMet will have to replace only 27 acres that suffer this loss;

- wetlands destroyed will not be replaced in-kind;
- mitigation projects assume that permitting agencies will allow restoration and preservation credit for restoring and protecting coniferous bog and swamp that are already functioning as wetland communities;
- how the new wetlands are established;
- if there is a contingency plan if mitigation fails; and
- restoration should have already occurred.

Thematic Response

The FEIS includes the proposed direct compensatory mitigation credits and ratios for the NorthMet Project Proposed Action (see Tables 5.2.3-17, 5.2.3-18, and 5.2.3-19) which are based on the federal guidance policies and state replacement ratio rules. Currently, neither the USACE St. Paul District, nor the State of Minnesota has made a final determination of the compensation ratios required to offset the direct impacts of the NorthMet Project Proposed Action. The final decision on compensatory mitigation ratios for direct wetland impacts would be determined during permitting.

FEIS Section 5.2.3.3.2 discusses how the 2009 USACE St. Paul District Policy and the state policy for base compensation ratios could be applied for the NorthMet Project Proposed Action. As noted, the base compensation ratio for high-quality, difficult-to-replace bog and forested wetlands would be increased from 1.5:1 to 2:1 while the base compensation ratio for low- to moderate-quality wetlands would be set at 1.5:1 (USACE 2013, as cited in the FEIS). The 2009 USACE St. Paul District Policy allows for in-kind, in-place, and in-advance incentives to reduce the recommended base ratios and these would be considered at the time of permitting. The final decision on compensatory mitigation ratios will be determined at the time of the CWA Section 404 permit decision based on current District guidance.

Minnesota Rules, part 7050.0186, requires compensatory mitigation to be sufficient to ensure replacement of the diminished or lost designated uses of the wetland that was physically altered. Based on the WCA wetland replacement standards (*Minnesota Rules* 8420.0522, Subpart 4), the required replacement ratio would be either 1:1 or 1.5:1. For those wetlands that are replaced in the watershed with the same wetland type, a majority of which are in-kind, the base replacement ratio that would likely be required is 1:1 and for those wetlands that are replaced outside of the watershed, the ratio would be increased to 1.5:1. The final decision on replacement ratios will be determined at the time of the permit decision.

The NorthMet Project Proposed Action is estimated to directly impact 913.8 acres. Depending on the location, type, and timing of compensatory mitigation, the minimum required amount of replacement wetlands for direct impacts, based upon USEPA recommendations, could potentially range from 913.8 acres up to 1,827.6 acres (i.e., 1:1 up to 2:1 compensation ratios). The USACE has concluded that the mitigation sites selected and the wetland credits generated at the three mitigation sites would be acceptable for use in compensating for direct wetland losses. The USACE has not made a final decision on the mitigation ratios that would be required to compensate for direct wetland impacts; if fully successful, it is likely these three mitigation sites would generate sufficient credits to compensate for the 940 acres of direct and fragmented wetland impacts. In the event that not all of the credits generated by these sites are utilized to compensate for direct wetland impacts, any excess credits could be used to compensate for indirect losses (USACE 2015a, as cited in the FEIS). The current proposed mitigation presented in the FEIS shows that PolyMet could have an excess of mitigation credits from the three mitigation sites if the mitigation sites are successful and meet the performance standards. However, it is understood that mitigation sites sometimes are not fully successful and contingency plans (discussed below) would be developed for the NorthMet Project Proposed Action and approved during permitting. If the wetland monitoring identifies indirect effects and compensatory mitigation is required, the excess mitigation may be allowed to be used for the indirect effects. The USACE encourages the development of mitigation for foreseeable indirect effects, which the current proposed mitigation plan appears to achieve. The FEIS has been updated to note that the excess credits could be used for indirect effects if the monitoring shows mitigation is required. The three mitigation sites are not being developed under the federal banking process.

The majority of the credits proposed by PolyMet would be in-kind mitigation and nearly one-third of the credits would be from within the NorthMet Project area watershed (see Tables 5.2.3-17, 5.2.3-18, 5.2.3-19). Based on PolyMet's current mitigation proposal and assuming the mitigation efforts are fully successful and target communities are established, 83 percent of the impacts to coniferous bogs would be mitigated by in-kind and in-place credits, or 439.9 coniferous bog credits; the remaining 17 percent would be replaced out-of-kind. Out-of-kind credits would be used to mitigate for impacts on wet meadow, shallow marsh, deep marsh, open bog, and coniferous bog communities; these would not be replaced in-kind because of hydrological and ecological constraints at the proposed mitigation sites. Forty seven percent of the wetland impacts are proposed to be replaced in-kind, in-place, and before the impacts occur on-site. An additional 29 percent of the proposed impacts are proposed to be replaced in-kind and before the impacts occur. Most of the additional mitigation credits that are proposed outside of the watershed would fulfill mitigation requirements above the minimum 1:1 ratio. The proposed wetland impact, avoidance, minimization, mitigation, and monitoring plan presented in the FEIS would be reviewed, modified as required, and approved during permitting; therefore, this information could change during permitting.

With restoration, some functions are replaced quickly such as flood storage, water quality benefits, vegetation filter, water flow, pollutants binding with the soil, vegetation absorbing contaminants in the water column, etc. While wildlife habitat replacement would be a long-term benefit from restoration, some short-term benefits for certain species such as mallards, etc. would be provision of cover and nesting areas. Performance standards have been developed and incorporated into the mitigation plan for the three sites to guide the restoration activities and to monitor whether the vegetation and hydrology are meeting the design goals. Restoration activities at the mitigation sites have not commenced yet and would not be initiated until appropriate approvals and permits have been obtained. The state and federal agencies have not yet made a determination on the drainage status of the mitigation sites (i.e., drained, partially drained, etc.); this determination, including credit ratios, would be made during permitting. PolyMet plans to complete initial phases of restoration on all of the proposed off-site wetland mitigation at least one full growing season prior to the occurrence of the wetland impacts for which the mitigation would compensate.

FEIS Section 5.2.3.3.3 has been updated with additional information on the monitoring plan for the mitigation sites and the contingencies for unsuccessful mitigation. In addition, the FEIS

Sections 5.2.3.3.2 and 5.2.3.3.4 have been updated with additional details on how the mitigation sites would be developed and monitored.

Theme WET 05

Theme Statement

Compensatory mitigation sites should replace lost wetland functions including:

- replace wetlands of the same caliber (quality, functions and values) and support the same complexity and biodiversity of species;
- address the loss of peat lands and that the formation takes decades;
- address that restoration of coniferous bogs is very difficult and a long process, and has a low success rate;
- should not displace other sensitive habitat;
- provide for in-kind for coniferous bogs; and
- address the loss of carbon and methane storage capacity.

Thematic Response

As described in FEIS Section 5.2.3.3.2, the planning process utilized the wetland replacement standards of the Minnesota Wetlands Conservation Act (*Minnesota Rules* 8420.0522), the compensatory mitigation requirements under the state water quality standards (*Minnesota Rules* 7050.0186), and the 2009 USACE Saint Paul District Policy. When developing the proposed compensatory mitigation strategy, the primary goal was to restore high-quality wetland communities with the same habitat type, quality, and functions as those areas likely to be impacted by the NorthMet Project Proposed Action. The proposed wetland restoration and enhancement performance criteria place a strong emphasis on ensuring that the proposed mitigation strategy provides for the adequate replacement of lost functions. In addition, it is standard procedure to complete a baseline study of reference wetland habitats which is then often used to aid in the development of mitigation wetlands to restore native habitats. In order to enhance and preserve the integrity of the habitats created as part of the proposed compensatory mitigation, during the design phase of the wetland mitigation, a planting plan and vegetation performance criteria would be developed which would ensure vegetative species richness and diversity based on the results of a baseline study of reference wetland habitats. Mitigation plans for the three sites have been developed and submitted to the appropriate agencies for review and approval as part of the permitting process.

Wetland functions are defined as what the wetland actually does (e.g., detain floodwaters, provide habitat, and assimilate nutrients) and these functions can be measured (e.g., acre-feet of floodwater storage, plant species richness, rate of sediment deposition, uptake of phosphorus in pounds/acre/year).Values are human perceptions, which vary from individual to individual. For purposes of compensatory mitigation, the focus is on functions and the 2008 Federal Mitigation Rule specifically eliminated use of the term “values.” An abbreviated MnRAM functional assessment, which was agreed upon by the USACE, was utilized to assess wetland functions for the Mine Site, Transportation and Utility Corridor, and Plant Site. Both the USACE and MDNR require functions to be replaced; however, both agencies use a set of defined ratio requirements to determine the number of acres required to replace functions lost, as there is currently no suitable quantitative functional assessment method in Minnesota. Based on the findings and where impacts occur (e.g., types of wetlands), the mitigation ratios and credits have been increased to take into account the functions lost due to the NorthMet Project Proposed Action. For example, additional compensatory mitigation (i.e., a higher replacement ratio) is proposed to offset loss of bog wetlands, a difficult-to-replace wetland type. All of the wetland mitigation proposed would be restoration with a minimal component of wetland preservation; no creation of wetlands would be part of the off-site mitigation.

The NorthMet Project Proposed Action would impact approximately 537.6 acres of bog habitat (approximately 530.0 acres of coniferous bog and approximately 7.6 acres of open bog). However, based on PolyMet's proposal, the proposed compensatory mitigation would restore approximately 439.9 acres of coniferous bog communities in-kind. Loss of coniferous bog and open bog communities would be offset at a mitigation ratio of 1.58:1 and 2:1, respectively (i.e., 1.58 credits and 2.0 credits to offset each acre lost) resulting in 840.0 credits to offset the loss of coniferous bog and 15.3 credits to offset the loss of open bog. The proposed mitigation proposes to restore previously impacted bog habitat as opposed to other methods of compensatory mitigation, namely creation. As such, the probability of the restored bog to become self-sustainable and successful is greatly increased. Bogs are difficult ecosystems to restore given their special biochemical and geophysical requirements combined with their long development periods to maturity. However, major advances in restoration methodologies have increased the success rate of restoring these habitats. Performance standards have been proposed by PolyMet and the necessary performance standards would be approved during permitting for the mitigation sites to guide the restoration activities and to monitor whether vegetation and hydrology are meeting the design goals.

Eilling and Knighton (1984) noted that one of the major factors inhibiting the successful restoration of bogs was the inability of previously impacted bogs to support recolonization by bog plants. Schouwenaars (1988a, 1998b, and 1993) has documented that insufficient hydrology is typically the one of the main reasons why bog restorations fail. Lastly, the successful reintroduction of sphagnum moss (*Sphagnum* spp.) has been shown to be critical to long-term sustainability and viability for restorations of bog habitats (Clymo 1984, Trettin et al. 1996, and Schouwenaars 1988a). As such, during the design phase, methodologies to restore the bog habitats focus on ensuring that the site has suitable organic soils; restoration of sufficient groundwater hydrologic inputs and retention of available surface water; and re-establishment of sufficient *Sphagnum* spp. cover densities. More specifically, Schouwenaars (1993) was able to show that deep drainage systems (e.g., tile drains, ditching, and similar methodologies) may have increased the downward seepage. As such, blocking relic drainage structures is the first step to rewetting bogs and further interventions may be required to ensure bog plant diaspores are provided optimal growing conditions (Trettin et al. 1996).

For the Zim Site, which includes bog restoration, the interior ditches would be filled, raised berms would be leveled and drain tiles would be disabled to restore wetland hydrology. Native, harvested bog material would be spread throughout the site to facilitate the re-introduction of sphagnum mosses and other bog species that cannot be easily re-introduced by seed. Damming and/or filling the drainage ditches and breaching the tile drains is likely to contribute a considerable amount of groundwater within the 15-inch critical saturation zone for *Sphagnum* spp. regeneration (Schouwenaars 1988a). Additionally, the combination of inward and external water control measures would be considered in order to increase the available water storage capacity near the surface to limit fluctuations in water level (i.e., inward controls) and to decrease downward hydrologic losses to maintain a higher water table (i.e., external).

The successful reintroduction of *Sphagnum* spp. to the restored bogs has been included in the design criteria. Clymo (1984) observed that the reintroduction of *Sphagnum* spp. was critical since those species were responsible for specific conditions found in bogs. As such, the design of the restored bogs would include methodologies which have been shown to successfully reintroduce *Sphagnum* spp. such as those presented by Trettin et al. (1996) which include the collection of live *Sphagnum* spp. specimens from reference habitats to seed the restoration site by spreading the live specimens on sufficiently prepared substrates combined with suitable designed microtopography and the application of natural ground cover (e.g., weed-free straw). The use of live specimens to seed restored bogs resulted in no observed negative impacts to the collection habitat and resulted in the reestablishment of *Sphagnum* spp. populations within a few months (Trettin et al. 1996). Moreover, the application of phosphorus-rich nutrients, including fertilizers, has been shown to benefit bog mosses and improve the success of bog restorations (Sottocornola et al. 2007). As described in FEIS Section 5.2.3.3.2, vegetation and hydrology would be managed and monitored to ensure the performance standards of the restored bogs are successfully met.

The proposed compensatory mitigation sites include three off-site locations that are active sod farms and/or under agricultural production, and have been previously impacted via drainage structures, land manipulation, and other common anthropogenic sources typically associated with agricultural production. Therefore, there is little concern that sensitive habitats would be displaced as a result of the proposed mitigation sites. However, in order to ensure that other sensitive ecological receptors, such as threatened or endangered species and rare habitat communities, are not unintentionally adversely affected as a result of the proposed compensatory wetland mitigation, the proposed mitigation sites have been evaluated for the potential presence of and impact to existing sensitive habitats. A Biological Assessment has been prepared for the NorthMet Project Proposed Action which includes the three mitigation sites.

The majority of the credits proposed by PolyMet would be in-kind mitigation and nearly one-third of the credits would be from within the NorthMet Project area watershed (see Tables 5.23-17, 5.2.3-18, 5.2.3-19). Eighty-three percent of the impacts to coniferous bogs would be mitigated by in-kind and in-place credits, or 439.9 coniferous bog credits; the remaining 17 percent would be replaced out-of-kind. Out-of-kind credits would be used to mitigate for impacts on wet meadow, shallow marsh, deep marsh, open bog, and coniferous bog communities; these would not be replaced in-kind because of hydrological and ecological constraints at the proposed mitigation sites. Forty seven percent of the wetland impacts are proposed to be replaced in-kind, in-place, and before the impacts occur on-site. An additional 29 percent of the proposed impacts are proposed to be replaced in-kind and before the impacts occur on-site. Most of the additional mitigation credits that are proposed outside of the watershed would fulfill mitigation requirements above the minimum 1:1 ratio.

The NorthMet Project Proposed Action would result in a loss of carbon and methane storage capacity as a result of impacts to wetland resources. Established and functioning wetlands often serve as a carbon "sink" wherein carbon dioxide (CO_2) is sequestered as a result of natural biogeochemical processes. However, as a product of CO_2 sequestration, methane (CH4) is produced and released into the atmosphere. Both CO_2 and CH4 are greenhouse gases; however, they function differently. CO_2 remains active in the atmosphere longer while CH4 absorbs more atmospheric infrared radiation (Whiting and Fung 2001). Whiting and Chanton (1993) demonstrated that carbon fixation in flooded wetland habitats was intimately related to CH4 production and emission into the atmosphere. In fact, Matthews and Fung (1997) found that northern latitude wetlands emitted relatively more CH4 than southern wetlands, likely as a result of the long winters and resultant shorter growing season. As such, the directive to address the loss of both carbon and methane storage as a result of the NorthMet Project Proposed Action is impracticable. Barr (2012l, as cited in the FEIS) assessed the carbon cycle effects due to direct and indirect impacts proposed by the NorthMet Project Proposed Action. That assessment determined that approximately 12,535 metric tons per year of greenhouse gas emissions (in CO_2-equivalents) would be released as a one-time event (i.e., not recurring over the life of the project). The assessment also noted that the aboveground forest carbon stock loss due to NorthMet Project Proposed Action impacts is a theoretical maximum of the amount of CO_2 stored in the impacted forest vegetation and that the estimate should not be interpreted that all carbon would necessarily be emitted over a short timescale as CO_2. The NorthMet Project Proposed Action would result in the loss of approximately 940.7 acres of direct and fragmented wetland impacts; however, the proposed compensatory mitigation includes the restoration and preservation of approximately 1,602.7 acres of wetland habitat, an approximately 1.6:1 mitigation ratio per USACE Policy and WCA rule crediting. Therefore, the loss of potential carbon sequestration provided by existing wetlands would be sufficiently mitigated via the restoration of nearly twice the acreage of wetlands proposed to be impacted. The mitigation sites are peat soils that have been drained; however, if the hydrology to the peatlands is restored, the release of carbon would be stopped and the sites would again function as carbon storage.

Theme WET 06

Theme Statement

The FEIS should describe the site selection process used to designate the location of the mitigation sites as it is unclear where the compensatory wetlands would be found. In addition:

- restoration work should not occur at the Sax-Zim Bog;
- Zim Site is already wet and serves the functions of a wetland;
- data must be provided documenting the biodiversity of these lands;
- mitigation sites are currently being developed and have not yet been permitted by the USACE; and
- none of the sites should be qualified as mitigation.

Thematic Response

Please refer to the response to theme WET 03 regarding the discussion of the considerations for site selection process.

The Zim Site is not the same as the Sax-Zim Bog site (which is a current banking proposal in this area, unrelated to the NorthMet Project). Please refer to FEIS Figure 5.2.3-30 which shows the mitigation site locations. The state and federal agencies have not yet made a determination on the drainage status of the mitigation sites (i.e., drained, partially drained, etc.); this determination, including credit ratios, would be made during permitting. The USACE has concluded that the mitigation sites selected and the wetland credits generated at the three mitigation sites would be acceptable for use in compensating for direct wetland losses. The USACE has not made a final decision on the mitigation ratios that would be required to compensate for direct wetland impacts; if the mitigation is fully successful, it is likely these three mitigation sites would generate sufficient credits to compensate for the 940 acres of direct and fragmented wetland impacts. In the event that not all of the credits generated by these sites are utilized to compensate for direct wetland impacts, any excess credits could be used to compensate for indirect losses (USACE 2015a, as cited in the FEIS). Currently, neither the USACE St. Paul District, nor the State of Minnesota has made a final determination of the compensation ratios required to offset the direct impacts of the NorthMet Project Proposed Action. The final decision on compensatory mitigation ratios for direct wetland impacts would be determined during permitting.

The role of biodiversity, including floristic diversity, is included as part of the wetland habitat functions that are addressed during mitigation site selection. The goal of the selected mitigation sites is to provide robust and diverse plant communities. The proposed mitigation plan captures the importance of biodiversity; replacing in-kind to the extent practical, lost functions of the impacted wetlands including those specific to the proposed impacted coniferous bogs of the proposed project. The mitigation ratios would also be adjusted accordingly to account for uncertainties in quantifying the degree functions provided. As such, the mitigation ratios have been increased in order to account for that uncertainty. Please refer to the response to theme WET 03 for more information on functions.

Theme WET 07

Theme Statement

The FEIS should more fully and clearly disclose the environmental impacts of the direct and indirect losses of wetlands, and should assess the significance of those impacts. FEIS should consider/describe:

- was a standard definition of “wetland” used?;
- limiting direct impacts on less than 57 percent of existing wetlands;
- how the footprint of 912.5 acres was calculated and does this include wetland and buffer zones and was a standard definition of wetland used;
- total acres of wetlands in the Partridge River and Embarrass River watersheds where adverse impacts are reasonably foreseeable, whether as a result of fragmentation, mine drawdown, hydrologic changes, seepages, leaks, spills or deposition of contaminants;
- underestimation of the number of wetland acres to be permanently disturbed, as well as their biological quality;
- providing the number and/or range of estimates of indirect wetlands impacts and fragmentation of directly and indirectly affected wetlands;
- whether or not the analysis took into account climate change in the 200+ year project life; and

- why was only one wetland surveyed south of the Transportation and Utility Corridor.

Thematic Response

The NorthMet Project Proposed Action would directly impact 913.8 acres of wetlands; however, actions have been taken to avoid, minimize, and mitigate wetland impacts as discussed in FEIS Section 5.2.3.3. The modifications that have occurred during the development of the EIS have resulted in avoidance and minimization of impacts to wetland resources. To date, these modifications have reduced the acreage of wetlands impacted from 1,257 to 913.8 acres, a 27 percent decrease. The NorthMet Project Proposed Action would provide compensatory mitigation for the 913.8 acres of direct impacts as well as for the 26.9 acres of fragmented wetlands at three off-site mitigation sites. FEIS Section 5.2.3.2 provides a detailed discussion of the direct impacts and potential indirect effects as a result of the NorthMet Project Proposed Action. In addition, the proposed wetland mitigation and wetland monitoring plans are discussed in FEIS Section 5.2.3.3.2.

Wetland boundaries were identified using the routine wetland delineation procedures of the Corps of Engineers Wetlands Delineation Manual (USACE 1987, as cited in the FEIS) (the "Manual") and were reviewed by the appropriate agencies. The Manual contains a standard definition of "wetland" and methodology to apply that definition in the field; both USACE and MDNR use this Manual. The methodology and evaluation criteria that were utilized for determining direct impacts and indirect effects to wetlands resources is discussed in FEIS Section 5.2.3.1.1 and the impacts that could occur from the NorthMet Project Proposed Action are discussed in detail in FEIS Section 5.2.3.2.

FEIS Section 4.2.3.1.3 provides a discussion of the wetland functional assessment that was performed for the wetlands at the Mine Site and along the Transportation and Utility Corridor; this discussion notes that the MnRAM was used to assess wetland functions on the Mine Site and along the Transportation and Utility Corridor. During the field wetland surveys for the Project areas, data was collected related to the functions of each wetland within the proposed Project areas (i.e., Mine Site, Transportation and Utility Corridor, Plant Site) under an abbreviated MnRAM approach. The vegetative diversity/integrity within each wetland was rated using the guidelines in the Minnesota Routine Assessment Method for Evaluating Wetland Functions, Version 3.0 (MNRAM 3.0). A total of 87 wetlands were evaluated at the Mine Site for vegetative diversity/integrity and overall functional quality rating and is summarized in FEIS Table 4.2.3-4. Wetland data forms with the MnRAM information collected in the field was presented in Wetland Delineation and Wetland Functional Assessment Report (Barr 2006d, as cited in the FEIS). Approximately 92 percent of the wetland resources in the Mine Site are of high overall wetland quality and 8 percent are of moderate overall wetland quality. Furthermore, the wetlands along the Transportation and Utility Corridor were also assessed using the same approach, and all 21 wetlands have been rated as high quality. The four wetland resources along the Railroad Connection Corridor are moderately affected and have a high vegetative diversity/integrity. FEIS Section 4.2.3.2.3 describes the findings of the MnRAM assessment for the Plant Site. The majority (92 percent) of the wetlands within the Plant Site are currently rated as low-quality with low vegetative diversity/integrity and the eight percent are rated as moderate quality. The wetlands within the Hydrometallurgical Residue Facility are currently rated as low-quality and the wetlands within the Colby Lake Water Pipeline Corridor are rated as low quality (93 percent) and moderate quality (7 percent). The field work that was completed for the federal lands that are beyond the Mine Site boundary included a MnRAM evaluation for representative wetland locations. At these representative locations, 63 questions given in MnRAM 3.2 were addressed, and all factors were evaluated for each wetland surveyed (see FEIS Section 4.3.3). This approach differed from the Project areas where mining activities would occur and was agreed to by the USACE. Therefore, the wetland assessment sites that are identified on the figures in the FEIS are associated with the federal lands evaluations. However, as indicated above, all wetlands within the NorthMet Project areas associated with the mining activities had an abbreviated MnRAM performed.

FEIS Section 5.2.3 discusses the percentage of high, medium, and low quality wetlands to be impacted by the mining features. The wetland assessment sites that were shown on SDEIS Figure 4.2.3-2 are wetland assessment sites, using MnRAM, that were collected for the federal lands and are now shown on FEIS Figure 4.3.3-1. FEIS Section 4.3.3 includes a discussion on these findings.

A qualitative assessment of the potential impacts of climate change on wetlands is included in FEIS Section 5.2.7.2.4. The Greenhouse Gas and Climate Change Evaluation (Barr 2012l, as cited in the FEIS) addressed the 20 year project life plus the 60 year post-closure period.

The direct, indirect, and cumulative assessments that were performed for the NorthMet Project Proposed Action were agreed upon during the Wetland Impact Assessment Planning Group and per the Wetland Analysis Work Plan (PolyMet 2011b, as cited in the FEIS).

Theme WET 08

Theme Statement

The discussion of indirect wetlands impacts in the PolyMet SDEIS is inadequate and potentially misleading. The methodology and criteria used for assessing indirect impacts should be properly described. In particular,

- the proposed analog method of assessing potential indirect impacts from mine site pit dewatering is not adequate and is unverified and based on anecdotal and limited observations, and as such should not be the sole means of indirect impact assessment for the SDEIS (e.g. GLIFWC provided an analysis, etc.);
- Tribal Cooperating Agency objections to use an analogue method include: 1) mine pit will be hundreds of feet deeper than any of the analogue mine pits; 2) mine pit walls will be crystalline and sedimentary bedrock versus the analogue mine pits in sedimentary bedrock only; 3) data collected from the site would be relatively inexpensive and should be used to inform impact assessment; and 4) relying on only a partial set of available analogue data as the source of information to estimate dewatering impacts is selective and not scientifically robust;
- GLIFWC's method of analogue assessment used all available drawdown data for the Mesabi Iron Range, and did not automatically exclude wetlands classified as ombrotrophic from being considered impacted by drawdown;
- a hydrological study, pump test, and/or laser test must be done;
- the FEIS should also not use the natural range of variation in stream levels to determine indirect wetland effects;

- explain how the 20% threshold was determined and should also recognize that the term fragmentation may define indirect impacts other than changes in watershed size;
- the indirect wetland effects need to be assessed for evaporation resulting from loss of vegetation cover, which should include ombrotrophic wetlands;
- explain why were the wetlands in the Northshore Mine and areas directly north of that mine excluded; and
- describe in more detail the criteria used to determine fragmentation losses.

Thematic Response

FEIS Section 5.2.3.3 has been revised to include more information on the monitoring and mitigation plan for the indirect wetland effects. The indirect effects analyses performed for the EIS were not performed to characterize impacts but were done to inform where monitoring should take place for those areas that were identified as having a potential for indirect wetland effects. As a result of these analyses performed to determine where monitoring should occur, quantification of wetland types and acres of potential indirect wetland effects were also generated. The Co-lead Agencies agree that multiple factors can affect whether a wetland would experience indirect effects due to a project. FEIS Section 5.2.3 provides these quantitative values of all potential indirect wetland effects. Potential indirect wetland effects from the NorthMet Project Proposed Action were assessed as a result from one of the following six factors: 1) wetland fragmentation; 2) change in wetland hydrology from changes in watershed area; 3) changes in wetland hydrology from groundwater drawdown resulting from open pit mine dewatering; 4) changes in wetland hydrology from groundwater drawdown resulting from operation of the Plant Site, including groundwater seepage containment; 5) changes in stream flow near the Mine Site and Plant Site and associated effects on wetlands abutting the streams; and 6) change in wetland water quality related to atmospheric deposition of dust and rail car spillage associated with Mine Site and Plant Site operations. The assessments provided wetland type and acreage for all six factors; however, only wetland acreages were provided for change in wetland water quality related to atmospheric deposition of dust and rail car spillage associated with Mine Site and Plant Site operations. The methodology and criteria used for assessing potential indirect wetland effects are described in FEIS Section 5.2.3.1.2.

The Co-lead Agencies believe that the analog method used in the SDEIS to assess potential indirect effects from mine dewatering is adequate. Further, the FEIS has been revised to address concerns raised by the Bands regarding the assertion that ombrotrophic bogs would not be impacted by mine dewatering. FEIS Section 5.2.3.2.2 applies a more conservative assumption of the potential indirect effects for all bog communities within the 0-1,000-ft analog zone. Specifically, ombrotrophic bogs were reclassified from the "no effect" category to the "low likelihood" category, the same status as that assigned to minerotrophic bogs. The complex mixes of bedrock, surficial deposits, and wetland soils at the Mine Site impede the ability to reasonably model (e.g., using MODFLOW) and accurately assess the potential effect of pit dewatering on wetlands. In light of this modeling limitation, wetlands were divided into zones based on distance from the open pit. The closer a wetland was to the pit during dewatering, the greater the water table drawdown would be and the greater potential there would be for hydrologic effects on overlying wetlands. These impact assessment methodologies are presented in FEIS Sections 5.2.2.3.2 and 5.2.3.1.2.

The Co-lead Agencies are not relying solely on the potential impact zones determined in the analog method for the FEIS but would be monitoring wetlands for potential indirect effects. In the event that the required wetland monitoring identifies additional indirect effects, permit conditions would likely include a plan for adaptive management practices to be implemented. Additional compensatory mitigation would be required if indirect wetland impacts are identified during monitoring and annual reporting.

Fragmentation and a change in watershed area (20 percent or greater) are two of the six factors, as noted above, being considered in the identification of potential indirect wetland effects that would be actively monitored due to the NorthMet Project Proposed Action, if the project were to be permitted. PolyMet proposes that if a wetland would potentially experience three or more of these factors, a monitoring well and a vegetation plot would be installed at that wetland for use in monitoring for indirect effects. A rating system (0-6) was developed for the wetlands based on the number of factors that may potentially affect it. Wetlands that were not determined to be potentially indirectly affected would be rated as zero, and wetlands that were determined to be potentially indirectly affected by all six factors would be rated as a 6; however, no wetlands were rated as a 6 (see Figures 5.2.3-24 through 5.2.3-29). Monitoring is proposed within all wetlands with a factor rating of 3 to 5 and also for a subset of those wetlands with factor ratings of 1 or 2 as described in FEIS Section 5.2.3.3 (see Figures 5.3.2-31 and 5.2.3-32).

The 20 percent change in watershed area is a metric used to assist in identifying wetlands to be monitored for indirect effects. It comes from a scientific paper (Richter et. al 2011) and its use in the EIS indirect effects wetland assessment is based on the assessment of potential water-related impacts (including to aquatics) in the EIS. With regard to daily flow alterations (i.e., in streams or rivers), the paper states that, "Alterations greater than 20% will likely result in moderate to major changes in natural structure and ecosystem functions,…"

Though the 20 percent metric discussed in this paper is applied to streams and rivers, the Co-lead Agencies believe that a 20 percent change is a reasonable metric to apply when identifying wetlands for monitoring, in particular with respect to potential ecological changes that may be triggered with a change in watershed contribution (water yield) of this magnitude or greater. As stated above, the 20 percent change in watershed is just one of six factors used to identify which wetlands would be proposed to be actively monitored for indirect effects.

FEIS Section 5.2.3.1.2 has been updated to provide more information on the methodology and criteria for determining potential indirect fragmented wetland effects. Fragmentation is another of the six factors described above. The wetland fragments that are not expected to maintain their functions, approximately 26.9 acres, have been identified in FEIS Section 5.2.3 and on Figure 5.2.3-1. PolyMet's proposed mitigation for the NorthMet Project Proposed Action would be providing upfront compensatory mitigation for the 26.9 acres of wetland fragmentation (see Tables 5.23-17, 5.2.3-18, 5.2.3-19). The monitoring and mitigation requirements for indirect effects, including fragmentation, would be determined during permitting. The wetland fragments that have not been accounted for in the upfront mitigation would be included in the wetland hydrology and vegetation monitoring plan that would be developed and implemented for the NorthMet Project Proposed Action. FEIS Section 5.2.3.3 includes a detailed discussion on the monitoring and mitigation plan for the indirect wetland effects. The proposed wetland impact, avoidance, minimization, mitigation and monitoring plan presented in the FEIS would be reviewed, modified as required, and approved during permitting; therefore, this information could change during permitting.

When an agency is evaluating reasonably foreseeable significant adverse effects on the human environment in an EIS and there is incomplete or unavailable information because the overall costs of obtaining it are exorbitant or the means to obtain it are not known, NEPA directs the agency to make it clear that such information is lacking, discuss the relevance of the lacking information, and discuss any information relevant to evaluation of the future impacts. In these cases, NEPA also directs the agency to evaluate these impacts based upon theoretical approaches or research methods generally accepted in the scientific community provided that the analysis of the impacts is supported by credible scientific evidence, is not based on pure conjecture, and is within the rule of reason.

The Co-lead Agencies believe this is the case for evaluating indirect wetland effects. The Co-lead Agencies have thoroughly considered throughout the development of the EIS and through the Wetland Impact Assessment Planning Work Group how to assess potential indirect wetland effects. As a result, strengths and weaknesses of the approach used, as well as other suggested approaches, have been carefully considered. The Co-lead Agencies ultimately decided the use of the analog method and the 20 percent metric described in FEIS Section 5.2.3 as factors considered in identifying potential indirect effects to wetlands is a credible and reasonable approach consistent with the requirements of NEPA.

Please refer to the response to theme WET 09 for more information on ombrotrophic wetlands and the evaluation that was done. A hydrological study, pump test, and/or laser test was not performed as the Co-lead Agencies utilized the analog approach for assessing potential groundwater drawdown.

Areas that would have a loss of vegetative cover were identified as directly impacted wetland resource areas. These de-vegetated areas would be located under infrastructure footprint such as stockpiles, haul roads, etc. The areas outside of the directly impacted areas would be monitored for changes in vegetation and hydrology as described in FEIS Section 5.2.3.3.

As stated in FEIS Section 5.2.3.1.2, wetland acreage by wetland type was calculated using GIS analysis with 500-ft radius increments beginning at the mine pits and continuing out to a total radius of 10,000 ft (for a total of 20 increments); and 500-ft radius increments beginning at the Plant Site and continuing out to the Embarrass River. The area of analysis for the indirect effects extended beyond the NorthMet Project area component boundaries and included Area 1 and Area 2, as identified in FEIS Section 4.2.3. Wetlands in the Northshore Mine and areas directly north of the Northshore Mine have been excluded from the evaluation as agreed upon during the Wetland IAP Group discussions and by the Co-lead Agencies. The wetlands located on the Northshore Mine site were excluded as they are associated with that active project, the Northshore (Peter Mitchell) pit would be the predominant influence to the adjacent wetlands, and it would be the responsibility of Northshore to determine wetland effects in that area. Furthermore, the fact that a portion of the Northshore Mine is located in a different watershed and there is a watershed divide was considered in that decision. The cumulative effects discussion included that portion of the Northshore Project that is located in the Partridge River Watershed.

Theme WET 09

Theme Statement

The identification of ombrotrophic and minerotrophic bogs should be reevaluated; limited data were collected, and these features may have been misclassified. The FEIS should also acknowledge (and if necessary, revise its analysis to reflect) that the memorandum used to identify bogs was not an assessment of the hydrologic conditions of wetlands in a dewatered state but rather an assessment of surface hydrology under normal conditions. The assessment should consider:

- appearance of fen indicator species (e.g. northern white cedar, bog birch, balsam fir, alder, and willow) in the coniferous bog type at the NorthMet site clearly indicates that these peatlands are minerotrophic fens and not ombrotrophic bogs;
- ombrotrophic bogs have the following features: 1) are mounded (i.e. raised) 2) contain no fen indicators 3) have surface waters with a pH less than 4.2 and Ca less than 2 mg/l.
- relying on a two-day site visit of the bog wetlands and on the data collected to support wetland delineation will not provide the detail needed to track changes in site-specific wetland plant communities and hydrology;
- use of the DNR Field Guide to the Native Plant Communities of Northeastern Minnesota which separates bogs from fens by the absence of fen indicator species;
- recommend some data on peat depths (which can be quickly compiled with a probe). The periodic re-sampling of these plots would provide the best and most cost-efficient indicator for major impacts of mining operations on the wetlands in the NorthMet site; and
- unless the bogs were in fact perched (which is probable but not supported by data included within this memorandum) they would still be connected to underlying groundwater flow systems and could be affected by drawdown.

Thematic Response

Summary

Eggers (2015, as cited in the FEIS) emphasized that it is imperative to understand that the distinction between the types of bog vegetative communities (ombrotrophic vs. somewhat minerotrophic) was used to estimate potential indirect effects for discussion purposes in the SDEIS and to recognize that those estimates would not be used to determine compensatory mitigation requirements should the NorthMet Project Proposed Action be authorized by the regulatory agencies.

An assumption made in the SDEIS was that ombrotrophic bogs would not be impacted by the proposed mine dewatering compared to affects to the somewhat minerotrophic bogs. However, public comments submitted on the SDEIS prompted a more conservative approach (i.e., projecting greater wetland impacts) for the FEIS. That approach assigns all bog communities the same likelihood of hydrology effects due to mine dewatering. The wetland analysis presented in FEIS Section 5.2.3.2.2, incorporates this more conservative assumption of the potential indirect effects to bogs and reassigned all bog communities within the 0-1,000 ft analog zone the "low likelihood" category of wetland hydrology effects (Eggers 2015). This resulted in moving the ombrotrophic bog community from the "no effect" to the more conservative "low likelihood" category. The 0-1,000 ft analog zone was described by Adams and Liljegren (ERM and MDNR 2011, as cited in the FEIS) wherein significant surficial groundwater drawdown was most likely to occur and is most likely to be measurable. As such, Eggers (2015, as cited in the FEIS) concluded that it would be reasonable to expect that groundwater drawdown would likely result in some level of hydrology effect experienced by all wetland types within this zone.

For the 1,000-2,000 ft. analog zone, Eggers (2015, as cited in the FEIS) noted that Adams and Liljegren (ERM and MDNR 2011, as cited in the FEIS) stated that drawdown of the surficial groundwater may occur but would likely be much less than the 0-1,000 ft zone and may not be discernible from natural variation. The FEIS includes both ombrotrophic bogs and somewhat minerotrophic bogs in the "no effect" category for this zone.

Thus, for purposes, the differentiation of ombrotrophic versus somewhat minerotrophic bog communities is no longer an important factor for estimating potential indirect effects due to mine dewatering.

If the NorthMet Project Proposed Action receives all of the necessary regulatory authorizations, any compensatory mitigation requirements to offset indirect wetland effects would be based on quantitative field data (e.g., hydrology and vegetation) collected during monitoring that would confirm or refute assumptions made regarding indirect effects.

<u>Presence of Any Minerotrophic Species Precludes Ombrotrophic Bog Status</u>

It is inaccurate to assert that the presence of one or more plant species not listed by Appendix D – List of Bog Species in the "Field Guide to the Native Plant Communities of Minnesota – The Laurentian Mixed Forest Province" (MDNR 2003b, as cited in the FEIS) precludes a determination that the community is an ombrotrophic bog (Eggers 2015). The Acid Peatland System (MDNR 2003b, as cited in the FEIS) explains that single individuals and single clones of minerotrophic species can occur within ombrotrophic bogs. More specifically, the description of the Northern Spruce Bog (i.e., APn80) community clearly states that, "minerotrophic species are absent or present only as single individuals or single clones…" (MDNR 2003b, as cited in the FEIS). Similarly, the Northern Open Bog (i.e., APn90) community definition states that, "Minerotrophic indicators are absent or extremely rare; vegetation is composed mostly of bog species." (MDNR 2003b, as cited in the FEIS).

<u>Fieldwork was Insufficient to Accurately Differentiate Ombrotrophic vs. Minerotrophic Bogs</u>

The Wetlands IAP Group site visit in September 2010 focused on field-checking the wetland plant community mapping and wetland delineation work. All plant species within each plant community were recorded as part of the field work. Eggers (2015, as cited in the FEIS) noted that some of the non-dominant species recorded were only single individuals or small patches with less than one percent areal cover. However, that level of detail was not recorded in the field since it was not necessary in order to properly apply the Eggers and Reed classification system. It was also noted that the field investigation frequently included the upland (i.e., mineral soil)/wetland (i.e., peatland) boundary in an effort to validate the accuracy of the wetland delineation (Eggers 2015, as cited in the FEIS). As a result, it is likely that minerotrophic species were included in the species observations when in actuality those species did not occur in substantive quantities within the broader wetland community but were only present within the narrow ecotone between the upland/wetland interfaces (relates to discussion in Item 2 above). Eggers (2015, as cited in the FEIS) noted that the work completed during the 2010 field investigations was not optimal for distinguishing between ombrotrophic vs. somewhat minerotrophic bog communities. Following the 2010 field investigations, discussions occurred concerning whether more expansive and intensive field work utilizing relieves, precise measurements of pH and mineral concentrations, and other factors should be accomplished; however, this effort was not implemented because of a determination that more detailed information would not result in a definitive answer regarding potential indirect effects to bog communities (Eggers 2015). Major uncertainties would remain including:

- Because ombrotrophic bogs are precipitation-driven systems, to what degree, if any, would these communities by impacted by groundwater drawdown due to the mine dewatering; and
- Are flowpath connections with groundwater present within some or all of the ombrotrophic bog communities within the project site?

Instead, Eggers (2015, as cited in the FEIS) proposed an alternative approach to apply more conservative assumptions of potential indirect effects to all bog communities as discussed above.

Technical Criteria to Differentiate Bog Community Types

Dr. Paul H. Glaser, an expert on peatlands who has conducted extensive research on the peatlands of northern Minnesota, provided detailed comments regarding criteria for ombrotrophic bogs which are also noted by MNDNR (2003b, as cited in the FEIS):

- The landform type is a raised bog that is always higher than the peatland margin;
- There is an absence of minerotrophic (i.e., fen) indicator species;
- The surface water chemistry has a pH of <4.2 and calcium concentrations of <2 mg/l; and
- The hydrology and source of minerals is entirely sourced from precipitation.

There was across-the-board agreement by the Co-lead Agencies, Wetlands IAP Group, and public comments on the SDEIS, that MNDNR (2003b, as cited in the FEIS) was the appropriate standard to differentiate ombrotrophic vs. somewhat minerotrophic bog communities.

Measure Peat Depths as part of Monitoring for Indirect Impacts

Bogs are well known to have a long-term imbalance between litter production and the decomposition of organic matter resultant from high water tables (Strakova et al. 2012) which results in the accumulation of peat material within peatlands. The depth of peat material as well as the composition of the vegetative communities of peat bogs can change over time resultant from indirect effects to the habitat from decreased hydrology resulting in a reduced thickness of peat as well as a change in the vegetative community (Laine et al. 1995, Weltzin et al. 2000, Robroek et al. 2007, Breeuwer et al. 2009, and Strakova et al. 2012). Numerous studies have demonstrated that the overall quantity (i.e., thickness), quality, and location of peat that is produced in bogs is affected only after experiencing a reduction in the water table depth (Laiho et al. 2003; Murphy et al. 2009; and Stakova et al. 2010, 2012).

As such, the dewatering of peatlands resulting in the subsequent oxidation of peat soils often leads to subsidence over an extended period of time and can be measured; however, changes in the elevation of the water table would become evident much more quickly than subsidence of the peat material. Therefore, hydrology data generated by the proposed monitoring plan utilizing shallow wells and water level data loggers would exhibit indicators of indirect effects to bogs at the earliest stage. Subsequently, the vegetation would begin to exhibit changes. Measureable subsidence of peat soils would be less responsive (i.e., slower to occur). Consequently, the suggestion that data on the depth of peat within the bogs be gathered is not an efficient methodology to determine the occurrence of indirect impacts. In summary, the proposed monitoring efforts offer sufficient early detection of potential indirect effects to bogs.

<u>Groundwater Flow Paths and Ombrotrophic Bogs</u>

Ombrotrophic bog communities can have flowpath connections with groundwater; therefore, those communities could potentially be sensitive to effects resultant from groundwater drawdown unless they support perched water table mounds (Eggers 2015, as cited in the FEIS). Although perched recharge mounds may exist within the NorthMet Project area, Eggers (2015, as cited in the FEIS) noted that in order to confirm this hypothesis, an extensive study utilizing piezometer nests installed to depths both above and below the confining layer to demonstrate the presence/absence of a perched water table mound would be required. The comments submitted combined with cited literature (e.g., Siegel and Glaser 1987) present sufficient evidence to support the conclusion that ombrotrophic bogs can have flowpath connections with groundwater (Eggers 2015, as cited in the FEIS).

The effort to determine if the NorthMet Project area ombrotrophic bogs are in fact perched or if they exhibit flowpaths to groundwater would be exorbitantly cost prohibitive and would not result in any sufficient information that would drastically alter the conclusions of whether ombrotrophic bogs would experience any potential indirect effects. FEIS Section 5.2.3.2.2 has been updated to make a more conservative assumption of the potential indirect effects for all bog communities within the 0-1,000 ft analog zone by reclassifying ombrotrophic bogs from the "no effect" category to "low likelihood" category for potential wetland hydrology effects.

Theme WET 10

Theme Statement

The FEIS should provide a more complete evaluation of indirect wetland impacts resulting from change in hydrology due to groundwater drawdown, and impacts to river baseflows and riparian wetlands. In particular, the FEIS should provide a single estimate or range of acres and wetland types that would be affected by groundwater drawdown and if needed provide the worst case analysis. The analysis is inaccurate, because:

- impact zones and distances are not well described and do not agree with the automatic exclusion of ombrotrophic wetlands from potential drawdown effects;
- the water table would be drawn down for an unknown distance around the mine resulting in significant impacts and higher than reported acreage impacts, as well as drawdown of Partridge River and its riparian wetlands, and would be expected to have a greater effect on smaller wetlands as opposed to larger ones;
- groundwater drawdown is likely to result in impacts on ombrotrophic bogs, and these impacts must be included in the SDEIS as the new head pressure could lead to impacts of water seeping out of the ombrotrophic wetlands where there is a hydrologic connection to the saturated layer;
- in the absence of adequate rationale for the assumption that groundwater flowing from the mine features would not enter [minerotrophic] wetlands, it must be assumed that

contamination would impact all wetlands that are hydrologically connected to groundwater in each flow path; and

- use of the Canisteo Pit as an analog must be adjusted to account for the difference in depth of the NorthMet pit, and this assessment must use relevant information from other mine pits.

The SDEIS should be revised to remove assertions that coniferous and open bogs would be unaffected by groundwater disturbances, as this is unsupported by scientific literature and field data and FEIS should use hydrologic data to characterize the wetlands and identify groundwater connections with the wetlands. In addition, hydraulic testing needs to be conducted at the Tailings Basin.

GLIFWC conducted an independent assessment using the same methods as the Co-lead Agencies, along with additional analog data from other mining-impacted sites, and the assessment found an estimated total of 5719.75 acres of wetlands would be potentially susceptible to severe indirect impacts from mine pit drawdown (Zone 1). The finding that the Partridge River would act as a natural barrier to the cone of depression suggests that the riparian zone of the Partridge River will not be affected by groundwater drawdown. GLIFWC independent analysis estimated drawdowns of 3 to 5 feet under the river, which would severely reduce baseflow in the channel, indirectly impact riparian wetlands downstream, and affect other surface water features.

Thematic Response

The indirect effects analyses performed for the EIS were not performed to characterize impacts but were done to inform where monitoring should take place for those areas that were identified as having a potential for indirect wetland effects. As a result of these analyses performed to determine where monitoring should occur, quantification of wetland types and acres of potential indirect wetland effects were also generated. The FEIS quantitatively assessed potential indirect wetland effects as a result from 1) changes in wetland hydrology from groundwater drawdown resulting from open pit mine dewatering; and 2) changes in wetland hydrology from groundwater drawdown resulting from operation of the Plant Site including groundwater seepage containment.

The wetland mitigation and monitoring plan would be reviewed and approved by the appropriate agencies during permitting. Monitoring is proposed within all wetlands containing a potential indirect wetland impact factor rating of 3 to 5 and a sampling of those wetlands with factor ratings of 1 or 2 as described in FEIS Section 5.2.3.3 (see Figures 5.3.2-31 and 5.2.3-32).

Please refer to the response to theme WET 08 for more information on the analog method and the response to theme WET 09 for more information on ombrotrophic bog wetlands.

Please refer to the responses to themes WR 10, WR 112, and WR 120 for more information on groundwater flow from the mine features. Please refer to the response to theme WR 86 for information on the how the Partridge River would act as a natural barrier to the cone of depression.

Theme WET 11

Theme Statement

The FEIS should more thoroughly examine, and should provide quantitative predictions for the potential for indirect wetland effects and their tributaries resulting from water quality changes due to fugitive dust and ore spillage along the Transportation and Utility Corridor. Examples should be provided from other sulfide mines where this has not proven to be a concern. The FEIS should provide an assessment of the potential for indirect wetland effects from water quality changes due to air deposition from dust, metals, and sulfur.

The FEIS should provide:

- rationale for using 100% of background level as a cutoff for impacts;
- an explanation of the impacts on water quality at this level of deposition;
- a discussion of why areas with less deposition will not be affected or contribute to impacts downstream;
- an assessment of impacts on water quality resulting from deposition greater than 100% of background levels; and
- information on the amount of sulfur or metals that will be deposited within the greater than 100% of background levels line;

The FEIS should also:

- Clarify whether indirect wetland effects from fugitive dust or air deposition would occur on Second Creek or Spring Mine Creek;
- Examine the potential impacts from fugitive dust on wetlands including evaluating how blasting activities might cause indirect wetlands impacts;
- Provide an analysis of the potential toxic effects of sulfur and heavy metals upon wetland vegetation from fugitive dust and precipitation;
- Reassess mitigation measures for fugitive sulfide dust;
- Reevaluate claims that the discharge of sulfates and metals will not impact wetlands and will not exceed water quality standards;
- Consider the impact of fugitive dust and plant emissions on mercury levels in the wetlands and address whether dust deposition will result in increased mercury methylation, and what will be done to control such affects, should they occur; and
- Evaluation of the transport of solutes during the spring snowmelt flush.

Thematic Response

The rail haul of ore is not unique, but it is not common either. In northern Minnesota, rail haulage used to be very common. LTVSMC hauled ore to their crusher at the NorthMet Plant Site during their operation. U.S. Steel’s Minntac mine historically hauled their ore by rail for many years before changing to all truck haulage. Northshore hauls crushed ore by rail to Silver Bay. Canadian National Railroad hauls crushed limestone by rail to U.S. Steel’s Minntac facility in similar side dump cars that PolyMet would be utilizing. Northshore Mining hauls tailings in similar side dump cars as U.S. Steel’s Minntac facility. Carmeuse’s lime quarry in Michigan hauls limestone by rail to their plant. Quebec Cartier Mining (QCM) hauls iron ore from their mine to their plant. However, PolyMet would be refurbishing the ore cars to minimize gaps along the hinges and joint areas, which would reduce the potential for ore spillage from rail cars.

Dust, ore spillage, and stockpile leakage is not a regulated discharge to wetlands under the Section 404 of the CWA; however, USACE would consider these types of potential effects in their determination of the LEDPA under the Section 404(b)(1) permit alternative analysis. The potential effects of dust, ore spillage, and stockpile leakage would be evaluated by MPCA under the Section 401 Water Quality Certification and NPDES permitting.

The analysis for potential indirect wetland effects resulting from water quality changes was a qualitative assessment of the types of effects that may affect each wetland. Wetlands that could be potentially affected through multiple pathways were identified as having a higher likelihood of indirect effects. The proposed wetland monitoring program has been designed with specific attention to these higher likelihood wetlands that are more likely to be affected. Quantitative analysis of these impacts has not been performed as agreed upon during the Wetland IAP Group and per the Wetland Analysis Work Plan (PolyMet 2011b, as cited in the FEIS).

As discussed in FEIS Section 5.2.3.2.2, subsection Water Quality Changes„ the deposition of dust, sulfate, and metals was modeled and compared to National Atmospheric Deposition Program or literature-based background deposition values. The screening analysis for depositional effects conducted to estimate potential annual deposition of dust, metals, and sulfur to wetlands within and adjacent to the Mine Site was performed using AERMOD. The estimated deposition from fugitive dust emissions was used to identify wetlands that have the potential for water quality changes. The estimated deposition from fugitive dust emissions was used to identify a threshold for a negative effect on vegetation. The maximum area for potential indirect effects based on the modeling was identified to occur relatively close to the respective operating boundary of the Mine Site and Plant Site. The deposition modeling results for dust, metals, and sulfur would likely not have an adverse effect on wetlands; however, the modeling only indicated those areas that had deposition rates greater than 100 percent of background deposition. This screening analysis was intended to identify wetlands for potential inclusion in the future wetland monitoring program for the NorthMet Project Proposed Action.

Given the conservatism in air dispersion modeling in general and modeling fugitive dust specifically, an incremental potential change in dust-related deposition of 100 percent of background was selected because its represents a sufficiently large enough incremental increase that monitoring would have a higher probability of detecting a change if actual deposition due to the NorthMet Project Proposed Action were to increase to the modeled level. The reasons that the modeling used in the SDEIS is conservative include:

- The method for estimating fugitive dust emissions from the Tailings Basin and the Mine Site that are in the coarse size fraction, 10 microns in aerodynamic diameter or larger (PM10 up to about PM30);
- Modeling fugitive dust emissions with AERMOD over-predicts potential air concentrations and deposition (potential over-prediction by a factor of 4; Cowherd 2012); and
- This initial assessment assumes sulfur and metals are 100 percent soluble, but sulfur and metals (including Hg) associated with fugitive dust are within the mineral matrix of the particles and are not water soluble or bioavailable upon deposition.

It should be noted that some physical/chemical process is needed to release the sulfur and metals from the mineral matrix. Chemical weathering is the most likely release mechanism for sulfate and metals inherent to the mineral matrix of the deposited dust particles but this was not incorporated into the results presented in the Wetlands Data Package. Chemical weathering is affected by temperature (Brady 1974) and is likely to be slower within a wetland where the near-surface water table creates a generally cool microclimate. It is also important to recognize that wetlands are known to retain metals and serve as a net sink for nutrients and metals (O'Sullivan et al. 1999; Asapo et al. 2012; Ness et al 2014). As discussed by Ness et al. (2014), sequestration of metals by wetlands occurs naturally and has been ongoing for centuries through many processes including plant uptake, adsorption (binding to soil or organic matter), and precipitation (formation of solid compounds) (Wright and Reddy 2012). Any metal released into solution from deposited dust particles has a high probability to be adsorbed to organic matter and sequestered within the wetland (Urban et al. 2011; Ness et al. 2014). Any sulfate contributed by fugitive dust has a high probability to be sequestered (Urban et al. 1989). The potential amounts of sulfate and metals that may be released from fugitive dust to wetlands are estimated to be small and within the variability of background concentrations. Because wetlands are a net sink for metals and sulfate, wetland areas that may receive NorthMet Project Proposed Action's fugitive dust deposition and the small amount of sulfate and metals that may be released from the fugitive dust are not expected to be affected or contribute significantly to downstream areas.

In a preliminary conservative assessment, when accounting for weathering of the dust particles, the potential additional sulfate that could be added to a wetland ranges from 0.07 to 0.13 milligrams per liter (mg/L) at the location of maximum modeled deposition at the Mine Site and from 0.19 to 0.26 mg/L at the location of maximum modeled deposition at the Plant Site (Barr 2014c, as cited in the FEIS). Background concentrations of sulfate in streams draining wetlands in northeast Minnesota range from about 1 to 8 mg/L (Berndt and Bavin 2009; Barr 2010c, as cited in the FEIS, Barr 2014c, as cited in the FEIS; Rolfhus et al. 2015). The estimated potential incremental increase in sulfate from the deposition of the NorthMet Project Proposed Action's fugitive dust emissions is within the variability of background concentrations and is not expected to have a measurable effect on water quality. When accounting for weathering of dust particles, the potential additional concentrations of metals that could be added to a wetland are expected to be small compared to background concentrations of metals in streams draining wetlands. If metal concentrations would be higher than expected, as noted by Wright and Reddy (2012), "...elevated concentrations of metals do not necessarily result in problem releases to water or excessive plant uptake." Since natural wetlands are known to retain metals (such as sulfide minerals, organic complexes, etc.) (Wright and Reddy 2012; Dean et al. 2013; Ness et al. 2014), it is unlikely that metals from fugitive dust would have a significant effect on water quality or any downstream environments.

The amount of sulfur and metals potentially deposited within the greater than 100 percent background levels line would depend on a number of factors including the actual amount of dust deposited during operations and the metals inherent to the mineral matrix. In general, this fugitive dust contains minor amounts of arsenic, cadmium, chromium, copper, lead, manganese, nickel, sulfur, selenium, vanadium, and zinc (PolyMet 2015b, as cited in the FEIS). But the fact that these metals are "deposited" within the mineral matrix of fugitive dust does not mean that they are "available." Availability depends on potential weathering of the fugitive dust and potential release of each parameter from the mineral matrix of the particle and this weathering is known to be relatively slow (PolyMet 2015q, as cited in the FEIS). Potential sulfate associated with the release of sulfur from fugitive dust is estimated to be small and well below background values. Metals that may be potentially released from fugitive dust have a high probability to be sequestered by organic matter. Overall, because the modeling of fugitive dust emissions is considered to provide a conservative overestimate of potential deposition it is unlikely that the sulfur and metals inherent to the mineral matrix of the fugitive dust particles would have any significant effect on nearby wetlands. Researchers have identified the overestimation of emissions from fugitive dust sources (Fitz et al. 2002) and the conservatism in the modeling of fugitive dust (Cowherd 2012) and deposition (Etyemezian et al). Because of the known conservatism (i.e., overestimation) in modeling fugitive dust emissions, the estimates of potential deposition are overestimates. As discussed in FEIS Sections 5.2.3.2.2 and 5.2.3.2.4, the localized area of potentially high deposition at the Mine Site is just south of the ore loading pocket and just east of the Category 2/3 Stockpile and for the Plant Site is adjacent to the Tailings Basin. These areas would be considered in any future monitoring to be conducted for the Project, if approved.

The FEIS indicates that there would be no potential indirect wetland effects from fugitive dust to Second Creek. In addition, there would be no indirect effect to Spring Mine Creek as the area is forested and dust would settle on the organic soil and be sequestered.

Dust emissions from blasting in the open pits were not included in the air quality modeling because the air dispersion models employed are not suitable for this type of potential emission source. PolyMet has developed a Fugitive Emission Control Plan for the NorthMet Project Proposed Action. Proper blast design and other procedures in the Fugitive Emission Control Plan would minimize dust generation and transport beyond the mine pits. PolyMet would be required to report exceptions from the Fugitive Emission Control Plan to MPCA. In addition, PolyMet would be required under the Permit to Mine to have a blast monitoring plan that would follow *Minnesota Rules* 6132, which outlines blast monitoring and auditing requirements. Also, drilling and blasting activities would be conducted in accordance with the Mine Safety and Health Administration (MSHA) Rules and Regulations. The blasting plan would require provisions to limit dispersion of dust, including monitoring of the weather and wind direction at the time of each blast. The monitoring results of the blast would be analyzed and any violations of the Permit to Mine would be immediately reported to the commissioner and the facility would implement immediate corrective action, or the facility would work with the commissioner and develop and implement contingency actions as required until the blast monitoring results are in compliance (*Minnesota Rules* 6132.3100).

Minnesota's acid deposition standard recognized that aquatic systems were more sensitive to sulfur inputs and that a wet sulfate deposition standard of 11 kilogram/hectare/year (kg/ha/yr) (3.6 kg/ha/yr wet sulfur) was considered protective of chemistry and biota (MPCA 1985). Others identified that a wet sulfate deposition standard of 15 kg/ha/yr (approximately 5 kg/ha/yr wet sulfur) would be protective of the aquatic systems (MPCA 1985). Sulfate dosing of wetlands in the Marcell Experimental Forest near Grand Rapids that was more than four times background (approximately 28 kg/ha/yr wet sulfate; approximately 9 kg/ha/yr as wet sulfur) did not identify any vegetation-related affects due to the additional sulfur (Jeremiason et al. 2006). At 100 percent of background, the "total" potential sulfur deposition (wet + dry) estimated for the NorthMet Project Proposed Action would be approximately 3.2 kg/ha/yr (background + NorthMet Project Proposed Action). Given that higher doses of sulfur are considered protective of aquatic chemistry and biota, and/or did not show any toxic effects to wetland vegetation, the potential particle-bound sulfur that may be contributed to wetlands by the NorthMet Project Proposed Action would not be expected to result in any adverse effects to vegetation.

The fugitive dust would not be reasonably expected to be toxic to the touch and would not be reasonably expected to be directly toxic to vegetation, as it is typically part of road construction materials and/or tailings. The wetland dust deposition analysis identified that metals are expected to be particle-bound, within the mineral matrix of the rock particle. Therefore, the mineral particle must undergo physical or chemical weathering to release the metals. This is typically a slow release over time, measured in years. Metals deposited or applied to mineral and wetland soils have been shown to be sequestered in the upper soil layers and not be available to vegetation. Because of the potential small amounts of metals from fugitive dust that may be available in surface soils for uptake by plants, and the sequestering of most of the metals in soil should they be weathered out of the dust over time, the potential for the metals to be toxic to vegetation is very low. Monitoring of the areas estimated to have metal deposition greater than 100 percent of background would occur as part of the wetland monitoring program which would assess if potential indirect effects occur as a result of the NorthMet Project Proposed Action.

The reevaluation indicates the estimated potential incremental increase in sulfate and metals from the deposition of the Project's fugitive dust emissions is expected to be within the variability of background concentrations and is not expected to have a measurable or significant effect on water quality.

The highest estimated deposition of mercury from the NorthMet Project Proposed Action stack emissions to a terrestrial watershed was 0.21 $\mu g/m^2/yr$ (air emissions scenario 1, 50 percent oxidized mercury; Heikkila Lake watershed; Barr 2013j, as cited in the FEIS). The potential release of mercury from fugitive dust particles (mercury that is inherent to the mineral matrix) is expected to be slow and is considered negligible compared to the potential input of mercury from the NorthMet Project Proposed Action's air emissions. Grigal et al. (2000) estimated mercury deposition (throughfall, stemflow, litterfall) to a small peatland in north-central Minnesota to be about 31 $\mu g/m^2/yr$. Grigal (2002) estimated average mercury deposition of 38 $\mu g/m^2/yr$ (throughfall, stemflow, litterfall) to temperate and boreal terrestrial systems. In comparison, background deposition for aquatic systems, primarily lakes, is estimated to be about 12.5 $\mu g/m^2/yr$ (MPCA 2007). The potential additional deposition of 0.21 $\mu g/m^2/yr$ to wetlands/peatlands from the Project is about 0.7 percent of estimated background for terrestrial systems. The potential small incremental addition of mercury to wetlands from the NorthMet Project Proposed Action is within the variability of background deposition estimates and is not expected to have any measurable effect on the mercury methylation process in wetlands in the NorthMet Project Proposed Action area. Sulfate addition to sensitive environments has been a concern for some time (MPCA 2006a, as cited in the FEIS). The NorthMet Project Proposed Action's potential deposition of sulfur to wetlands from fugitive dust and air emissions was evaluated in the Mercury Overview document (Barr 2014c, as cited in the FEIS). At the location of maximum modeled deposition, the potential incremental increase in sulfate surface water concentrations from fugitive dust, when accounting for weathering, ranges from 0.07 to 0.13 mg/L at the Mine Site and 0.19 to 0.26 mg/L at the Plant Site, respectively. Sulfate from potential deposition of sulfur from stack air emissions (S02, sulfuric acid mist (SAM), particulate S) is much smaller than that estimated for fugitive dust. The potential incremental increases in sulfate surface water concentrations from deposition of fugitive dust and stack emissions were summed: Mine Site sum = 0.13 mg/L (only dust deposition, no contribution from Plant Site air emissions); Plant Site sum = 0.03 + 0.005 + 0.04 + 0.26 = 0.34 mg/L. Background sulfate concentrations in streams draining wetlands range from about 1 to 7 mg/L. The potential incremental increase in sulfate concentration that may be related to deposition of fugitive dust to wetlands and stack emissions is within background variability. As identified by Barr (2010c, as cited in the FEIS), methylmercury concentrations in wetland streams having average sulfate concentrations of 17 mg/L and 152 mg/L were not statistically different from background wetland streams having average sulfate concentrations of 1.1 to 1.3 mg/L. Therefore, a potential incremental change of 0.2 to 0.3 mg/L sulfate in surface water is not expected to have any statistically measurable effect on the mercury methylation process in wetlands in the Project area.

Fugitive dust deposition during the snow-free months of approximately mid-April through October is related to the coarse size fraction (10 microns and larger). Once deposited, these particles are expected to settle and mix with the existing materials at the ground/water surface. Under most conditions in the Hoyt Lakes area in a forested/vegetated watershed, the snowmelt does not result in notable erosion of the upland/wetland system. Therefore, any particles deposited during the snow free months are expected to remain in place at the soil/water surface during the active snowmelt. Fugitive dust particles deposited during the winter season (approximately November through March) are expected to be retained within the snowpack (Conway 1996; Doherty et al. 2013). There may be periodic melting during the winter months that would redistribute some of these particles downward in the snowpack, but most of these insoluble mineral dust particles would be expected to remain in the snowpack (Conway et al. 1996; Doherty et al. 2013). Warming of the snowpack during early April occurs first, then ripening of the snowpack (decreasing snow depth and increase in the water content of the smaller snowpack), followed by output (release of water). In this stage of the melt, relatively insoluble fugitive dust particles (coarse size fraction) would be expected to remain in the snowpack, settling downward with the melting snow (Conway et al. 1996; Doherty et al. 2013) and eventually settling out on the soil or ice surface (if melting occurs on the surface of a lake or wetland). Conway et al. (1996) identified that particles larger than about 5 microns in size were not affected by melt waters and remained in the snowpack. In addition, the relatively flat slope of wetlands enhances downward movement of water and coarse size particles rather than lateral flow. As the water table rises in the wetland, water moves to the edge of the wetland/mineral soil interface (the lagg area) and then continues downgradient to form streamflow. Water moving across the wetland would carry dissolved constituents such as metals attached to dissolved organic carbon, but the larger particles (coarse size fraction) are not expected to be carried in the meltwater because they are insoluble (Conway et al. 1996; Doherty et al. 2013) and because the slow movement of water across the wetland to the lagg area does not have the capacity to carry these larger particles. The potential additional sulfate and metals released to wetlands from the NorthMet Project Proposed Action's estimated fugitive dust emissions are expected to be small and within the variability of background concentrations. Because of the slow movement of water within the relatively flat wetland that promotes the settling out of larger particles and the expected small amount of metals and sulfur that may be released from deposited particles because of the cold temperatures in the snowpack and the snowmelt water that limit chemical weathering, the NorthMet Project Proposed Action is not expected to have any significant effect on sulfur or metal concentrations during snowmelt.

Theme WET 12

Theme Statement

The FEIS should fully describe the basis that the project would not 1) result in indirect effects on wetlands abutting the rivers and creeks (e.g. Partridge River, Spring Mine Creek, Second Creek, etc.) near the mine and plant site and 2) that leakage and seepage from the proposed Project would not affect nearby wetland water quality and their tributaries or result in a lack of water flowing to the wetlands and tributaries. The FEIS should:

- Address the efficiency of the tailings basin seepage capture system as it is unlined and isn't designed to collect seepage from the east side. Seepage from the east side is likely to drain to Spring Mine Creek. There are no predictions regarding the possibility that tailings piped from the processing plant to the tailings basin could be spilled, what will happen if tailings embankments may fail, or that water standards would be exceeded;
- Provide adequate support for the assumption that seepage will not affect wetland water quality of Second Creek and its associated wetlands;
- Assume that some leakage would occur, and given the site-specific conditions for the proposed location of the HRF, the risk for highly contaminated seepage to exit the HRF and flow to wetlands in the Embarrass River Watershed;
- Address if, as a result of construction of the FTB containment system, there will be a lack of water to tributaries, it seems there would also be a lack of water flowing to adjacent wetlands. Although some wetlands will be monitored for hydrological and vegetation changes, it seems as if the extent of monitoring is not sufficient to ensure there are no secondary wetland impacts; and
- Clarify the conclusion, no indirect effects would occur on the Partridge River and four other creeks because augmented flows from the project would be within average flow (and stage) without the project, are based on potential added drying out of adjacent wetlands and rewetting since using averages can mask such events.

Thematic Response

Please refer to the responses to themes PD 08, PD 10, PD 12, PD 17, PD 18, WR 18, WR 54, WR 67, WR 69, WR 90, WR 102, WR 112, WR 117, WR 119, WR 120, WR 131, WR 132, WR 166, WR 185, and WR 202 for more information on potential indirect effects to wetlands abutting the rivers and creeks, leakage and seepage from the NorthMet Project Proposed Action, and stream flows.

Theme WET 13

Theme Statement

The Proposed Action would cause the release of carbon and methane stored in the peatland/bog wetlands that would be destroyed; the destruction of these systems would also reduce the regional capacity for future carbon sequestration and result in climate change concerns.

Thematic Response

As previously discussed in the response to theme WET 05, the NorthMet Project Proposed Action would not result in the release of methane (CH4) from the proposed loss of wetland habitats. Wetlands act as carbon sinks that sequester carbon dioxide (CO_2). As a result of carbon cycling through the wetland system, a portion of sequestered carbon is mineralized to gaseous end products resulting in the production of CH4, which is released to the atmosphere. As such, the assumption that the NorthMet Project Proposed Action would result in an increase of methane stored in the peat bogs is incorrect. The loss of wetland habitat at the NorthMet Project area would result in a one-time release of 12,535 metric tons per year of greenhouse gas emissions (i.e., CO_2-equivalents approximately stored carbon within those habitats (Barr 2012l, as cited in the FEIS). It is important to note that the loss of carbon sequestration capacity is fundamentally different from emission rates since it represents a loss of greenhouse gas absorptive capability (i.e., how effective the system is at absorbing carbon) and capacity (i.e., the amount of carbon able to be absorbed) as opposed to an actual contributing emission. However, Barr (2012l, as cited in the FEIS) also noted that the net effect of the loss of carbon sequestration capacity is essentially the same as emissions. The Barr report also noted that the projected calculated release of CO_2-equivalents is a one-time event; however, it should not be assumed that all aboveground forest carbon would necessarily be released over a short timescale and that net carbon cycle impacts are highly dependent on the end-use of the cleared vegetation. For example, timber harvested for boards manufactured into furniture or buildings which is typically maintained for an extended period of years or decades, would degrade and decompose (i.e., release their stored carbon) at a much slower pace than timber that is utilized for firewood or woodchips which would ultimately decompose at a much faster rate. Harvested timber is typically utilized for a multitude of purposes dependent on numerous variables including market value, stand quantity and quality, tree species, demand, among others. As such, predetermining the end-use of an entire stand of timber is unfeasible.

Additionally, the assumption that the NorthMet Project Proposed Action would result in the destruction of the carbon storage potential of the region is erroneous. That assumption discounts the contributions of the proposed compensatory wetland mitigation. The NorthMet Project Proposed Action would result in the loss of approximately 913.8 acres of directly impacted wetlands whereas the NorthMet Project Proposed Action would result in 1,799.7 acres of wetland mitigation (an impact to mitigation ratio of approximately 2:1).

Theme WET 14

Theme Statement

The proposed Land Exchange would be a significant net loss of wetlands both quality and function and would not be in compliance with Executive Orders 11990 and 11988. The Land Exchange:

- should be based on wetland quality and type, and not merely on acreage;
- would not increase wetland acreage or mitigate in any way for the wetland losses at the Mine Site by transferring the non-federal lands to the Forest Service;
- would result in trading a far more contiguous and of higher overall quality wetland area for scattered areas across the non-federal parcels and of not equal or ecological value;

- would the USFS be compensated for loss of biodiversity that is not equally replaced;
- does not calculate indirect wetland loses in the land exchange;
- needs to address how the loss of acres of wetlands and loss of the one hundred mile swamp would be made up and acknowledge that it is a loss; and
- needs to address if new protected wetlands would be provided and/or would new wetlands be created on the exchanged lands.

Thematic Response

As described in FEIS Section 1.4.3, FLPMA requires that the values of the lands exchanged are equal or, if they are not equal, the values shall be equalized by the payment of money so long as the payment does not exceed 25 percent of the total value of the lands transferred out of federal ownership. (36 CFR 254.12). The USFS relies on professional appraisals to determine market value. Such appraisals must conform to Uniform Appraisal Standards for Federal Land Acquisitions and the Uniform Standards of Professional Appraisal Practice of the Appraisal Foundation. Refer to theme LAN02 for more information.

The Land Exchange Proposed Action and Land Exchange Alternative B must also comply with two EOs that are related to wetlands and floodplains. EO 11990 applies to land exchanges such that, as much as practicable, the exchange does not result in the loss of wetland resources. EO 11988 applies to land exchanges such that, as much as practicable, the exchange does not result in an increase in the flood damage potential.

As noted in FEIS Section 5.3.3.1, the potential net change that the Land Exchange Proposed Action and alternatives would have on wetland resources was evaluated using two types of criteria: 1) criteria assessing conformity to EOs 11990 and 11988, which requires a wetland acre-for-acre analysis and a floodplain acre-for-acre analysis of the federal estate, and 2) criteria used in an analysis of wetlands and floodplain habitat, as well as other water resource indicators. As stated in the FEIS, to satisfy the requirements of EOs 11990 and 11988, the USFS policy is to use the following three conditions (FSH 5409.13 § 33.43c): 1) the value of the wetlands or floodplains for properties received and conveyed is equal (balancing test) and the land exchange is in the public interest; 2) reservations or restrictions are retained on the unbalanced portion of the wetlands and floodplains on the federal lands when the land exchange is in the public interest but does not meet the balancing test; and 3) the federal property is removed from the exchange proposal when the conditions described in the preceding items 1 or 2 cannot be met. In addition to evaluating wetlands in accordance with the two EOs, analysis of the Land Exchange included information on wetland community types as well as ecological floodplains. The methodology and evaluation criteria utilized for the wetland resource evaluation for the Land Exchange is presented in FEIS Section 5.3.3.1.

The Land Exchange Proposed Action and the Land Exchange Alternative B meet the first condition (balancing test), which requires the value of the wetlands or floodplains is equal for properties received and conveyed. Therefore, as stated in FEIS Section 5.3.3, the Land Exchange Proposed Action and Land Exchange Alternative B would comply with EOs 11990 and 11988, as there would not be a loss of wetland and floodplain resources to the federal estate. All of the lands proposed for exchange are located within the 1854 Ceded Territory of northeastern Minnesota. The Land Exchange Proposed Action equalization requirements are discussed in theme LAN02 as well as in FEIS Section 1.4.3.

Furthermore, the lands to be exchanged are not required to be of a certain size, contiguous of each other, within the same watershed of the federal lands, within a reasonable distance to the federal lands to be exchanged, and/or within the 1854 Ceded Territory. However, a land exchange must conform to the standards and guidelines of the Forest Plan as well as be of equal value and meet the EOs 111990 and 11998. The Land Exchange Proposed Action and Land Exchange Alternative B would conform to the Forest Plan and would not result in a loss of wetland and floodplain resources to the federal estate. Four of the five tracts involved with the land exchange have existing wetland resources located on them as described in FEIS Sections 4.3.3 and 5.3.3.

The lands involved in the Land Exchange Proposed Action or Land Exchange Alternative B are not intended to be the wetland mitigation sites that are required as part of permitting (Section 404, Section 401, and WCA) of the mining activities; the wetlands mitigation sites for the wetland impacts of the mining activities are discussed in FEIS Section 5.2.3. Compensatory mitigation that is required as a result of the impacts from the mining activities is described in FEIS Section 5.2.3.3. FEIS Section 5.2.3 includes information on functions that would be impacted and replaced by the proposed mitigation required as a result of the mining activities.

Please refer to the LAN01 for more information on the factors that are evaluated for the public interest review by the USFS, and the equalization requirements are discussed in LAN02 as well as in FEIS Section 1.4.3. Furthermore, the FEIS discloses which non-federal tracts would be required for each Land Exchange alternative (FEIS Section 5.3). Appraisal reports completed in 2013 indicate that the Land Exchange Proposed Action would meet federal value requirements if all five non-federal land tracts (6,722.5 (GLO) acres) offered by PolyMet would be exchanged for 6,650.2 (GLO) acres of federal land. The appraisal reports indicate that Land Exchange Alternative B would meet the federal value requirements if non-federal Tract 1, Hay Lake (4,651.5 (GLO) acres), would be exchanged for a smaller federal parcel of 4,887.3 (GLO) acres. If the ROD approves the Land Exchange, a current appraisal, approved by the USFS, will be required to verify equal value.

The Weeks Act authorizes land exchanges so long as "public interests would be benefitted thereby." (16 USC 516) Lands acquired by the United States pursuant to the Weeks Act, whether by purchase or exchange, are subject to all provisions of the Act. (16 USC 516). Lands conveyed from federal ownership would no longer be under federal control and therefore would not be managed under the Forest Plan and/or influenced by the authority (the Weeks Act) under which the United States acquired them. This is consistent with other land exchanges that have occurred in the Superior National Forest. The NEPA analysis would inform the USFS decision on the public interest determination and the decision would be presented in the ROD. While the federal lands, if transferred to PolyMet, would still be located within the proclamation boundary of the Superior National Forest, they would be private lands and no longer managed by the Forest Service.

As presented in the FEIS, there would be little to no likelihood of potential indirect effects based on the analog approach to wetlands located on federal lands that would border the area, if the land exchange is approved. However, monitoring would be performed to determine if effects occur and any effects would be addressed per permit conditions, if approved. Please refer to the response to theme WET 01 for more information on mitigation and monitoring for potential indirect effects.

Theme WET 15

Theme Statement

The proposed Land Exchange would result in a net loss of wetlands and function values for the St. Louis River Watershed/Lake Superior Basin, and the mitigation (e.g. wetland mitigation sites, non-federal exchange lands) would be outside of the watershed.

Thematic Response

The NorthMet Project Proposed Action would result in a loss of wetland resource areas in the St. Louis River Watershed. However, one of the three mitigation sites is located within the same watershed as the NorthMet Project Proposed Action. Overall, the Land Exchange Proposed Action and Land Exchange Alternative B would result in an increase to the federal estate of wetland acreage, and thus would be in conformity with EO 11990 (see Tables 5.3.3-1). The non-federal lands proposed as part of the land exchange are not the mitigation sites that are proposed as compensatory mitigation for the mining activities impacts. The non-federal lands to be exchanged, if approved, are not required to be within the same watershed. These lands are all lands that are located within the proclamation boundary of the Superior National Forest and would consolidate land ownership management. Please refer to themes LAN 01, LAN 03, and LAN 06 for more information.

Theme WET 16

Theme Statement

The proposed Land Exchange does not meet the Superior National Forest Plan's goals and objectives for avoiding loss of wetlands, specifically:

It is possible to avoid wetland impacts since PolyMet's deed does not allow them to open-pit mine, and the Forest Service is not obligated to go forward with the land exchange as land exchanges are discretionary and voluntary real estate transactions between the Federal government and a non-Federal party.

The land exchange and the PolyMet open-pit mine would be inconsistent within Forest Plan, G-WS-13, p. 2-15 and G-WS-15, p. 2-15.

Thematic Response

The USFS manages the Superior National Forest in conformance with many laws, regulations, executive orders, and policies. In all cases, the Forest Plan is consistent with national law, policy, and direction (USFS 2004c, as cited in the EIS). As discussed in the FEIS, the USFS' position is that the mineral rights that were reserved do not include the right to surface mine as proposed by PolyMet. In order to resolve this conflict, a proposed land exchange has been presented as part of the NorthMet Mining Project. Please refer to the response to theme WET 14 for more information on the Weeks Act.

Please refer to the responses to themes LAN 02 and LAN 04 for more information on the public interest determination for the USFS and how the Land Exchange Proposed Action would comply with the Forest Plan and other USFS policies.

In addition, the Land Exchange Proposed Action and the Land Exchange Alternative B would be consistent with the goals of the Forest Plan for wetlands (G-WS-13 and G-WS-15; page 2-15). The Land Exchange Proposed Action and the Land Exchange Alternative B, the conveyance and acquisition of lands, would not result in wetland impacts; however, the mining activities of the NorthMet Project Proposed Action would result in wetland impacts that cannot be avoided but have been minimized and/or compensated for the loss through the Section 404, Section 401, and the WCA permitting processes. The Land Exchange Proposed Action and the Land Exchange Alternative B would not result in a net loss of wetland acres to the federal estate and/or result in reduced water quality within a wetland, or upstream or downstream of a wetland. The non-federal lands for the Land Exchange Proposed Action and the Land Exchange Alternative B would be incorporated within the adjacent federal ownership and managed in accordance with the Forest Plan direction for the particular management area. Lands conveyed from federal ownership would no longer be subject to federal control and would therefore not be managed under the Forest Plan. The No Action Alternative would continue to apply to the federal lands managed by the USFS. The NorthMet Project Proposed Action is subject to a number of regulatory permits, reviews, and approvals which would include determining if the proposed mining activities would result in a change to water quality. Please see FEIS Section 5.2.2 for detailed discussion on water resources and FEIS Section 5.2.3 for a discussion of wetland resources.

Theme WET 17

Theme Statement

The wetland boundaries on the lands proposed for exchange are approximate and not all wetlands have been delineated. Therefore it should not be assumed that there has been an appropriate examination of the wetland functions and values and that there would be an equal exchange. In addition, land exchange analysis should include:

- an assessment of the functions that would be lost to the Partridge and St. Louis River watersheds accompanied by an assessment of the degree to which the loss of those functions would be replaced by the proposed mitigation for the project; and
- an assessment and/or percentage of the non-Federal lands that contain coniferous bogs as was done for the Federal lands.

Thematic Response

As stated in FEIS Section 4.3.3.2.1, wetland boundaries and community types for the non-federal lands were identified from aerial photographic interpretation and field studies. The boundaries of wetlands were determined based on aerial photograph interpretation and NWI mapping, with some refining of wetland boundaries during field studies. Wetland boundaries were determined in the field based on hydrologic and vegetative characteristics and were more accurate where survey routes crossed or were near wetland boundaries. Approximate wetland boundaries and wetland types based on habitat mapping are shown on Figures 4.3.3-3 and 4.3.3-4. Surveys covered nearly all portions of the parcels, although not all wetlands were field surveyed (AECOM 2011b, as cited in the FEIS; AECOM 2011c, as cited in the FEIS).The analysis for the land exchange did not require wetland delineations to be performed as no impacts or activities would be occurring on these lands and these lands would be incorporated into Superior National

Forest and the USFS's responsibility for managing the lands. If any future activities were to occur on the lands, wetland delineation would then be required.

As stated in FEIS Section 5.3.3.1, the analysis of the wetland resources for the Land Exchange Proposed Action and Alternatives was guided by evaluation criteria that were developed by the USFS and other Co-lead Agencies, which included a comparison of wetland resource acreages, wetland resources types, wetland functions, floodplain acreages, and other water resources acreages. GIS data and field observations were used and then compared over an area of analysis that included the federal and non-federal lands.

The wetland assessment data that was collected for the non-federal lands was performed in the Cowardin et al. (1979) system and the federal lands were collected in Eggers and Reed (1997, as cited in the FEIS) classification system. Since the wetland data was characterized differently, the information is not directly comparable. Therefore, some wetland types were grouped on the non-federal lands and cannot be presented in the same format as the federal lands. The tables presented in 5.3.3 include footnotes explaining that the coniferous bogs on the non-federal lands were grouped with coniferous swamps during field data collection.

Please refer to the response to theme WET 14 for more information on the Land Exchange Proposed Action and Land Exchange Alternative B, including how the land exchange would meet equalization requirements and address EOs 11990 and 11988.

Theme WET 18

Theme Statement

The SDEIS contains inadequate analysis of the cumulative effects of wetland loss. The analysis should include additional projects (e.g. Northshore Mine, U.S. Steel Minntac mine expansion, U.S. Steel Keetac expansion, United Taconite Tailings Basin, Cliffs Erie's mine pit expansion, mining and/or road improvement projects), additional watersheds beyond the two that would be directly affected such as St. Louis River Watershed, indirect impacts, effects on wetland values, and should differentiate by wetland type and value. The cumulative analysis for wetlands:

- strictly compares wetland acreage between pre-settlement (which is based on imprecise estimates), current, and proposed conditions. Use accurate numbers for wetland acres lost in the area over the past few decades instead of using an unknown pre-settlement number as the baseline;
- should not include the East Pit wetland or the West Pit in its calculations as they would not meet water quality standards. Also referring to the West Pit as deep water habitat, habitat for what?; and
- disregarded the cumulative effects of evaporation drawdown from defoliated ground, accelerated defoliation from drying, dusting, the toxic effects of toxic dust or watering, increase runoff from dry defoliated ground, and draw down from the mine pit on vegetation.

Thematic Response

FEIS Section 6.2.1 describes the rationale for how the cumulative effects assessment areas (CEAAs) were identified for NorthMet Project Proposed Action as well as provides a list of projects and actions that were considered in the cumulative effects wetland analysis. The CEAAs for individual resource areas vary based on the potential for cumulative effects and not on a single overall assessment area. FEIS Section 6.2.3 explains the specific wetland resource CEAA used. The spatial area for the wetland analysis was determined to be the Partridge and Embarrass River watersheds for the DEIS and was determined during the Wetland IAP Working Group that the watershed spatial area would not change from the DEIS. The wetland cumulative effects methodology and assessment approach was developed based on the Wetland IAP Working Group and is presented in the Wetland Analysis Work Plan (PolyMet 2011b, as cited in the FEIS). FEIS Section 6.2.3.1 provides a description of the approach that was used for the wetland cumulative analysis. The direct, indirect, and cumulative assessments that were performed for the NorthMet Project Proposed Action were agreed upon by the Wetland Impact Assessment Planning Group and per the Wetland Analysis Work Plan (PolyMet 2011b, as cited in the FEIS). Furthermore, the east pit is no longer included in the cumulative analysis; however, the West Pit is considered as a deepwater resource (a mine pit water body) in the future. Deepwater resources were estimated for the analysis by using a combination of the MDNR Mesabi Mining Features (2008); interpretation of 2003, 2008, 2009, and 2010 FSA aerial photographs; and NWI datasets. Lake resources (lacustrine water body) acreages were estimated using the USGS National Hydrograph Dataset and the NWI datasets.

The majority of the Northshore Mine is located outside of the CEAA for wetlands; however, that portion of the NorthMet Project Proposed Action that is located within the Partridge River Watershed was included in the analysis. The following projects were not considered in the wetland resources cumulative analysis as they are outside the Partridge and Embarrass River watersheds: U.S. Steel Minntac mine expansion, U.S. Steel Keetac expansion, United Taconite Tailings Basin, and Cliffs Erie's mine pit expansion. Those projects that were considered reasonably foreseeable and within the Partridge and Embarrass River watersheds were considered in the wetland cumulative analysis. Please refer to response to theme CU 02 for more information.

It is difficult to predict potential indirect wetland effects within the CEAA, and difficult to know what the potential indirect wetland effects would be for the projects assessed other than the NorthMet Project Proposed Action. However, based on the amount of potential indirect wetland effects that could occur from the NorthMet Project Proposed Action, there could be 0.1 to 12.0 percent cumulatively lost, in addition to the direct wetland impacts assessed, within the Partridge and Embarrass River watersheds as a result of the NorthMet Project Proposed Action.

Please refer to the response to theme WET 08 for more information on evaporation.

Theme WET 19

Theme Statement

Wetlands that would be impacted by the Proposed Action, including the One Hundred Mile Swamp, have been named an Area of High Biodiversity Significance by the Minnesota Biological Survey, and the U.S. EPA has stated that it is likely an Aquatic Resource of National Importance due to its high biodiversity. In addition, the EIS does not accurately portray the ecological significance, drainage, watershed, or borders of the One Hundred Mile Swamp. Specific concerns include:

- The loss of ecological significant habitat that provides critical habitat to plants and animals;

- the mapping misrepresents the boundary implying that the drainage of the swamp is in one direction only and away from the boundary waters and the area should be reevaluated and mapped;
- delineated boundaries for the One Hundred Mile Swamp do exist and are available at http://www.nationalatlas.gov/streamer;
- 10.4 mile long depression straddling the Laurentian Divide that drains to both the Partridge River which is a tributary to the St. Louis River and Langley Creek which is a tributary to the Rainy Lake (BWCAW) Watershed and therefore the mine cannot possibly be isolated geographically from the BWCAW;
- estimate the proportion of mine waste that flows to the two watersheds by requiring lateral hydraulic conductivity testing in the One Hundred Mile Swamp; and
- disrupting such a large contiguous wetland such as the One Hundred Mile Swamp with its calcareous fens violates Minnesota Statutes 103G.223 of the Minnesota Wetlands Conservation Act, and Minnesota Statutes 84.0895 because of Minnesota's endangered species law.

Thematic Response

FEIS Sections 4.2.4 and 4.3.4 discuss and provide maps of MBS Sites (see Figures 4.2.4-1, 4.2.4-4, 4.3.4-1, and 4.3.4-2) to clarify location and extent of these communities. FEIS Sections 5.2.4 and 5.3.4 include information about the impacts to MBS sites and native plant communities. The WCA rules (including those parts applicable to mining projects under *Minnesota Rules* 8420.0930) include a special consideration for wetlands that are rare natural communities (*Minnesota Rules* 8420.0515, Subpart 3). FEIS Sections 3.2.2 and 5.2.4 describe mine reclamation activities that would be completed as part of the NorthMet Project Proposed Action, some of which may allow such MBS sites to re-establish. *Minnesota Rules* 6132.2700 require that a project site be reclaimed once mining has ceased. The goals of such reclamation are to "control erosion, to screen mining areas from non-compatible uses, and to provide for subsequent land uses such as wildlife habitat or timber production." The rules also include requirements about the characteristics and planting schedule for vegetation used in reclamation. The Permit to Mine would address special consideration of wetlands that include rare natural communities. Additional information on rare natural communities would be included in the wetland permit application as part of the Permit to Mine process for further refinement of site-specific conditions.

FEIS Section 5.2.3, Table 5.2.3-1, indicates that there would be a total of 758.2 acres of direct wetland impacts at the Mine Site. A portion of the approximate boundary for the One Hundred Mile Swamp would be located within the Mine Site boundary. PolyMet would ultimately need to satisfy both the federal and state mitigation requirements for providing compensatory mitigation for impacts to wetlands. The number of mitigation credits to be earned by replacement wetlands would be determined during permitting by the appropriate agencies reviewing the wetland mitigation plan.

The USEPA reviews and comments on Federal Environmental Impact Statements pursuant to their authorities and responsibilities under the National Environmental Policy Act, Section 309 of the Clean Air Act, and Section 404 of the Clean Water Act. The USEPA has additional authorities under Section 404 of the CWA. Under Section 404(c) of the CWA, the USEPA has the authority to prohibit, restrict, or deny the discharge of dredged or fill material at defined sites in waters of the United States (including wetlands) whenever it determines, after notice and opportunity for public hearing, that use of such sites for disposal would have an unacceptable adverse impact on one or more resources, including fisheries, wildlife, municipal water supplies, or recreational areas. The 404(q) Memorandum of Agreement between the USACE and USEPA provides a procedure considering both agencies' views on projects including procedures for elevating unresolved issues to regional and national levels. The 404(q) process is used by the USEPA when they wish to initiate consultation regarding concerns they may have about the impacts of a proposed project. Elevation of issues related to specific individual permit cases would be limited to those cases that involve aquatic resources of national importance. Procedures for elevation of such specific cases are provided in Part IV - Elevation of Individual Permit Decisions. In these cases the USEPA determines that issuance of the permit would result in unacceptable adverse effects to Aquatic Resources of National Importance. The USEPA raised this as an initial concern in their February 18, 2010 comment letter on the USACE public notice. The SDEIS has addressed many of the USEPA's concerns, and the lead agencies continue to work with the USEPA to address their comments on the SDEIS. The USACE may also consult with the USEPA on issues of interest to them while writing the ROD.

There are no calcareous fens located within the NorthMet Project Proposed Action as confirmed through wetland mapping and field work. WCA requirements would be addressed under the MDNR Permit to Mine.

A National Atlas shows a single wetland complex (referred to as One Hundred Mile Swamp) as straddling the major watershed divide separating the Superior Basin from the Rainy River Basin. This appears to indicate that this wetland complex creates a conduit for water originating from the Mine Site to reach the Dunka River, and ultimately, the BWCAW. This single wetland complex shown on the National Atlas is not a delineated wetland; it does not meet the definition in accordance with the Manual (USACE 1987). The One Hundred Mile Swamp has not been delineated. The FEIS shows the approximate boundary of this complex. Wetlands are delineated using many factors in addition to hydrology; the boundary, as shown on the National Atlas, of the One Hundred Mile Swamp as continuous across this boundary does not equate to a hydrologic connection. There are two hydrologic barriers between the Mine Site and the Rainy River Basin, including:

High ground north of the Partridge River creates a watershed divide separating the Superior and Rainy River Basins, and prevents surface water from passing between the two. This major watershed divide is included in the National Atlas, as well as USGS and MDNR data sets. This divide is accurately presented in the Figures 4.2.2-1 and 5.2.2-22.

Yelp Creek and the Partridge River encircle the north, east, and south sides of the Mine Site. These streams create a hydrologic "sink" for sources of water originating at the Mine Site. Surface runoff or groundwater seepage leaving the Mine Site would follow a gradient into Yelp Creek or the Partridge River, as opposed to continuing uphill towards the watershed divide (see FEIS Figure 5.2.2-4). Yelp Creek and the Partridge River extend further west (i.e., more fully encompassing the Mine Site) than is shown on the map in question.

Theme WET 20

Theme Statement

Alternatives for avoiding, minimizing, and/or mitigating impacts to wetlands were not considered. The FEIS should include a thorough sequencing plan that demonstrates adherence to the mitigation hierarchy of avoid, minimize, and mitigate impacts as required by state and federal law and evaluate meaningful alternatives for avoiding and minimizing wetland impacts such as underground mining which was taken out of consideration largely for economic justifications. Furthermore, alternatives for avoiding impacts to wetlands that are difficult to replace should be considered, given how difficult these features are to recreate.

Thematic Response

FEIS Section 5.2.3.3 discusses multiple measures that were assessed to avoid, minimize, and mitigate any potential impacts to regulated wetlands as a result of the proposed project. In addition, several project alternatives were considered including those alternative's potential impacts on wetland resources. As described in 3.2.3.1.2, alternatives to the NorthMet Project Proposed Action were identified in accordance with the requirements of NEPA, CEQ regulations, Forest Service NEPA regulations, and MEQB rules for MEPA.

Alternatives have been developed and evaluated in three stages during the Environmental Review Process; the scoping stage (2005), the DEIS stage (2009), and the SDEIS stage (2011). FEIS Section 3.2.3 includes a discussion of the process and alternatives that were considered for the NorthMet Project Proposed Action. The modifications that have occurred during the development of the EIS have resulted in avoidance and minimization of impacts to wetland resources. To date, these modifications have reduced the acreage of wetlands impacted from 1,257 to 913.8 acres, a 27 percent decrease. In addition to the NorthMet Project Proposed Action, a "No Action Alternative" is also being considered. PolyMet proposes to avoid and minimize wetland impacts through a number of measures that are incorporated into the NorthMet Project Proposed Action. Direct wetland impacts at the Mine Site have been reduced during the development of the NorthMet Project Proposed Action. FEIS Section 5.2.3.3.1 includes six considerations that were proposed in order to avoid unnecessary impacts to wetland resources and seven considerations that were proposed that would minimize impacts to wetland resources as part of the NorthMet Project Proposed Action.

FEIS Section 5.2.3.3 also describes, in depth, the mitigation strategies for the NorthMet Project Proposed Action including how sites were selected, mitigation ratios, and other factors. Please refer to the responses to themes WET 03, WET 05, and WET 06 for more information on siting and mitigation.

The screening of alternatives are described in FEIS Section 3.2.3.1.2 and were evaluated against the purpose and need for the proposed project, the technical feasibility of the alternative, the economic feasibility, the availability of necessary resources to implement the alternative, and the environmental or socioeconomic benefits of the alternative. Alternatives that did not meet the screening criteria were discarded from further consideration. Alternatives that were removed from further consideration are summarized in FEIS Table 3.2-17. Consideration of the Underground Mining Alternative was described in FEIS Section 3.2.3.4.1.

Theme WET 21

Theme Statement

To adequately evaluate wetland composition, structure and function, affected wetlands should be classified using a different classification system, such as the MN DNR Native Plant Community (NPC) or the one used by County Biological Survey. In addition, the FEIS should clearly state the criteria used for the baseline wetland evaluation. The FEIS should include:

- description of what is the Eggers and Reed classification System and whether or not other classification system(s) could have been used;
- did the 2010 re-evaluation of wetlands use a lower standard;
- describe in more detail the wetland assessment protocol and the assessment sites used, including the methods used at those locations, why these locations were chosen, and how will they be used (e.g., for monitoring future wetland conditions);
- peer reviewed indicators of ombrotrophic bogs in classifying wetland plant communities and what are ombrotrophic wetlands;
- different types of wetlands are not well defined; and
- who performed the SDEIS classification of wetlands.

Thematic Response

The classification system utilized to characterize wetlands for the NorthMet Project Proposed Action, Wetland Plants and Plant Communities of Minnesota and Wisconsin (Eggers and Reed 1997, as cited in the FEIS, now expanded and updated in Version 3.1 (Eggers and Reed 2014, as cited in the FEIS)), is the same system adopted by the USACE-St. Paul District and Minnesota Board of Water and Soil Resources to track wetland impacts and compensatory mitigation for their respective wetland regulatory programs. This classification system was designed to be rapidly utilized to classify wetland plant communities without extensive vegetative analyses. Eggers and Reed (1997, 2014, as cited in the FEIS) provides a dichotomous key with a progressive series of either/or descriptions of plant community characteristics whereby an investigator is able to quickly and sufficiently classify the plant community being evaluated. Each plant community is described – including composition, structure, hydrology and soils – along with descriptions, photographs and ink drawings of representative plant species. All wetland classification systems have some limitations; however, the Eggers and Reed (1997, 2014, as cited in the FEIS) methodology sufficiently characterizes and describes the 15 major wetland plant communities that occur in Minnesota. Utilization of a methodology the employs a more complex system of classification would be inefficient, time-consuming and not warranted for most regulatory applications. The purpose of classifying the wetland plant communities within the NorthMet Project area was to characterize wetlands as part of the evaluation of wetland functions, potential adverse impacts, compensatory mitigation requirements, alternative designs/locations for project features, etc. As such, utilization of the classifications described by Eggers and Reed (1997, 2014, as cited in the FEIS) are sufficient for the purposes of an EIS. Furthermore, the Co-lead Agencies agreed to use the Eggers and Reed Classification system for the NorthMet Project Proposed Action as well as have reviewed the accuracy of the wetland characterization, mapping, and surveys.

The 2010 re-evaluation completed by Barr (2011d, as cited in the FEIS) used the same classification standard, Eggers and Reed (1997, 2014, as cited in the FEIS) as did the previous evaluations. As described in FEIS Section 4.2.3, wetland characterization, mapping, and surveys for the NorthMet Project areas were conducted between 2004 and 2010 by PolyMet's contractors. Information for the evaluations conducted for the NorthMet Project Proposed Action utilized multiple data sources, as described in FEIS Section 4.2.3, including: USGS topographic and USFWS NWI maps, aerial photographs, soil survey data, and field investigations. Wetland types are described in FEIS Table 4.2.3-1.

An abbreviated MnRAM functional assessment, which was agreed upon by the USACE, was utilized to assess wetland functions for the Mine Site, Transportation and Utility Corridor, and Plant Site. Please refer to the responses to themes WET 03, WE T05, and WET 07 for more information on how the NorthMet Project Proposed Action considered wetland functions. Please refer to response to theme WET 01 for more information on monitoring.

As described in FEIS Section 4.2.3.1.2, wetlands that are primarily dependent on precipitation for their hydrology are classified as ombrotrophic. Although the hydrology of ombrotrophic wetlands is primarily driven by precipitation, they can have groundwater flowpaths. As such, they may be susceptible to effects from groundwater drawdown associated with mining operations; however, that susceptibility is estimated to be low (Eggers 2015, as cited in the FEIS). Please refer to the response to theme WET 09 for more information on ombrotrophic bogs. Also please refer to FEIS Table 4.2.3-1 for more information on wetland types.

Theme WET 22

Theme Statement

The monitoring plan is of insufficient detail and should include:

- additional reference wells for pre-project monitoring;
- biological monitoring, including annual vegetation surveys, done in conjunction with hydrologic monitoring locations, and hydrologic monitoring using continuous recorders (and collecting data at daily, weekly and monthly intervals) at all sampling sites, with all data collected made available to the Co-Lead Agencies and to the public;
- shallow monitoring wells or piezometers and deeper wells at the same locations to provide better evidence of the impacts of groundwater drawdown and might determine whether there is a layer separating the surface from the aquifers;
- weather stations at one or more sites to help distinguish true drawdown impacts from the effects of weather and climate;
- multi-parameter biological monitoring is also recommended, not just of plants with focus on edges of the wetlands and other locations that provide early indicators of hydrologic impacts;
- annual and growing season hydroperiods and hydropatterns are biologically important for determining wetland function and should be reported in consultation with agency staff;
- monitoring parameters at reference wetlands should be the same as impacted wetlands in terms of frequencies, type and locations. Reference locations should be free of all direct and

indirect effects from the NorthMet project or other disturbance, including existing or future mining projects, yet close enough in proximity, setting and type that weather and other regional factors are reasonably similar to that of the impacted wetlands;

- monitor all wetlands, including ombrotrophic bogs, for changes in hydrology and wetland plant diversity, assemblage and peat depth which should be done using a scientifically accepted and easily repeatable method such as relevé plots or randomized grid of sample points;
- vegetation plot observations every other growing season by a botanist with experience in identifying peatland plants with reporting to regulatory agency within four months of the observed change, to allow for timely mitigative actions;
- all wetland mitigation should occur within 1 growing season of the observed change;
- monitoring should continue for the life of the mine at all locations, even if indirect effects have been mitigated to ensure that the completed mitigation projects offset the eventual loss of wetland function and area; and
- all species within the plot need to be identified and assigned a semi-quantitative or quantitative measure of abundance and dispersion. In each plot, water samples should be collected from the peat surface (if there is standing water) or shallow pits. Recommended that pH measurements be made at the time of sampling or the end of each sampling day. The water samples should then be filtered and acidified for analysis of cations (but not anions). In addition to the metals and anions most likely to be contaminants from mining operations these measurements also need to include Ca.

Thematic Response

The USACE, MDNR, and MPCA have a suite of approaches for measuring effects for projects and are based on an established set of procedures resulting in a better understanding of project effects. Each project that is permitted by the agencies is tailored to the project and is site-specific. The mitigation and monitoring requirements would be determined during permitting.

The wetland mitigation and monitoring section, FEIS Section 5.2.3.3, has been revised to include additional details on the proposed monitoring and wetland adaptive plan. The wetland mitigation and monitoring would be reviewed and approved by the appropriate regulatory agencies responsible for authorizing the permit application during the permitting process. Monitoring is proposed within all wetlands containing a potential indirect wetland impact factor rating of 3 to 5 and a sampling of those wetlands with factor ratings of 1 or 2 as described in FEIS Section 5.2.3.3 (see Figures 5.3.2-31 and 5.2.3-32).

Many suggestions were provided regarding how best to quantify indirect impacts. While potential changes to wetland plant communities would be monitored, change in the vegetation community are typically slower to manifest and identify compared to changes in hydrology. The USACE believes that closely monitoring hydrology early and often during the NorthMet Project Proposed Action provides sufficient assurances of observing any indicators of anticipated changes to the wetland communities.

Theme WET 23

Theme Statement

The FEIS should acknowledge, and its impact assessment discussion should reflect the fact that the proposed Project would result in the largest permitted loss of wetlands in the history of the state of Minnesota.

Thematic Response

These comments generally stated that the FEIS should acknowledge the extent of loss of wetlands from the NorthMet Mining Proposed Action. The FEIS does describe the amount of wetlands that would be impacted by the NorthMet Project Proposed Action and how this impact would be mitigated through the USACE and State of Minnesota permitting process after issuance. The USACE's ROD would reference information in the FEIS and present any additional information required by the USACE to support its permit decision. The final evaluation and determination in the ROD would be made pursuant to the USACE's statutory authority and regulatory responsibilities under NEPA, the CWA, the 404(b)(1) Guidelines, the USACE's Public Interest Review, and other applicable laws and regulatory requirements. No changes were made to the FEIS as a result of these comments Furthermore, WCA requirements would be addressed under the MDNR Permit to Mine.

Theme WET 24

Theme Statement

General opposition to the Project due to impacts on wetlands

Thematic Response

These comments generally opposed the NorthMet Project Proposed Action on the grounds of its impact on wetlands. Because no specific information was provided, no changes were made to the FEIS.

Theme WET 25

Theme Statement

General support for the Project due minimization of impacts on wetlands and the reclamation and mitigation plans that would replace the wetlands lost due to mining.

Thematic Response

These comments generally supported the NorthMet Project Proposed Action because it would have minimal impact on wetlands. Because no specific information was provided, no changes were made to the FEIS.

A.5.22 Issue: Terrestrial Wildlife Species (WI)

Theme WI 01

Theme Statement

The FEIS should provide additional analysis of direct, indirect, and cumulative effects (including those from the changing climate) on ETSC, RFSS, SGCN, migratory species, and common wildlife species, and should incorporate the August 19, 2013, Minnesota ETSC species status list, along with any federal status changes. Sensitive species should be moved to suitable adjacent habitats, and alternative mitigation should be considered (e.g., accelerated revegetation of the Mine Site after closure). Local knowledge could be used to assess current wildlife habits (e.g., for nesting eagles). Species of concern include moose, Canada lynx, gray wolf, long-eared bat, migratory bird species, bald and golden eagles, black bear, belted kingfishers, hooded mergansers, common terns, common loons, black-backed woodpecker, boreal owl, spruce grouse, Northern goshawk, wood turtle, and the monarch butterfly.

Thematic Response

FEIS sections 4.2.5, 4.3.5, 5.2.5, and 5.3.5 (Wildlife) have been updated to include the new state endangered, threatened, and special concern (ETSC) status listings from August 19, 2013, as well as new federal status listing changes (northern long-eared bat and gray wolf). FEIS Section 5.2.4.2 provides a listing of MDNR-acceptable potential mitigation measures for impacts on habitat. These mitigation measures would be decided upon at the time of permitting. Mitigation measures for wildlife species would be considered during the Endangered Species Act Section 7 consultation process. MDNR generally does not consider relocation of sensitive species to be an acceptable mitigation measure because may have unanticipated effects on other organisms at the new site. Additional discussion has been added to the FEIS regarding wildlife species, especially those species whose status was changed (Canada lynx, northern long-eared bat, gray wolf, moose, little brown myotis, eastern pipistrelle, boreal owl, northern goshawk, Laurentian tiger beetle, Freija's grizzled skipper, taiga alpine, Nabokov's blue, and bald eagle).

Theme WI 02

Theme Statement

The NorthMet Proposed Project and Land Exchange would lead to a net loss and fragmentation of wildlife habitat, wetlands, and biodiversity sites. These effects will be exacerbated by climate change, especially for sensitive species. The Land Exchange guidelines should be reconsidered, and similar habitats should be restored on site and elsewhere. A thorough evaluation is essential, given the risks and potential effects to natural resources. An assessment of all habitats, including local and regional ecology, could be used as a basis for a more thorough recovery plan. Areas of concern include the MDNR Headwaters Site, the Sand Lake Peatlands Scientific and Natural Area, the USFS Big Lake candidate Research Natural Area, Superior National Forest, designated Important Bird Areas, Areas of High Biodiversity Significance, and wetlands as Critical Canada lynx habitat and important moose, fish, and invertebrate habitat.

Thematic Response

The FEIS wildlife sections include information about NorthMet Project Proposed Action impacts to wildlife habitat types and Minnesota Biological Survey (MBS) Sites of Biodiversity Significance. FEIS Sections 4.2.4 and 4.3.4 provide maps of the MBS Sites (Figures 4.2.4-1, 4.2.4-4, 4.3.4-1, 4.3.4-2). The WCA rules (including those parts applicable to mining projects under *Minnesota Rules* 8420.0930) include a special consideration for wetlands that are rare natural communities (*Minnesota Rules* 8420.0515, Subpart 3).

Minnesota Rules 6132.2700 require that a project site be reclaimed once mining has ceased. The goals of such reclamation are to "control erosion, to screen mining areas from non-compatible uses, and to provide for subsequent land uses such as wildlife habitat or timber production." The rules also include requirements about the characteristics and planting schedule for vegetation used in reclamation. The Permit to Mine would address special consideration of wetlands that include rare natural communities. Additional information on rare natural communities would be included in the wetland permit application as part of the Permit to Mine process for further refinement of site-specific conditions.

FEIS Sections 4.2.5.1.1 and 5.2.5.2.2 discuss the additive effect of climate change on moose. As described in the response to theme AIR 01, there is little information in the literature specifically on climate change in Northern Minnesota. Information related to weather trends in the midwestern United States (based on rainfall measurements, storm damage costs, and other information) is incorporated into FEIS Section 5.2.7.

Theme WI 03

Theme Statement

The FEIS should provide additional analysis of direct, indirect, and cumulative effects (including water, air, and noise pollution, and increased vulnerability due to climate change) on wildlife (e.g., moose and browsing habits, train collisions, additional energy expenditures) and wildlife travel corridors due to the Project and the Land Exchange. In particular, the FEIS should discuss mitigation measures for effects on corridors and species. A new wildlife corridor study should be undertaken, wildlife corridors should be designated and protected, and particular attention should be given to cumulative effects on Corridor 17. Contradictory language about the lynx's use of corridors such as roads should be revised. Species of concern include moose, Canada lynx, aquatic animals, small vertebrates, wood turtle, and invertebrates.

Thematic Response

The FEIS wildlife sections include an analysis of the wildlife corridors, including their use by various species. *Minnesota Rules* 6132.2700 require that a project site be reclaimed once mining has ceased. The goals of such reclamation are to "control erosion, to screen mining areas from non-compatible uses, and to provide for subsequent land uses such as wildlife habitat or timber production." The rules also include requirements about the characteristics and planting schedule for vegetation used in reclamation. Mitigation measures for wildlife species would be considered during the Endangered Species Act Section 7 consultation process.

Theme WI 04

Theme Statement

Pollution from dust or windborne or waterborne chemicals such as arsenic, mercury, manganese, thallium, copper, nickel, or sulfuric acid, and light pollution from the Project would impact wildlife species such as the common loon, mink, or birds that depend on fish or other aquatic organisms, near and downstream of the Project. The FEIS should model these effects, should more thoroughly identify opportunities for mitigation, and should include a plan to discourage wildlife (e.g., waterfowl) use of mine pit lakes and the Tailings Basin.

Thematic Response

FEIS Section 5.2.5.2.3 includes descriptions of impacts to wildlife, including light and chemical pollution. The wildlife analysis utilizes the modeling in the Water Resources (FEIS Section 5.2.2), Air Quality (FEIS Section 5.2.7), and Visual Resources (FEIS Section 5.2.11) sections to analyze the types of potential wildlife effects. As stated in FEIS Section 5.2.5.2.3, the West Pit and WWTF ponds would be fenced to deter wildlife species from using the water. It is unlikely for the West Pit to provide quality foraging habitat as there would be a lack of emergent or submerged vegetation along the pit limits. Any water discharged from the pits would be treated to meet water quality standards and would not likely affect wildlife species downstream of discharge. As discussed in FEIS Section 5.2.6, the NorthMet Project Proposed Action would meet all Class 2B (aquatic life) water quality standards with the possible exception of aluminum and lead in the Embarrass River. These findings are applicable to non-aquatic species that use the Embarrass River. The responses to themes AIR 04 and AIR 09 discuss the assessment of potentially reactive dust, and the Secondary National Ambient Air Quality Standards that would be protective of vegetation and wildlife. The response to theme MERC 02 provides more information about how mercury bioaccumulation was estimated.

Theme WI 05

Theme Statement

The FEIS should provide additional analysis regarding effects on wildlife (e.g., moose, Canada lynx, gray wolf, northern long-eared bat) displaced by the NorthMet Project due to noise/vibration or habitat disturbance. This analysis should include effects on population dynamics, carrying capacity, and the local ecosystem, and should include an evaluation of potential effects at the local and regional level.

Thematic Response

The FEIS wildlife sections include an analysis of wildlife displacement effects due to the NorthMet Project Proposed Action. FEIS Section 5.2.5.2.3 discusses the potential effects to species based on habitat preferences, and uses available scientific literature to analyze displacement effects on local and regional ecology due to noise or increased human activities. The wildlife analysis cross-references FEIS Section 5.2.8 (Noise). The response to theme N04 also discusses potential effects on wildlife. Although wildlife species are likely to be sensitive to changes in noise levels, there are no local, national, or international standards or limits that are applicable to the NorthMet Project Proposed Action. Information about each individual species' tolerance of noise and vibration may not be available.

Theme WI 06

Theme Statement

The FEIS should describe how Project-related hydrologic changes and flow level fluctuations would affect amphibians and other sensitive wildlife species. The FEIS should also provide more details on long-term beaver control.

Thematic Response

The FEIS wildlife sections include an analysis of hydrology changes and impacts to amphibians or other sensitive species. As cited in the Wetlands Data Package (PolyMet 2015b, as cited in the FEIS), the XP-SWMM model estimates that changes in the average annual flow of the Partridge and Embarrass rivers would be within naturally occurring annual variation; thus, there would be limited hydrologic changes. As a result, effects to amphibians and other sensitive wildlife species due to hydrologic changes would be limited. The Reclamation Plan (PolyMet 2015g, as cited in the FEIS) explains that when roads or railroads are abandoned, culverts would be removed to prevent damming and access impediments for aquatic life. These locations would also be graded and vegetated to provide a stable stream bank.

The Reclamation Plan (PolyMet 2015g, as cited in the FEIS) states that during reclamation monitoring and maintenance, areas that have been damaged by erosion, animal activity (e.g., beaver dams), or that have lost vegetation would be identified and repaired.

Theme WI 07

Theme Statement

The SDEIS does not consider effects on animal populations and wildlife corridors from accidents, system failures, and unforeseen or catastrophic events.

Thematic Response

The FEIS wildlife sections cross-reference FEIS Section 5.2.13 (Hazardous Materials), which discusses probabilities of accidents, spills, system failures, or unforeseen events. FEIS Section 5.2.13 also states that, given the project design and operational commitments, there would be no significant adverse effects expected from the proposed use or generation of hazardous wastes by the NorthMet Project Proposed Action. FEIS Section 5.2.14 (Geotechnical Stability) also discusses slope and dam design, stability, monitoring, and adaptive management of the Tailings Basin and or Hydrometallurgical Residue Facility to reduce the risk of failure. Effects to animal populations and wildlife corridors due to accidents or system failures are not anticipated.

Theme WI 08

Theme Statement

The cumulative effects analysis should be expanded to consider effects on wildlife associated with climate change, and should generally provide the kind of detailed analysis required by NEPA. Analysis should include all projects seeking hard rock mineral prospecting permits, as well as state or local transportation projects. Lake Superior and the St. Louis River should be reconsidered in the cumulative effects analysis.

Thematic Response

FEIS Section 6.2.5, along with the rest of Chapter 6, has been updated since the SDEIS to include additional cumulative projects. The spatial assessment area for each resource has been described along with the rationale for why it is considered adequate in scope.

As described in the response to theme AIR 01, there is little information in the literature specifically on climate change in Northern Minnesota. Information related to weather trends in the midwestern United States (based on rainfall measurements, storm damage costs, and other information) is incorporated into FEIS Section 5.2.7.

Theme WI 09

Theme Statement

The FEIS should provide additional analysis of effects on wildlife species used for subsistence and/or harvest (game and furbearer species), as well as those considered culturally important to the Bands (e.g., moose), especially within the 1854 Ceded Territory.

Thematic Response

The FEIS wildlife sections provide an analysis of wildlife species used for subsistence/harvest, as well as those culturally important to the Bands. FEIS Section 4.2.9.3.3 identifies species potentially harvested in the 1854 Ceded Territory, while FEIS Section 5.2.9.2.2 explains that a lack of data regarding use of such species in the NorthMet Project area likely indicates limited present day use in that area due to general inaccessibility. FEIS Section 5.2.5.2.5 discusses the types of potential effects to common and/or game species, which are similar to effects on ETSC species. The FEIS has been revised to include additional detail regarding moose, and this discussion has been moved to the state ETSC species discussion, due to its new state listing status. The response to theme CR 01 also discusses effects to resources important to the Bands.

Theme WI 10

Theme Statement

The FEIS should fully evaluate West Pit Backfill, Underground Mine, or other alternatives to evaluate whether their effects on wildlife and wildlife habitat (in particular Canada lynx) would be less than in the Proposed Action. The FEIS should also consider additional alternatives and mitigation techniques, such as the construction of wildlife tunnels, widening of culverts, and the use of fencing.

Thematic Response

The FEIS wildlife sections have been revised to incorporate changes to the Project Description since the SDEIS, as they relate to impacts on wildlife species or habitat. Mitigation measures would be considered during the Endangered Species Act Section 7 consultation process, and decisions on incidental take would be determined at its conclusion. The Underground Mine, West Pit Backfill, and other alternatives have been screened against several factors, including the Purpose and Need, technical and economic feasibility, availability, and environmental or socioeconomic benefit. FEIS Section 3.2.3.3 describes alternatives (including the West Pit

Backfill and Underground Mine) that have been considered but eliminated from detailed analysis in the EIS. The responses to themes ALT 01 and ALT 03 provide additional information about the Underground Mine and West Pit Backfill alternatives, respectively. FEIS Section 5.2.5.2.3 states that the West Pit and WWTF ponds would be fenced to deter wildlife species from using the water. The Reclamation Plan (PolyMet 2015g, as cited in the FEIS) explains that when roads or railroads would be abandoned, culverts would be removed to prevent damming and access impediments for aquatic life. These locations would also be graded and vegetated to provide a stable stream bank resembling natural conditions. FEIS Table 7.3.5-1 discusses the land exchange alternatives presented in the FEIS to compare effects to wildlife species.

Theme WI 11

Theme Statement

Conclusions in the FEIS should reference and be consistent with the Biological Assessment/Biological Opinion, the Endangered Species Act consultation, and Migratory Bird Treaty Act/Bald and Golden Eagle Protection Act compliance. In particular, the FEIS should ensure consistency when addressing the Canada lynx survey and habitat, mercury risks, and northern long-eared bat habitat.

Thematic Response

The FEIS wildlife sections discuss conclusions from the Biological Assessment/Biological Opinion and the Endangered Species Act consultation, including conclusions regarding Canada lynx surveys and habitat, mercury risks, and northern long-eared bat. The Biological Assessment has been revised to further clarify Canada lynx surveys, and states that no lynx sign was found on the federal lands or Projects areas, and that lynx sign was found 5 miles south and east of the Mine Site. The Biological Assessment states that the NorthMet Project Proposed Action is likely to adversely affect Canada lynx, and may affect but is not likely to adversely affect Canada lynx critical habitat. Should the northern long-eared bat be listed as threatened or endangered under the ESA, the NorthMet Project Proposed Action may affect but is not likely to adversely affect the northern long-eared bat. The USFWS determined that critical habitat for the northern long-eared bat is not determinable at this time.

Theme WI 12

Theme Statement

The FEIS should discuss how the Project conflicts with or conforms to wildlife-related Forest Plan objectives.

Thematic Response

FEIS Section 5.2.5 discusses Forest Plan objectives in light of unsuitable habitat percentage within Lynx Analysis Units (LAU). For example, FEIS Section 5.2.5.2.1 explains that the percentage of LAU 12 unsuitable for lynx would increase from 4.0 to 6.1 percent under the NorthMet Project Proposed Action. The Forest Plan guideline G-WL-3 states that unsuitable habitat not exceed 30 percent of the LAU.

Theme WI 13

Theme Statement

The risks to sensitive and biodiverse ecosystems—the BWCAW, Lake Superior, and Superior National Forest—and to wildlife and wildlife habitat are too great to proceed with the Project as proposed.

Thematic Response

This comment has been received and acknowledged by the Co-lead Agencies. Impacts to wildlife species and habitats are addressed in FEIS Sections 5.2.5 and 5.3.5.

A.5.23 Issue: Wilderness and Special Designation Areas (WILD)

Theme WILD 01

Theme Statement

The SDEIS fails to adequately analyze, and/or incorrectly characterizes effects on wilderness and special designation areas, including the Superior National Forest, the BWCAW, Voyageurs National Park, and Quetico Provincial Park. Further information is required to assure the public that wilderness will be preserved and protected.

Thematic Response

The FEIS analyzes and characterizes the impacts to wilderness and other special designation areas in FEIS Section 5.2.12. This section uses data presented in Section 4.2.12 for wilderness or special designation areas (including the Superior National Forest, BWCAW). Both Voyageurs National Park and Quetico Provincial Park are outside of the 25 mile analysis area for the NorthMet FEIS and therefore have not been analyzed as no impacts are expected to these areas.

Theme WILD 02

Theme Statement

The NorthMet Mining Project will have unacceptable impacts on the BWCAW , Voyageurs National Park, Superior National Forest, and Lake Superior. Northeast Minnesota should remain pristine and untouched by industrial pollution.

Thematic Response

The NorthMet Project Proposed Action will have no direct effects on wilderness and special designation areas. Please see FEIS Section 5.2.12 for further discussion of this.

Theme WILD 03

Theme Statement

As demonstrated by the SDEIS, the NorthMet Mining Project would not adversely affect the BWCAW and Superior National Forest.

Thematic Response

The impacts from the NorthMet Project Proposed Action on wilderness and other special designation areas are discussed in detail in FEIS Section 5.2.12.2.

A.5.24 Issue: Water Resources (WR)

Please note that, due to the complexity of the subject matter, Themes WR 025, WR 060, and WR 173 each have several subthemes.

Theme WR 001

Theme Statement

When sulfide ore is exposed to water and oxygen, sulfuric acid is produced. A decrease in rock particle size increases the surface area exposed to water and oxygen. As acid dissolves rock, heavy metals are released. Natrojarosite would dissolve and cause acidity.

Acid mine drainage would start sooner than expected, occur for too long and pH would be lower than expected. The Tailings Basin would become acidic. Ferrous mine tailings produce acid runoff. Sulfuric acid, mercury and other metals contaminate water and impact human and aquatic life, wildlife and ecosystems.

The SDEIS does not describe how the future pH of leachate from waste rock and mine pits is predicted, why not all sulfide sulfur has the same potential for release, that predictions of pH are highly uncertain though likely underestimated, and how low pH would be effectively mitigated.

Thematic Response

Solution pH is a dynamic chemical condition, and the GoldSim model did not attempt to predict the actual pH of leachate from the various NorthMet facilities. However, sulfide minerals oxidation in mine waste does cause pH to decrease, and this chemical shift causes an increase in oxidation rates, concentration caps, and associated solute concentrations in leachate. These effects from pH decreases are incorporated explicitly into the GoldSim model for both non-acid-generating and acid-generating waste.

The non-acid-generating materials are tailings and Category 1 waste rock (0.12% sulfide S or less). This classification is based on humidity cell tests operated on 38 samples of NorthMet Category 1 waste rock continuously for up to 8 years (duration 194 to 436 weeks, listed in Large Table 1 of the Waste Characterization Data Package) (PolyMet 2015q, as cited in the FEIS). None of these materials produced acidic leachate (see time plots of effluent pH in "Attachment 2 Trend Analysis for Rock Humidity Cells" to "Attachment A Water Quality Modeling for Waste Rock and Pit Walls" to the Waste Characterization Data Package, PolyMet 2015q as cited in the FEIS). The 0.12% sulfide S threshold for defining non-acid generating rock is supported by these multi-year humidity-cell tests, which indicate that: 1) Sulfide minerals oxidize in approximately proportional to the concentration of sulfide, so that the oxidation rate (and thus the acid-production rate) decrease over time as the sulfide sulfur is consumed (Waste Characterization Data Package, Feb 2015, Attachment C [2015 Update on Kinetic Test Data], Attachment A [Graphs]); and 2 [PolyMet 2015q, as cited in the FEIS]) Between approximately 100 and 200 weeks after starting the kinetic tests, the pH of the effluents reaches a minimum, and thereafter the pH becomes steady or increase slightly (Waste Characterization Data Package, Feb 2015, Attachment F Update on Tailings Humidity Cell Test Data [PolyMet 2015q, as cited in the FEIS]). Thus, the GoldSim model of the tailings incorporates an estimated range for pH, but not temporal trend. Based on the measured pH in multi-year weathering tests on tailings (and also results from tests on Category 1 waste rock, which is also <0.12 percent sulfide S), and incorporating a small correction for the possibility that carbon dioxide pressure may be higher in the tailings s than in the atmosphere, the PolyMet tailing effluent over the long-term (i.e., 50 to 100 years, and beyond) should range between pH of approximately 7.1 and 7.7, and the general trend should be fore pH to increase from the low end to the high end of this pH range with increasing time (Waste Characterization Data Package, Figure 8-18 Modeled Category 1 Waste Rock pH [PolyMet 2015q, as cited in the FEIS]).

In the net-acid-generating waste, the effect of pH is incorporated by accounting for the duration of exposure before onset of acidic conditions (mean values range from 0 for Virginia Formation to 6.8 years for Duluth Complex), and the increase in oxidation rates and concentration caps that occur with acid onset (Waste Characterization Data Package, Section 8.2.5 Acidity Factor [PolyMet 2015q, as cited in the FEIS]). Once acidic conditions begin, the model accounts for the rapid increase in oxidation rate and then associated decay as an increasing fraction of the original sulfide is consumed (Waste Characterization Data Package, Section 9.4 Acidification and Long-Term Decay in Constituent Release [PolyMet 2015q, as cited in the FEIS]). Concentration caps also increase as the rock pore water changes from neutral to acidic (Waste Characterization Data Package, Section 9.5 Concentration Caps [PolyMet 2015q, as cited in the FEIS]; concentration cap values are presented in Table 1-31 through 1-33, Water Modeling Work Plan – Mine Site.) Leachate from these acid-generating materials are managed so that leachate is captured, either on lined facilities (Category 2/3, Category 4, and ore) or in pits (wall rock of East Pit and West Pit, or backfill to the East Pit) and treated prior to discharge.

The FEIS contains additional detail on the issue of how future pH of leachate is predicted; see FEIS Section 5.2.2.2.3 for more information.

Theme WR 002

Theme Statement

Lack of acidic leachate and pollutants from submerged waste rock and mine pit walls is assumed rather than verified by empirical data and testing. Impacts of high levels of chlorides in the inundated East Pit, Central Pit, and West Pit are not accurately evaluated. Other sources of chloride need to be identified as well. Pits should be lined and bentonite should be considered.

Thematic Response

The rate of oxidation and associated release of acidity and metals from waste rock and wall rock after it is submerged under water is discussed in the NorthMet Project Waste Characterization Data Package (PolyMet 2015q, as cited in the FEIS). An analysis based on the rate of oxygen diffusion in water found that after the waste rock was submerged by a layer of oxygenated water, the rate of oxidation in the rock would decrease by a factor of 1,000 relative to the oxidation rate when it was exposed to atmospheric oxygen. The analysis was based on the following two references: 1) Day, S. NorthMet Project Geochemical Uncertainty Analysis for Proposed Action - DRAFT. [Memorandum to PolyMet and Barr]. October 10, 2008. and 2) Morin, KA. Rates of sulfide oxidation in submerged environments: Implications for subaqueous disposal. Proceedings of the 17th Annual Mine Reclamation Symposium. Port Hardy, British Columbia : Mining Association of British Columbia, May 4-7, 1993. pp. 235-247. Based on this analysis, which is consistent with general results of studies on subaqueous disposal of sulfide-bearing mine waste, the GoldSim model assumed that oxidation in submerged wall rock and waste rock was negligible. Waste rock in the East Pit backfill could undergo slow oxidation by oxygen dissolved in groundwater flows into the pit, and the solutes produced by this mechanism would be subject to capture and treatment of the pore water in the backfill.

Regarding chloride in inundated pits, the GoldSim model incorporates the release of chloride to the backfilled pits, with release rates based on measured chloride leached from waste rock in the weathering tests (i.e., humidity cells). The West Pit Lake, and backfilled East and Central pits, are included in the monitoring and management planning, so that water from these would be pumped out and treated to achieve water quality targets.

Theme WR 003

Theme Statement

The gaging data used to estimate Partridge River and Embarrass River baseflows are inappropriate. The SDEIS baseflow estimates are based on gaging stations located many miles downstream of the Mine Site and Plant Site and use data that were collected decades ago. Current and future estimated baseflows using this data are unreliable.

Thematic Response

Groundwater baseflows used in the SDEIS are best-estimate values and were retained in the FEIS. SDEIS groundwater baseflow values were based on 1) winter 1986-1987 and winter 1987-1988 USGS stream gaging in the Partridge River at SW-006--a time when there were no discharges from the Northshore Mine Peter Mitchell Pit and 2) 1942-1963 gaging data in the Embarrass River, which includes years prior to the LTVSMC Tailings Basin startup (1957). When expressed as a groundwater baseflow yield per unit area, the similar results for both watersheds (approximately 0.05 cfs per square mile) support the approach used. The yield-per-unit area is similar to other watersheds in northern Minnesota. Studies have shown that streamflow characteristics in this part of Minnesota have not changed systematically over the last 50 years.

The only other available gaging data are from a station installed in 2011 at SW-003 on the Partridge River. However, interpretation of groundwater baseflow at SW-003 is not reliable for use in the GoldSim modeling of groundwater baseflow due to the complicating effects of Peter Mitchell Pit pumped discharges, seepage from the Northshore West Pond, and complex storage and release mechanisms in the wetlands that receive these flows.

More broadly, groundwater baseflow discharge varies with time and is a reflection of longer-term weather and climatic conditions. The variability of groundwater baseflow discharge is demonstrated by the examination of estimated values for several years using different methods. Evaluation of these values affirms continued reliance on the 1986-1987 USGS data for the Mine Site in the FEIS.

To better understand the relationship of groundwater baseflow to the GoldSim model's water quality impact projections, a sensitivity analysis for the Mine Site was conducted to evaluate if predicted NorthMet Project Proposed Action impacts would be sensitive to groundwater baseflow values. The sensitivity analysis considered the relationship of various model inputs to groundwater baseflow including hydraulic conductivity, recharge, and surface runoff chemical concentrations. The results indicate that modeled groundwater and surface water concentrations are moderately sensitive to changes in groundwater baseflow. However, the NorthMet Project Proposed Action's ability to meet groundwater quality and surface water quality evaluation criteria is not sensitive to changes in groundwater baseflow.

Theme WR 004

Theme Statement

Recent and ongoing gaging data collected in the Partridge River was not used in the SDEIS and must be incorporated into the baseflow analyses.

Thematic Response

The MDNR gage data were evaluated in determining the groundwater baseflow estimates for the FEIS. While the low-flow analyses conducted for SW-003 are considered high-quality, it is uncertain if the results can provide reliable estimates of groundwater baseflow for use in GoldSim due to the complicating effects of 1) pumped discharges from the Northshore Mine Peter Mitchell Pit, 2) seepage from the Northshore West Pond, and 3) complex storage/release mechanisms in the wetlands that receive these flows. These confounding factors associated with use of the SW-003 gage data make using this information in GoldSim problematic. See the response to theme WR 003 for additional information on the groundwater baseflow determination.

Theme WR 005

Theme Statement

Mine Site baseflow does not accurately consider the effects of the Northshore Mine pit dewatering discharge. The use of a higher baseflow value would lead to higher recharge into groundwater, which would decrease solute transport times in groundwater. Higher recharge would also increase the expected groundwater inflow into the dewatered mine pits.

Thematic Response

In GoldSim, groundwater baseflow to the Partridge River and Northshore discharge to the Partridge River are two unrelated flow inputs, which are quantified separately in the model. One does not affect the other. Groundwater baseflow is a natural process (related to aquifer recharge) and Northshore discharge is human-controlled. In quantifying groundwater baseflow at the Mine Site, the complicating effects of Northshore discharge were removed from the analysis by using stream gaging data for a time period when Northshore was not discharging to the river. Northshore discharge is not part of groundwater baseflow as defined in the Mine Site GoldSim model and is therefore not relevant to determining aquifer hydraulic conductivity, areal recharge, or groundwater travel times.

The flow inputs from the Northshore Mine to the Partridge River include more than just pumped discharges at SD-009. Northshore Mine inputs to the river also include: 1) seepage from the

Western Pond (which has been observed but cannot be directly measured) and 2) wetland storage and release mechanisms of previously pumped discharges. It is unlikely that flow inputs from the Northshore Mine to the Partridge River go to zero when there is no pumped discharge at SD-009.

The FEIS improves upon the SDEIS modeling by relying on recomputed Northshore flowrates using updated chemical data for surface water, groundwater, and Northshore discharge water. The updated value is a constant 2.6 cfs at a sulfate concentration of 28 mg/L, which is considered to be a reasonable modeling approximation of a highly variable hydrologic regime.

As reported in the FEIS, PolyMet performed a sensitivity analysis of Partridge River groundwater baseflow to assess the sensitivity of model parameters and results to this input. The analysis involved increasing groundwater baseflows by a factor of four and recalibrating the MODFLOW groundwater model and GoldSim existing conditions model to incorporate this change. The factor of four increase did not reflect a reinterpretation of stream gaging data or the idea that actual groundwater baseflows could be that high. It was a hypothetical increase used to stress the models so that the sensitivity of model results could be assessed. As expected, with higher groundwater baseflows, the following model sensitivities were identified: 1) aquifer recharge was higher, and 2) surficial aquifer hydraulic conductivities were higher, pit inflows were higher, and groundwater chemical transport to the Partridge River was faster. An important result was that some chemical concentrations in the river were higher, but the increases were not sufficient to change conclusions regarding the NorthMet Project Proposed Action impacts (e.g., the predicted frequency of sulfate exceedances at SW005 remained within acceptable limits).

Theme WR 006

Theme Statement

The Mine Site GoldSim model incorrectly assumes constant discharge from the Northshore Mine to the Partridge River; however, the pumping rates and timing from the Northshore Mine are highly variable and may cease in the future.

Thematic Response

It is acknowledged that pumped discharges from the Northshore Mine are sporadic and vary in magnitude. The GoldSim model is not designed to simulate flow and concentrations in the Partridge River when Northshore is pumping the Peter Mitchell Pit. This discharge greatly affects the flow of the Partridge River. There are two sources of the Northshore Mine to the Partridge River that are more continuous and have less variable flow: Western Pond seepage and wetland storage and release (of previously pumped water). GoldSim consolidates these flows into a single integrated Partridge River input that has a constant flow rate and uniform chemical concentrations. This constant rate input adequately characterizes flow from the Northshore Mine. For the FEIS analysis, this flow was increased to 2.6 cfs and the concentration of sulfate was increased to 28 mg/L.

Theme WR 007

Theme Statement

With regard to bedrock at the Mine Site, there is inadequate or inaccurate characterization, insufficient field testing, and an inadequate number of monitoring wells. There has been no study that proves or disapproves that water pollution would migrate via natural permeability or existing fractures. Additional evaluation is needed.

Thematic Response

Bedrock testing at the Mine Site consisted of:

- Five single-borehole specific-capacity tests conducted in deep coreholes located within the southern portion of the proposed West Pit. These tests were conducted primarily in the Duluth Complex and are considered most representative of bedrock between the Mine Site and the Partridge River.

- Five single-borehole specific-capacity tests conducted in deep coreholes located near the northern boundaries of the proposed West Pit and East Pit. These tests were conducted primarily in the Duluth Complex, but relatively close to its contact with the Virginia Formation.

- Four multiple-well pumping tests conducted along or near the northern boundaries of the proposed mine pits. These tests were conducted in both the Duluth Complex and Virginia Formation.

The bedrock tests provided reliable transmissivities and hydraulic conductivities of the Duluth Complex and Virginia Formation for impact assessment. In addition, bedrock hydraulic conductivities were estimated from calibration of the Mine Site MODFLOW model. The testing and model calibration program provided adequate characterization of bedrock properties at the Mine Site.

It is recognized that measured hydraulic conductivities from single-borehole tests performed in coreholes can sometimes underestimate the true in situ hydraulic conductivity. In consideration of this possibility and the interpretation that upper bedrock may be more permeable than deeper bedrock, the P50 (mode) hydraulic conductivity of bedrock flowpaths in the Mine Site GoldSim model (3.0 x 10-3 meters/day) was 21+E13 times greater than the geometric mean of values from the five Duluth tests conducted in the southern portion of the proposed West Pit (1.4 x 10-4 meters/day).

Bedrock water sampling was conducted in the following wells:

- Three aquifer test pumping wells located along or near the northern boundaries of the proposed mine pits that were sampled during 2005 and 2006. These wells were completed in both the Duluth Complex and Virginia Formation.

- Five observation wells located near the aquifer test pumping wells that were sampled between 2006 and 2013. Two wells were completed in the Duluth Complex and three were completed in the Virginia Formation.

The number of bedrock sampling wells and sampling events at the Mine Site is sufficient for the FEIS. See FEIS Section 5.2.2.3.2 for further information.

Comments cite a November 24, 1976 MPCA memorandum titled, "Minnamax Exploration Project Tour" that pertains to the historical Minnamax/Amax exploration project located 1 to 2 miles east of the NorthMet Project area. The relevant text in this memo is as follows:

The depth of the [exploration] shaft, at the time of the inspection was approximately 520 feet. At the 147 foot level, a fracture zone was encountered. Approximately 14 gallons a minute of water was infiltrating into the shaft. The fracture was grouted and sealed. In the core drilling operation, the fracture was noted; however, it was not identified as a water bearing fracture. In the core drilling, another fracture zone was identified at the 900 foot level. It is possible that additional water would be encountered at 900 feet.

It is uncertain if the observations made during this shaft excavation can be realistically applied to bedrock at the NorthMet Project area. The historical Minnamax/Amax project was located miles away from the NorthMet project and it is uncertain if geologic units and structures penetrated by the shaft are similar to those in the location of the NorthMet project. Further, it is not stated in the memo if the 14 gpm inflow was a sustained flow or if it decreased over time as commonly occurs in fractured rocks. The comments do not indicate if the fracture zone identified by core drilling at 900 feet caused significant inflows when the shaft reached that depth. It would be speculative to characterize the NorthMet Project area using observations made in the referenced MPCA memorandum.

Comments also cite a September 8, 1976 MPCA memo titled, “Amax Exploration, Incorporated Salt Water Spill” that discusses saline water encountered in an air-driven downhole hammer borehole at the Minnamax/Amax site. The relevant text in this memorandum is as follows:

The [saline] discharge began after hitting a confined pocket of water at the 1391 foot level on July 13, 1976. Although large quantities of water, as much as 275 gallons a minute, were being discharge, the drilling operation was continued to July 15.

It is uncertain if observations described in the MPCA memorandum are relevant to the NorthMet Project area including bedrock types and hydrogeologic conditions. The maximum depths of proposed NorthMet pits (approximately 700 feet) would be far less than 1,391 foot depth at which saline water was encountered at the Minnamax/Amax site. It is also uncertain if the 275 gpm flow rate was short-term or maintained for an extended period of time. Note that inflows to the PolyMet mine pits would be treated by the WWTF during operations, reclamation, and closure, so if saline water were encountered, it would be treated and discharged at concentrations meeting applicable water quality standards. See FEIS Section 5.2.2.3.2 for a discussion of potential impacts from saline waters.

In response to fracture flow issues raised, the FEIS expands the SDEIS analysis by further evaluating the possibility of fractures and faults at the Mine Site and Plant Site to determine what (if any) changes would be made to model assumptions to more accurately predict potential environmental effects for purposes of environmental review. Note that PolyMet proposes to grout and seal any permeable, water-bearing fractures identified in the mine pit walls during excavation. These issues are further discussed in FEIS Sections 4.2.2.2.1 and 5.2.2.2.1.

Theme WR 008

Theme Statement

With regard to bedrock at the Plant Site, there is no site characterization, no monitoring wells, and no field testing. Hydraulic and water chemistry data from discrete intervals in shallow (<50 feet) bedrock at the Tailings Basin would be useful to test the inference of a no-flow bedrock boundary. Bedrock groundwater chemistry could be useful at the Plant Site because constituents resulting from past activities at the former LTVSMC Tailings Basin may serve as a tracer to better understand solute transport through the bedrock. Additional evaluation is needed.

Thematic Response

The comments in this theme correctly note that there are no bedrock monitoring wells between the Tailings Basin and the Embarrass River.

During winter 2013-2014, an investigation of bedrock was conducted along the north, northwest, and west perimeter of the Tailings Basin. The investigation included five coreholes advanced into upper bedrock and 10 packer tests conducted in these holes. The investigation provided rock core, Rock Quality Designation data, and hydraulic conductivity of discrete intervals within the upper bedrock. The results of this investigation are reported in the document titled, "Hydrogeology of Fractured Bedrock in the Vicinity of the NorthMet Project" (Barr 2014b, as cited in the FEIS). Based on this investigation and studies performed at other Iron Range mine sites such as, "Hydrogeology of Glacial Drift, Mesabi Iron Range, Northeastern Minnesota" (Winter 1973, as cited in the FEIS) it is considered that bedrock at the Plant Site is adequately characterized for the FEIS; see FEIS Section 4.2.2.3.1 for more information. The Co-lead Agencies acknowledge that this investigation evaluated the hydraulic characteristics of upper bedrock, but did not sample bedrock groundwater for water quality analysis. However, bedrock groundwater sampling conducted at the Mine Site and regional studies of bedrock water quality are considered by the Co-lead Agencies to be adequate for characterizing bedrock water chemistry at the Plant Site.

The above investigation provides good evidence that upper bedrock has hydraulic conductivity that is about two orders of magnitude lower than that of the overlying surficial deposits. Further, investigations at the Mine Site suggest that deeper bedrock has hydraulic conductivity that is substantially lower than upper bedrock. Given these characterizations, it is reasonable to not consider flow/transport in bedrock between the Tailings Basin and the Embarrass River. Mathematical incorporation of a no-flow boundary at the base of the surficial aquifer in both the MODFLOW and GoldSim models is consistent with idea that flow/transport at the Plant Site is dominated by the hydrology of the surficial aquifer and that flow/transport in bedrock is comparatively not significant.

Considering chemicals in bedrock to constitute groundwater tracers of bedrock flow\transport is not likely to be definitive because there has been substantial surface seepage from the Tailings Basin for decades. This seepage migrates through wetlands and monitoring shows that in some locations the seepage has interacted with groundwater. If tailings basin chemicals were identified in bedrock, it would be uncertain if the chemicals were transported through bedrock or were derived from overlying groundwater in the surficial aquifer.

A comment states that "substantial contamination" has been found in domestic bedrock water wells north of the Plant Site. Based on a desktop review conducted by the MPCA of the residential well and monitoring well results (which in part included the consideration of chemical tracers), it is not apparent that elevated concentrations in some of the residential wells are caused by the Tailings Basin, but more likely reflect natural or localized background concentrations.

Theme WR 009

Theme Statement

The assumed bedrock hydraulic conductivity at the Mine Site is too low. It is lower than values used at similar sites and with similar rock types, and values used in regional studies.

Thematic Response

Bedrock hydraulic conductivity data from NorthMet Mining Project site-specific field testing and information obtained from other similar mine sites were compiled Barr 2014, as cited in the FEIS. The results of this compilation, which was prepared to address comments on this issue, show that bedrock hydraulic conductivity for different bedrock units is variable and tends to be higher in the uppermost portions of bedrock. This new information supports the position that revised bedrock hydraulic conductivity probability distributions used in the FEIS are reasonable for impact analysis in the GoldSim model. In summary, the field-estimated conductivities are generally considered to be the lower-bound of hydraulic conductivity. The conductivity variable was adjusted in the FEIS Mine Site GoldSim model to recognize the potential higher hydraulic conductivities in the upper portion of the bedrock.

Theme WR 010

Theme Statement

Chemical migration in bedrock is not adequately addressed in the SDEIS. Chemical migration is treated as negligible at the Mine Site and is ignored at the Plant Site. The water quality models do not consider fracture transport, assume no hydraulic connection between bedrock and surficial deposits, and assume no connection to wetlands along flowpaths. The SDEIS does not consider flow through faults that could divert groundwater in uncertain directions, depth of pollution in bedrock, the presence of brackish water, or the area of the pollution plume within the groundwater flowpaths.

Thematic Response

Impact assessment modeling relies on site characterization data that indicate the bulk hydraulic conductivity of upper bedrock is two to three orders of magnitude lower than the hydraulic conductivity of the surficial aquifer. Thus, groundwater flow and transport at both the Mine Site and Plant Site are dominated by the hydraulics of the surficial aquifer. Bedrock plays a negligible role in transporting site-derived chemicals to the Partridge River and Embarrass River.

It is acknowledge that there could be some hydraulic connections between bedrock and the surficial aquifer where transport is expected to be negligible. Given these factors, the approach was to not consider this possible connection in the NorthMet Project Proposed Action water quality models, but to recommend extensive monitoring during operations and closure to assess if interactions occur and if they would raise concerns for permitting agencies. If monitoring data indicate trends toward permit non-compliance, adaptive mitigation measures would be implemented to prevent or eliminate what is expected to be a small transport-related bedrock impact relative to surficial flows. See FEIS Section 5.2.2.3.5 for more information on adaptive mitigation measures and Section 5.2.2.3.6 for more information on monitoring.

The FEIS further evaluated the possibility of fractures and faults at the Mine Site and Plant Site to determine what (if any) changes need to be made to model assumptions to accurately predict potential environmental effects for purposes of environmental review. Although no change was made to the Plant Site GoldSim model, the FEIS Mine Site GoldSim model was modified to include a flow/transport zone 15 meters thick from that present in the SDEIS. The results of the analysis are included in FEIS Section 5.2.2.3.2. The responses to themes WR 169 and WR 007 also contain additional information.

It is incorrect to interpret that the presence of fractures necessarily implies higher groundwater flow and chemical transport rates. Regardless of the nature of fracture flow, the chemical flux (chemical mass per unit time per unit cross-sectional area) from source areas to perennial streams is controlled by the bulk hydraulic conductivity of the rock mass (as quantified by Darcy's law). Site-specific and regional studies of the bedrock hydrology indicate that the bulk hydraulic conductivity of bedrock is low. It doesn't matter if the flow is primarily through the rock matrix or fractures; the chemical mass flux on bedrock is simply not great enough to cause impacts to the Partridge or Embarrass rivers, or to any other receiving surface water bodies. Regardless of the interpretation of fracture flow, potential impacts to surface water are dominated by groundwater flow in the surficial aquifer, and the negligible effects of bedrock transport can be easily shown by hand calculations.

There are no bedrock boreholes at the Mine Site that have identified saline water at depths down to the ultimate pit bottoms. It is therefore unlikely that pit inflows would exhibit saline groundwater. Even if this were to occur, the pit water would be treated to reduce TDS to acceptable levels prior to discharge to surface water.

Theme WR 011

Theme Statement

Groundwater modeling does not consider that upper bedrock is more fractured and tends to be more permeable than deeper bedrock--a characteristic that is known to occur at similar sites. The models do not reflect the results of several well tests conducted in the upper bedrock Virginia Formation that exhibited relatively high hydraulic conductivities. The SDEIS does not consider more recent and reliable geologic data.

Thematic Response

In the FEIS Mine Site GoldSim model, bedrock flowpaths have been reconfigured with a bulk hydraulic conductivity that is approximately one order of magnitude higher than what was used in the SDEIS. In addition, the flowpaths are remodeled to be 15 meters thick to account for new information indicating that upper bedrock tends to have higher hydraulic conductivity, and this zone tends to control the overall groundwater flow within the bedrock. Note that there are no groundwater flowpaths in the Plant Site GoldSim model.

The Mine Site MODFLOW model does consider the Virginia Formation as a separate hydrostratigraphic unit and assigns a higher hydraulic conductivity to this unit compared to the Duluth Complex. The presence of higher hydraulic conductivity Virginia Formation explains the higher pit inflows predicted for the East Pit, which is partially excavated into this bedrock unit. Note that Virginia Formation is not relevant to bedrock flowpaths in the Mine Site GoldSim model because the flowpaths only exist in Duluth Complex rock.

The responses to themes WR 007, WR 008, and WR 017 contain additional information.

Theme WR 012

Theme Statement

The SDEIS does not consider the presence of known faults and fracture zones in the NorthMet Project Proposed Action area or the fact that isostatic rebound can create shallow open fractures. There is no site characterization or field testing of fracture properties and no acknowledgement that faults can transport groundwater in uncertain directions. Geological survey maps and PolyMet's own reports for the Canada Stock Exchange reveal significant faults and fractures. The SDEIS consistently downplays the significance of fracture flow and transport in bedrock, while also documenting that Area of Concern #8 has a plume of pollution propagating through fractures.

Thematic Response

The SDEIS disclosed that bedrock is variably fractured. The effects of fracturing are incorporated into the bulk hydraulic conductivity values used to characterize bedrock for the water quality impact assessment modeling. This is common practice in large-scale evaluations of bedrock hydraulics and the Mine Site GoldSim model was updated for the FEIS to better represent the likelihood of an upper zone of more fractured bedrock than deeper in the formation. Background bedrock-related conductivity information was also updated for the FEIS.

Structural faults may exist between mine facilities and perennial streams that receive groundwater discharge. Because the landscape is covered with surficial deposits and there are few bedrock outcrops, the existence of faults can only be inferred. It is unknown if faults (if and where they exist) behave as conduits or barriers to groundwater flow. Given these uncertainties, it is unlikely that any reasonable field program would be able to identify the existence, location, and hydraulic characteristics of faults that may or may not be present at the site. The FEIS documents the need to require a robust monitoring program during operations and closure to provide direct or indirect evidence on the existence of hydrologically significant faults. If significant faults were identified (i.e., faults that could lead to violation of water quality standards), then adaptive measures would be employed to mitigate the fault-related effects. See FEIS Section 5.2.2.3.5 and theme WR 169 for additional information.

Site characterization data indicate that the bulk hydraulic conductivity of upper bedrock is two to three orders of magnitude lower than the hydraulic conductivity of the surficial aquifer. Thus, groundwater flow and transport at both the Mine Site and Plant Site are dominated by the hydraulics of the surficial aquifer. Bedrock plays a negligible role in transporting site-derived chemicals to the Partridge and Embarrass rivers.

Cross-section MODFLOW models of the Tailings Basin surface and groundwater seepage containment system indicate that very high capture (greater than 90%) would be achieved in both the surficial deposits and underlying upper fractured bedrock. If there were leakage from the Tailings Basin into bedrock, it would be collected by the containment systems and bypass (if any) would be sufficiently small to not cause impacts that exceed water quality criteria.

Finally, field-testing and MODFLOW modeling performed at the Mine Site indicate that geologic materials between the Biwabik Iron Formation and the pit excavations (combination of Duluth Complex and Virginia Formation) have sufficiently low hydraulic conductivity to limit pit inflows of water derived from the Biwabik Formation. Geologic maps and cross sections of the Mine Site show that the geologic unit below the Duluth Complex is the Virginia Formation, not the Biwabik Iron Formation. The linear distance between the Biwabik Iron Formation and the three proposed mine pit excavations is greater than 150 feet, which is a sufficient buffer zone to limit pit inflows.

It is incorrect to interpret that the presence of fractures necessarily implies higher groundwater flow and chemical transport rates. Regardless of the nature of fracture flow, the chemical flux (chemical mass per unit time per unit cross-sectional area) from source areas to perennial streams is controlled by the bulk hydraulic conductivity of the rock mass (as quantified by Darcy's law). Site-specific and regional studies of the bedrock hydrology indicate that the bulk hydraulic conductivity of bedrock is low. It does not matter if the flow is primarily through the rock matrix or fractures; the chemical mass flux in bedrock is simply not great enough to cause impacts to the Partridge or Embarrass rivers, or to any other receiving surface waterbodies. Regardless of the interpretation of fracture flow, potential impacts to surface water are dominated by groundwater flow in the surficial aquifer, and the negligible effects of bedrock transport can be easily shown by hand calculations.

Theme WR 013

Theme Statement

The SDEIS does not consider that ammonia and tritium are observed in two deep Mine Site wells. Their presence indicates young groundwater at depth, an observation that conflicts with the assumption that bedrock has very low hydraulic conductivity. Reverse osmosis pilot testing did not consider ammonia and tritium pollutants.

Thematic Response

Tritium and non-ionized ammonia can be indicators of relatively young water. However, when these constituents are identified in water extracted from a borehole, the overriding question is whether or not foreign (young) water was introduced during the drilling process. There are many documented cases where tritium in borehole water could be traced to makeup water introduced during the drilling process to help maintain circulation. Experience indicates that conclusions about the age of groundwater based on tritium and non-ionized ammonia are unreliable unless it can be absolutely verified that no foreign (makeup) water was introduced during the drilling process. Given the isolated occurrences, additional verification is not warranted for the FEIS. Based upon this rationale, RO pilot-testing of ammonia and tritium is not justified.

Theme WR 014

Theme Statement

The SDEIS does not make use of bedrock information from hundreds of Mine Site boreholes including fracture traces, fracture weathering, and the presence of fault breccia or gouge.

Thematic Response

The FEIS relies on the report, "Hydrogeology of Fractured Bedrock in the Vicinity of the NorthMet Project" (Barr 2014b, as cited in the FEIS), which was reviewed by the Co-lead Agencies. Its relevant points include:

- There are, "...over 14,000 RQD measurements for the Duluth Complex within PolyMet's data base" ("RQD" is a measure of breaks in a segment of rock drill core, where 100% indicates no breaks and 0% indicates that all pieces of core within a core run are less than 10 centimeters long); and

- In Duluth Complex rock, the "average RQD increases from 73% at the top of bedrock to 94% within 40 feet below the top of bedrock" (lower RQD indicates higher frequency of core breaks).

In particular, Figure 3-6 of the report "RQD with depth in the Duluth Complex" (2014) illustrates the borehole data on RQD in bedrock. The hydrology of bedrock in the Mine Site and Plant Site has been revised in response to the further evaluation of bedrock hydrology, and these are described in FEIS Section 5.2.2.2.1.

The RQD data provide strong evidence that the upper 10 to 15 meters of bedrock tend to be more fractured and have higher hydraulic conductivity than deeper bedrock. This new information has been incorporated into the FEIS Mine Site GoldSim model. In the FEIS GoldSim model, groundwater flowpaths are 15 meters thick (compared to 100 meters in the SDEIS) and have hydraulic conductivities that are about one order-of-magnitude higher than the SDEIS values.

Theme WR 015

Theme Statement

The SEIS does not make use of bedrock information from geotechnical boreholes in the Tailings Basin area.

Thematic Response

During winter 2013-2014, an investigation of bedrock was conducted along the northern, northwestern, and western perimeters of the Tailings Basin. The investigation included five coreholes advanced into upper bedrock and 10 packer tests conducted in these holes. The investigation provided rock core, RQD data, and hydraulic conductivity of discrete intervals within the upper bedrock. The results of this investigation are reported in FEIS Section 4.2.2.3.1. Based on this investigation and studies performed at other Iron Range mine sites, bedrock at the Plant Site is adequately characterized for the FEIS.

Theme WR 016

Theme Statement

The SDEIS does not consider that blasting can create fractures and increase bedrock hydraulic conductivity. It is also possible that acid mine drainage could cause fractures to widen and become more permeable.

Thematic Response

Case histories provide strong evidence that blasting effects in open pits tend to extend no more than several tens of feet from the pit walls. As stated in Scott 2009, "provided the operations are designed using the approaches recommended and implemented to a reasonable standard then there should be negligible impact on the permeability of the pit walls more than 15 meters from the blast." This zone is very narrow when compared to the scale of the pits and the overall mine site. It is acknowledged that within this narrow zone, there may be increased fracture hydraulic conductivity and greater fracture surface area for chemical reactions to occur. This "damaged rock zone" was considered by the Co-lead Agencies during the Impact Assessment Planning process. The FEIS reasonably considers the effects of a narrow blast zone adjacent to the pit walls for the inputs used in the Mine Site GoldSim model.

Theme WR 017

Theme Statement

The assumed capture efficiency of the water collection systems at the Category 1 Stockpile has not been verified by modeling or calculations. A range of capture efficiency inputs should be used in modeling. The Category 1 Stockpile should be lined.

Thematic Response

The proposed capture system for the Category 1 Stockpile is a unique design that uses a slurry wall keyed into bedrock and a pumped collection trench that maintains depressed groundwater levels on the inside (stockpile-side) of the system. It is acknowledged that there are capture systems at other mine sites that do not operate with a high degree of capture, but these are different designs and cannot be directly compared to the system proposed for the Category 1 Stockpile. Based on a MODFLOW groundwater model specifically developed to assess capture efficiency of the Category 1 system, it was concluded that the system would achieve an overall efficiency between 90% and 94% for groundwater flowing in surficial deposits and bedrock. This analysis supports the conclusion that the proposed Category 1 surface and groundwater seepage containment system has a high probability of meeting its performance specifications; thus, there was no need to consider a range of capture efficiency inputs in modeling.

Theme WR 018

Theme Statement

Assumed capture efficiencies described for the Tailings Basin are wrong. The assumed capture efficiency of the water collection systems at the Tailings Basin (90% for groundwater and 100% for surface water) has not been verified by modeling or calculations.

Thematic Response

The FEIS relies on revised cross-section models from the SDEIS to evaluate containment systems on the northern, northwestern, and western sides of the Tailings Basin, which are documented in the revised NorthMet Project Water Management Plan - Plant (PolyMet 2015i, as cited in the FEIS). These new models consider the presence of an upper more-permeable bedrock zone directly below the slurry wall, with hydraulic properties based on 2014 packer tests conducted in five boreholes along the proposed capture system alignment. Sensitivity analyses have included variable bedrock hydraulic conductivity and different upper bedrock zone thicknesses up to 100 feet. The model results predict that the overall groundwater capture efficiencies of the proposed Tailings Basin surface and groundwater seepage containment system would be substantially greater than 90%. This analysis supports the conclusion that the assumption of 90% or greater groundwater capture efficiency is justified.

The FEIS describes a 2014 field program that investigated bedrock along the alignment of the proposed capture system on the northern, northwestern, and western sides of the Tailings Basin in FEIS Section 5.2.2.2.3. This investigation provided field data on bedrock hydraulic conductivity, RQD, and depth to top of bedrock. This information was used to develop MODFLOW cross-section models at three locations on the alignment to assess capture efficiency. The models included bedrock below the slurry wall.

The proposed design for the seepage capture systems include a surface berm with drains into the collection trench. This portion of the system is designed and would be maintained to achieve 100% capture of surface runoff on the tailings side of the system, which includes surface seepage from the Tailings Basins.

Theme WR 019

Theme Statement

The assumed capture efficiencies are unrealistically high because the SDEIS failed to consider leakage from cracks in the slurry wall at the contact point between the wall and bedrock. Capture efficiencies also did not consider groundwater underflow through bedrock below the slurry wall via fractures. Subsurface obstructions would also disrupt conductivity and the uniformity of the slurry wall. It is infeasible to construct a 1-foot thick slurry wall. The SDEIS is contradictory and unclear if the slurry wall is keyed into bedrock or not. There is a lack of capture system design detail in the SDEIS.

Thematic Response

For the surface and groundwater seepage containment system at the Tailings Basin, commenters expressed a concern that there could be bypass in bedrock below the slurry wall. To address this issue in the FEIS, cross-section models were revised to evaluate containment systems on the northern, northwestern, and western sides of the Tailings Basin, which are documented in the revised Water Management Plan - Plant (PolyMet 2015i, as cited in the FEIS). These new models considered the presence of an upper more-permeable bedrock zone directly below the slurry wall, with hydraulic properties based on 2014 packer tests conducted in five boreholes along the proposed capture system alignment. Sensitivity analyses included variable bedrock hydraulic conductivity and different upper bedrock zone thicknesses up to 15 meters. The new models explicitly consider groundwater flow in bedrock below the slurry wall and at the contact between the slurry wall and bedrock. For all scenarios considered, the model results predicted that the overall capture efficiencies of the proposed Tailings Basin surface and groundwater seepage containment system (with bedrock flow) would be substantially greater than 90%.

The slurry wall would be keyed into bedrock and Figure 3.2-28 in the FEIS has been revised to show this that the slurry wall is keyed into bedrock.

The design basis for the containment system is not to create a groundwater dam that "holds back" groundwater flow, but to reverse the pre-existing hydraulic gradient (and flow direction) across the facility. This is equivalent to saying the groundwater heads on the basin side of the facility would be lower than the heads on the opposite side. Regardless of the hydraulic conductivities of surficial deposits and shallow underlying bedrock, the new flow direction would be toward the Tailings Basin rather than away from it (which is currently the case). The conceptual hydraulics of the proposed capture system are shown on Figures 5.2.2-7 and 5.2.2-57 in the FEIS. If there are flaws in the slurry wall or imperfections at the contact between the slurry wall and bedrock, the amount of reversed groundwater flow into the collection trench may increase, but the degree of system capture would not be affected. Hydraulic gradient (and flow direction) reversal would be verified by field monitoring using appropriately placed piezometers in both surficial deposits and shallow bedrock. If monitoring shows that gradient reversal has not been achieved at some specific locations along the capture system, a variety of mitigation measures can be employed to insure that the gradient is reversed.

Details of the containment system design are beyond the scope, but are presented in the Plant Site Water Management Plan (PolyMet 2015i, as cited in the FEIS).

Theme WR 020

Theme Statement

The capture efficiency assumed in the SDEIS is higher than what is known to occur with similar collection systems (e.g., SD-026, Minntac and the Dunka Pit).

Thematic Response

The proposed containment system uses pumping on the tailings side of the slurry wall to reverse hydraulic gradients (i.e., groundwater flow directions) across the slurry wall and in underlying bedrock. In the vicinity of the system, the groundwater flows would be inward (toward) the Tailings Basin and not away from it. Relatively few capture systems have been built with this degree of pumping to cause a reversal of the pre-existing hydraulic gradients. The conceptual hydraulics of this type of system provides evidence that it would achieve complete or nearly complete capture. In addition, supporting MODFLOW cross-section models developed for the FEIS and documented in the NorthMet Project Water Management Plan - Plant (PolyMet 2015i, as cited in the FEIS) predict that the system would achieve its performance specifications.

Theme WR 021

Theme Statement

The SDEIS includes no discussion of long-term monitoring to verify capture system performance. The SDEIS does not discuss system performance over time, or acknowledge that performance would likely degrade over time requiring periodic replacement of system components. Pumps within the containment system may also fail. PolyMet should commit to a particular magnitude of head differential upgradient and downgradient of the containment system and to a depth of bedrock penetration for the wall.

Thematic Response

PolyMet's general plan for short- and long-term water monitoring is discussed in the FEIS and documented further in the Water Management Plans (PolyMet 2015r; PolyMet 2015i; PolyMet 2015d, as cited in the FEIS). The specific details of a comprehensive water monitoring plan would be developed during the permitting phase of the NorthMet Project Proposed Action.

The groundwater containment systems are designed to create inward hydraulic gradients across a low-permeability barrier wall keyed into bedrock. The gradient control is created by a pumped groundwater collection trench drain installed on the inside (facility-side) of the system. As described in the Water Management Plan (PolyMet 2015i, as cited in the FEIS), at important locations along the containment system alignment, paired piezometers would be installed on opposite sides of the barrier wall to verify that groundwater levels were lower on the inside (facility-side) of the wall compared to the outside. If an inward gradient were not verified at a particular location, adaptive mitigation measures would be implemented to ensure that an inward gradient was re-established. These types of mitigation measures are described in the Water Management Plan and include, but are not limited to, increased pumping of the inside groundwater collection trench drain and installation of pumped boreholes.

It is acknowledged that certain components of containment systems, like pumps, would need to be replaced periodically when water level monitoring indicates that performance is marginal and not readily compensated for by adaptive mitigation measures. The Permit to Mine financial assurance package for the NorthMet Project Proposed Action would ensure that future funding would be available if and when adaptive mitigation measures or component replacements were needed to achieve the containment system performance specifications. PolyMet has not made a commitment to a head differential or depth of penetration of the wall. These details would be specified as part of the permitting process.

Theme WR 022

Theme Statement

The FEIS should include a sensitivity analysis using capture efficiencies with appropriate adjustments of related model inputs. The FEIS should also define the acceptable level of capture efficiency.

Thematic Response

The capture efficiencies used in the FEIS GoldSim models are conservative and/or realistic for the purpose of impact analysis. The FEIS reports or reference documents that justify the assumed capture efficiencies are based on issue-specific groundwater modeling or credible hydrogeologic interpretations. Because these are engineered systems that can be designed and constructed to achieve required performance specifications, conducting a sensitivity analysis does not yield information relevant to understanding potential impacts.

Theme WR 023

Theme Statement

The SDEIS does not make adequate use of studies, experience or history at other relevant mines. Specific studies and sites that should be considered in the FEIS include, but are not limited to: the Regional Copper-Nickel Study; Maest and Kuipers, 2005 Predicting Water Quality at Hardrock Mines; Sudbury Mine; Butte Mine; Eagle Mine; Flambeau Mine; Dunka Pit; INCO exploration site; former LTVSMC Mine, Northshore Mine, Minntac, and data collected under the Cliffs Erie Consent Decree.

History shows that operations like PolyMet's pollute and produce acid mine drainage. There are no exceptions. The FEIS should describe the effectiveness of mitigation of impacted water resources at other mining operations. The FEIS should provide objective reporting of information gained at other mine sites related to the use of bentonite amendments, seepage capture systems, and reverse osmosis treatment, as well as effects related to sulfide ore and Minnesota pit lakes.

Thematic Response

The Co-lead Agencies rely upon the expertise and experience of their staff who bring to bear their knowledge of various studies and analyses performed on mine sites in Minnesota and elsewhere. This knowledge is applied in the review of documents prepared to evaluate the NorthMet Project Proposed Action potential effects.

It should be noted that the NorthMet Project Proposed Action is different from other mining projects in this part of Minnesota in the following ways: different ore type, designs for groundwater capture systems, and use of long-term mechanical treatment. While experiences gained on other projects are informative, they do not necessarily apply to the NorthMet Project Proposed Action. This is particularly true for groundwater capture systems because the NorthMet Project Proposed Action uses a design that differs from those at other Iron Range mine sites. The FEIS reflects consideration of information pertaining to the Dunka Pit that was directly relevant to the NorthMet Project Proposed Action. It is noteworthy that many aspects of operations at the Dunka Pit are dissimilar to the NorthMet Project Proposed Action in terms of hydrogeology and mine design.

The mitigation designs of the NorthMet Project Proposed Action are unlike measures discussed in the Regional Copper-Nickel Study. The NorthMet Project Proposed Action measures include: long-term mechanical water treatment, uniquely designed surface and groundwater seepage containment systems, subaqueous disposal of reactive waste rock, and synthetic covers and under-liners used at waste rock stockpiles and treatment ponds. In addition, the level of construction QA/QC proposed at the NorthMet Project site would be much higher than what has historically occurred at older mine sites in the Iron Range. It is erroneous to conclude that operation and closure of the NorthMet Project Proposed Action site would necessarily entail the same types of failures that have occurred at some historical mines. In fact, the unique designs and high-quality construction measures proposed are a response to past events.

The detailed and sophisticated water modeling work performed to support the FEIS far exceeds that conducted for existing mines in Minnesota. The models used for the NorthMet Project Proposed Action represent years of development, with input from the Proposer, Co-lead Agencies, Cooperating Agencies, and the public. Based on comments received on the SDEIS, modifications were made to the models to improve FEIS impact evaluations. It is the Co-lead Agency position that incomplete or inaccurate predictions made in the past at historical mining operations do not provide a basis for judging the quality of modeling used in the FEIS.

Theme WR 024

Theme Statement

The Cumulative Effects Assessment Area for Water Resources should include the entire St. Louis River Basin and should specifically consider the following mining facilities: the Northshore Mine Peter Mitchell Pit, Laskin Energy Center, ArcelorMittal, United Taconite, and Minntac. The FEIS should list total and cumulative effects in Table 6.2-2 and should acknowledge that water quality standards are already exceeded in Colby Lake. The FEIS should specifically consider cumulative effects on the BWCAW. The analysis should evaluate the significance of flow reductions from other projects.

Thematic Response

The SDEIS and FEIS provide a rationale for not including the St. Louis River Basin in the cumulative effects analysis in Section 6.2.3.3.1. The SDEIS and FEIS considered in the CEAA for water resources all of the facilities identified in Table 6.2-1. Table 4.2.2-18 summarizes existing water quality data for Colby Lake. This table shows the number of samples that exceeded the surface water evaluation criteria, which are based on water quality standards. Evaluation criteria can be found in Section 5.2.2. The BWCAW is in a different watershed than the NorthMet Project Proposed Action. Water from the NorthMet Project Proposed Action would not enter BWCAW watersheds.

Partridge River flows are currently highly influenced by the timing, magnitude, and number of discharges from human activities. The timing of the discharges can be intermittent, continuous, or otherwise varied depending upon the source, or the discharge may have ceased permanently or temporarily. The magnitude of discharges also varies.

The P50 average annual modeled flows were assessed for the 200-year simulation in the Partridge River at SW-004a. The NorthMet Project Proposed Action and the Northshore Mine influences are estimated to decrease by no more than 4 percent and increase by no more than 2 percent. This equates to a range of about +0.50 to –0.25 cfs. Figure 6.2.2-2 shows P10, P50 and P90 flow rates to represent the range of potential effects to flows to capture the uncertainty in the hydrology described above. The decrease in flows occurs during operations. Downstream of SW-004a and upstream of Colby Lake contributions from Cliffs Erie Pits total approximately 11 cfs.

Colby Lake water elevations are regulated and managed and this ultimately dictates flows from Colby Lake into the lower Partridge River. Partridge River flows into Colby Lake during peak flow events are pumped to the Whitewater Reservoir, thereby mitigating potential increases in flows from this source to the lower Partridge River. There is a minimum regulated water level threshold of 1,439 amsl on Colby Lake as required under MDNR Water Appropriation Permit 1949-0135. As this threshold is approached, water is diverted out of Whitewater Reservoir through set of gates to Colby Lake to increase Colby Lake water elevations and with it flow to the lower Partridge River. Due to Colby Lake’s hydrologic relationship with the Whitewater Reservoir and regulated management, no impacts to Colby Lake hydrology are expected.

Water would be discharged from SD-026 south of the Tailings Basin into Second Creek that is tributary to the lower Partridge River. Flows from SD-026 would be augmented by the NorthMet Project Proposed Action to maintain flows that existed prior to the installation of the containment system. Due to this augmentation, discharges from SD-026 may deviate from +/- 0.1 cfs from the baseline. This impact would be added to Mesabi Nugget’s 4.0 cfs seasonal discharge increase and an unknown impact from proposed Mesabi Mining Project.

Additional information has been added to Section 6.2.2.3.1 of the FEIS that describes the net effect of various activities on the upper and lower Partridge River and Colby Lake.

Theme WR 025

Theme Statement

There is insufficient geochemical characterization of materials to allow reliable estimates of chemical loading from the NorthMet Project Proposed Action. Geochemical model inputs, the approach to modeling geochemistry, and what pollution would be released to the environment are unclear.

Thematic Response

The geochemical characterization of NorthMet rock is related primarily to its net acid-generating potential, as indicated by the concentration of sulfide S in the rock and tailings. Rock with <0.12% sulfide S is determined to be non-acid-generating. This classification is based on humidity cell tests operated on 38 samples of NorthMet Category 1 waste rock continuously for up to 8 years (duration 194 to 436 weeks, listed in Large Table 1 of PolyMet 2015q, as cited in the FEIS); none of these materials produced acidic leachate (see time plots of effluent pH in "Attachment 2 Trend Analysis for Rock Humidity Cells" to "Attachment A Water Quality Modeling for Waste Rock and Pit Walls" of PolyMet 2015q, as cited in the FEIS). The 0.12% sulfide S threshold for defining non-acid-generating rock is supported by acid/base balance calculations: Duluth Complex rock in humidity-cell tests produced enough silicate buffering to neutralize 2.8 milligrams SO4/kg-wk of acidity, which corresponds to the acid production from rock containing 0.12% sulfide S (see Day 2014).

The samples subjected to humidity cell tests were selected to be: 1) spatially dispersed across the deposit, so that they included samples from each of the lithologic units and thus capture the variability in neutralizing potential and metal concentrations in the host rock (see Large Table 2 of PolyMet 2015q, as cited in the FEIS), and 2) chemically dispersed over the range of sulfide S concentrations, so that the estimates of oxidation rate and associated release of acid and metals could be reliably bracketed by ranges for uncertainty (Table 4-1 of SRK 2007b, as cited in the FEIS).

The estimates of sulfide S in all of NorthMet waste and ore are based on interpolation of sulfide S analyzed in recovered drill core (~18,800 analyzed samples). An independent geostatistical evaluation found that the number and spatial distribution of these sulfide analyzes supported adequately the geologic block model developed to describe the ore and waste rock (Optitech 2012).

The sulfide S in tailings is controlled by the ore-processing method, and composition is constrained to be non-acid-generating (<0.12% sulfide S). Reaction rates and solute release from tailings are estimated from 21 humidity cells on NorthMet tailings and 4 on LTVSMC tailings (Large Table 5 of PolyMet 2015q, as cited in the FEIS).

Environmental mine-waste guidance does not provide firm sample requirements, but recommendations in the Global Acid Rock Drainage (GARD) Guide include: "1 to 2 samples of representative material of each material type"; "Provide adequate information to make cost-effective, sustainable, and environmentally protective decisions regarding the management and disposal of waste materials;" and "Sufficient to adequately represent the variability within each geological unit and waste type" (INAP 2010, Chapter 4). The Co-lead Agencies believe that the distribution and number existing kinetic-test samples (42 of Category 1, 26 of Category 2/3, and

21 of Category 4) meet these guidance criteria, and are adequate for the NorthMet Mining Project and Land Exchange FEIS.

FEIS Section 5.2.2 reports what constituents would be released to the environment.

Subtheme WR 025-1

Theme Statement

The SDEIS assumes, incorrectly, that the only source of chloride in bedrock is brine that is present in fractures. This ignores the presence of chloride compounds in the bedrock. Include in the model of solute release from waste rock a quantitative estimate for chloride that is present in the mined rock itself and that will be released by blasting and/or crushing.

Thematic Response

The release of chloride from waste rock and tailings is included in the GoldSim water quality models applied to the NorthMet Project Proposed Action. For waste rock, chloride loading produced by dissolution of soluble minerals was estimated by the concentrations measured in the first flush of solutes from humidity cell tests (Waste Characterization Data Package, Large Tables 7 through 11 [PolyMet 2015q, as cited in the FEIS]). For NorthMet tailings, the crushing and metal-extraction processing is assumed to remove the majority of soluble chloride. In the GoldSim model of solute transport in tailings, chloride release from the tailings is thus assumed to be zero after they are emplaced in the tailings basin (PolyMet 2015q, as cited in the FEIS, Large Table 6; Water Modeling Work Plan, Tables 1-13 and 1-14). Instead, chloride released by the tailings is incorporated as a component of the slurry water used in transporting the tailings, with model concentrations listed for the initial Tailings Basin pond waters, and expected seepage of pore water at the toes of the Tailings Basin (Barr 2012d, as cited in the FEIS, Tables 1-44 and 1-54, respectively).

Subtheme WR 025-2

Theme Statement

Determine the effect of chloride dissolved in waters of the mine pits to: 1) groundwater quality, 2) the water treatment systems (WWTF, WWTP, and passive) effectiveness, and 3) requirements for disposal of water-treatment sludge.

Thematic Response

The analysis of effects from the NorthMet Project Proposed Action include estimates for the release of chloride from waste rock and tailings, based on chloride released by flushing of exposed rock (Large Tables 7 through 11, PolyMet 2015q, as cited in the FEIS). Results of the GoldSim water quality model incorporates sources of chloride, including water bypassing tailings and Category 1 waste rock interception trenches, in the estimates of surface and groundwater quality at evaluation points downgradient from the proposed Mine Site (Figures J-01.10.2 and J-06-10.1, PolyMet 2015m, as cited in the FEIS). To support design of the water quality treatment systems, modeling includes estimates of solutes (including chloride) to the West Pit Lake and backfilled East Pit (i.e., major sources of saline water to the proposed water treatment plants). Pilot-testing of the WWTP RO system produced over 95% removal of chloride from test waters (Figure 15 of Barr 2013, as cited in the FEIS). The concentrated brine from the reverse osmosis treatment plants would be evaporated and disposed offsite as waste solids (Section 5.2.2.6, PolyMet 2015j, as cited in the FEIS).

Subtheme WR 025-3

Theme Statement

Conduct acid-base-accounting analyses on more samples of NorthMet waste rock--the current number of samples is fewer than recommended by environmental guidance documents such as the GARD Guide, and the environmental characterization of the waste rock is thus inaccurate.

Thematic Response

The Global Acid Rock Drainage (GARD) Guide (INAP 2010) is not specific on the number of samples required, but suggests enough to determine "the statistical degree of confidence that is required for the assessment." Acid/base accounting in NorthMet rock is estimated using only sulfide S concentration, and approximately 18,800 samples of rock from the NorthMet Project Proposed Action drill core database were analyzed for sulfide S to support development of the deposit block model (Section 8.1.2.3 of PolyMet 2015q, as cited in the FEIS). An independent statistical analysis of this sulfide S data set determined that the number and spatial distribution of samples was adequate to support the model of sulfide S distribution in the NorthMet deposit ore and waste rock (Optitech 2012).

Regarding actual acid production, the host rock for the NorthMet Deposit ("Duluth Complex") differs from most hard-rock mines in that it does not contain carbonate minerals that usually provide the majority of the acid neutralization. Instead, neutralization is provided by silicate minerals, which generally react more slowly to neutralize acids. Acid-generating potential was thus estimated from sulfide S concentration in rock, but actual net-acid release potential was determined by measuring directly the release of excess actual acidity in effluent from multi-year humidity cell test (i.e., 38 tests on Category 1 waste rock, 35 tests on Category 2/3 waste rock, and 22 of Category 4 waste rock; see Attachment A, Table 2 in PolyMet 2015q, as cited in the FEIS).

Subtheme WR 025-4

Theme Statement

Revise the water-quality modeling to address the possibility that virtually all NorthMet waste rock may be net acid generating when considered in terms of acid/base accounting analyses

Thematic Response

See response to WR025-3.

Subtheme WR 025-5

Theme Statement

Include in the groundwater solute transport model an analysis of arsenic (III) and arsenic (V) attenuation values

Thematic Response

The estimate for arsenic soil/water partition coefficient (i.e., "Kd," which is proportional to the retardation of arsenic transport in groundwater relative to water) used in the GoldSim model is 25 L/Kg (Table 1-16, Barr 2012c, as cited in the FEIS). This value was obtained from Table C4 in Appendix C of the USEPA's "Soil Screening Guidance: User's Guide" (USEPA 1986).

The range of arsenic Kd values presented in the USEPA guidance draws on values reported in published studies, but it does not report separate Kd values for arsenic (III) and arsenic (V) oxidation states. However, the NorthMet Project Proposed Action GoldSim model used the lowest value (i.e., the value that produces the fastest transport in groundwater) reported in the 1996 USEPA guidance.

Subtheme WR 025-6

Theme Statement

Add the effect of mineral fibers to the effects of the NorthMet project on air and water quality, and on human-health risk.

Thematic Response

The WWTF and WWTP systems would remove essentially all particulate matter from the inflow prior to discharge. The pilot tests for the water treatment system describe the use of a greensand filter to protect the RO membranes by removing particulate solids in the water before it ever reached the membrane. Beyond this pre-osmosis filtration, the RO water treatment membrane separates particles the size of dissolved ions, and thus removes essentially all particulate matter, including colloidal-sized suspended particulate material (see Sections 4.1.4 and 7.3.3.5, Barr 2013f, as cited in the FEIS). Thus, there is not increase in human health risk associated with mineral fibers in WWTF or WWTP discharge.

Subtheme WR 025-7

Theme Statement

Revise the methods used to estimate solute release from sulfide mine rock (tailings, waste rock, and ore) so that they don't use the complicated methods used in the SDEIS (e.g., Ni:S ratio in solid rock) and instead use simpler methods that rely on empirical releases measured in weathering-test leachates.

Thematic Response

The methods used to estimate the release of metals and other anions from sulfide-bearing waste rock, tailings, and ore was developed among the Co-lead Agencies. Estimates of solute release from mine waste based directly on measured concentrations in mine waste effluent were found to be inaccurate for estimating long-term solute release from NorthMet rock. The source of this inaccuracy is the secondary precipitation of solutes in the waste material after it is released from the primary minerals. An example is the dissolution of the primary minerals pyrrhotite and olivine, both of which contain nickel. Although these two primary mineral phases dissolved, as indicated by SO4 and Mg in effluents, nickel concentrations in effluent were initially lower than expected, but would then increase if leachate pH decreased. The rationale for estimating solute-release rates using the combination of solid-phase concentrations and concentration caps is summarized in Section 4.1.3.1, 2011 Geochemical Update, of the Waste Characterization Data Package (PolyMet 2015q, as cited in the FEIS).

To accommodate this approach, the GoldSim model was altered to better reflect observed solute leaching while also preserving mass balance. Metals were release as primarily minerals dissolved, but allowed to be stored in secondary phases (modeled using "concentration caps") as they leach over time, with adjustment of cap concentration if warranted by changes in pore-water pH. The solute release for tailings are listed in the NorthMet Plant Site Water Modeling Work Plan, Tables 1-13 and 1-14 (Barr 2012d, as cited in the FEIS), and, for rock, in the NorthMet Mine Site Water Modeling Work Plan, Tables 1-24 through 1-27 (Barr 2012c, as cited in the FEIS).

Subtheme WR 025-8

Theme Statement

The pH-dependent concentration caps for Category 1 wastes should use AMAX pile leachate concentrations for pH values between 6.0 or 6.5 and pH 7.5

Thematic Response

The range in pH assumed in Category 1 waste rock effluent (GoldSim model range 7.0 to 7.5) is based on measured pH in leachate tests on Category 1 waste rock, adjusted to lower pH to account for the possibility that the CO_2 pressure in the waste rock pore space would be 10 times higher than atmospheric (PolyMet 2015q, as cited in the FEIS; Section 8.3.1.1 describes the methods and Figure 8-17 illustrates the measured pH in effluent from Category 1 waste rock over a range in sulfide S concentrations, and the pH range after assuming higher pressure of CO_2 in pore gas.) The comment provides no rationale for altering the estimate of the pH for Category 1 waste rock effluent, so the Co-lead Agencies believe that the pH range used in the FEIS is appropriate.

Subtheme WR 025-9

Theme Statement

Re-Evaluate the laboratory-to-field scale-up factors.

Thematic Response

The comments in this subtheme do not provide any rationale for why laboratory-to-field scale-up factors should be re-evaluated or revised. The MDNR thus stands by the laboratory-to-field scale-up factor that they developed for Category 1 waste rock, and scale-up factors would not be further evaluated.

The Co-lead Agencies made the decision to use a "scale factor" approach for modeling solute release rates from NorthMet Project Proposed Action waste, and also selected the specific ranges for each "scale-up factor" used to extrapolate from laboratory or analog field-site conditions to the NorthMet Project Proposed Action. Reaction rates for waste-rock oxidation and solute release under field conditions are extrapolated from multi-year humidity cell tests (Attachment A, PolyMet 2015q, as cited in the FEIS). The scale-up of Category 1 waste rock that would remain permanently aerated is particularly well-supported, with multi-year studies by the MDNR demonstrating solute release rates from laboratory tests to field-scale piles of rock from the Dunka Mine (PolyMet 2015q, as cited in the FEIS).

Subtheme WR 025-10

Theme Statement

Add the effect of nickel dissolution from silicate minerals (e.g., olivene) as a source of solutes leached from mine waste.

Thematic Response

The NorthMet Project Proposed Action GoldSim water-quality model includes nickel released from waste rock and tailings by two mechanisms: 1) oxidation of nickel-bearing sulfide S minerals (calculated as the product of S released and the Ni/S ratio in sulfide minerals) and 2) dissolution of nickel-bearing silicates minerals, calculated as the product of Mg released and the Ni/Mg ratio in silicates (Large Table 3, PolyMet 2015q, as cited in the FEIS). For tailings, nickel release parameter values are in the NorthMet Plant Site Water Modeling Work Plan (Tables 1-13 and 1-14 for sulfide-phase release, and Table 1-17 for silicate-phase release) (Barr 2012d, as cited in the FEIS). For waste rock and ore, Tables 1-24 through 1-27 of the NorthMet Mine Site Water Modeling Work Plan (Barr 2012c, as cited in the FEIS) list nickel release parameter values from sulfide and silicate.

Subtheme WR 025-11

Theme Statement

Revise the method used to estimate sulfate release rates from rock sulfur concentrations for Cat1 and Cat2/3 waste rock to include higher sulfate release rate data and include the effect of the "first flush" from humidity cell tests.

Thematic Response

The relationship between sulfate release rate and rock sulfur concentration is applied as a probabilistic model input as a normal distribution with a 95% confidence interval that includes sulfur normalized sulfate release rate values from 12.78 to 15.06 (mg/kg/wk/%S). This value interval covers the average values for the zero-intercept model from each individual rock category. The zero-intercept model was assumed as a reasonable approach based on the chemical reality that a rock containing no sulfur cannot release sulfate. As indicated in the Waste Characterization Data Package (PolyMet 2015q, as cited in the FEIS) the estimation approach is intended to represent the average of the entire mass of waste rock. The variability of the average value is less than the variability of the entire population and the selection of a more restricted rate value range reflects the limited variability of the average. The "first flush" from humidity cell tests is an artifact of sample handling, and not applicable to estimating reaction rates.

GoldSim accounts for periodic rock flushing by accounting for solutes released between events that flush water through mine waste.

Subtheme WR 025-12

Theme Statement

Conduct humidity-cell tests on more samples of NorthMet waste rock, because the current number (89) is too few to characterize 309 million tons of waste rock.

Thematic Response

The net acid-generating potential in the NorthMet Deposit is based primarily on the concentration of sulfide S in the rock, and an independent geostatistical evaluation found that the number and spatial distribution of analyzes for sulfide S (~18,800 rock samples) supported adequately the geologic block model developed to describe the ore and waste rock (Optitech 2012).

For kinetic tests, the samples were selected to be: 1) spatially dispersed across the deposit, so that they included samples from each rock type and lithologic units, weighed by expected tonnage of each, and thus capture the variability in neutralizing potential and metal concentrations in the host rock (see Large Table 3, PolyMet 2015q, as cited in the FEIS), and 2) chemically dispersed over the range of sulfide S concentrations, so that the estimates of oxidation rate and associated release of acid and metals could be reliably bracketed by ranges for uncertainty (Table 4-1 in SRK 2007b, as cited in the FEIS).

Environmental mine waste guidance does not provide firm sample requirements, but recommendations in the GARD guide include: "One to 2 samples of representative material of each material type" (from 2007 Australian guidance); "Provide adequate information to make cost-effective, sustainable, and environmentally protective decisions regarding the management and disposal of waste materials;" and "Sufficient to adequately represent the variability within each geological unit and waste type" (INAP 2010)

The Co-lead Agencies believe that the distribution and number existing kinetic-test samples (42 of Category 1, 26 of Category 2/3, and 21 of Category 4) meet these guidance criteria, and are adequate for the FEIS.

Subtheme WR 025-13

Theme Statement

Include all results of laboratory and field weathering tests in the GoldSim model, including specifically those test results that produced leachate pH below 6.0.

Thematic Response

The GoldSim model implementation of solute release from sulfide-bearing mine waste used the results of field and laboratory tests before and after the onset of acidic conditions. For Category 1 waste rock and tailings (i.e., non-acid-generating material), the estimates of solute release used only results from field or lab tests that produced near-neutral pH effluent. But for Category 2/3 and Category 4 waste rock, the duration before onset of acidic conditions and the change in oxidation rate after acid onset are both based on changes in measured humidity-cell effluent as it shifts from neutral to acidic pH (Section 8.2 of the Waste Characterization Data Package [PolyMet 2015q, as cited in the FEIS] and model parameters "Acidic_Onset_Time" and "Acid_Factor" in Table 1 of the Mine Site Water Modeling Data Package [PolyMet 2015m, as cited in the FEIS). This same table includes the decay in oxidation rate after acid onset caused by depletion of sulfide S minerals ("Decay_a1" and "Decay_a2"), as described in Section 9.2 and Attachment A of the Waste Characterization Data Package (PolyMet 2015q, as cited in the FEIS).

Subtheme WR 025-14

Theme Statement

Change the GoldSim model predictions to include results demonstrating that Category 1 waste rock can produce acidic leachate and release solutes to contact waters.

Thematic Response

The non-acid-generating materials are tailings and Category 1 waste rock (0.12% sulfide S or less). This classification is based on humidity-cell tests operated on 38 samples of NorthMet Category 1 waste rock continuously for up to 8 years (duration 194 to 436 weeks, listed in Large Table 1 of the Waste Characterization Data Package [PolyMet 2015q, as cited in the FEIS]). None of these materials produced acidic leachate (see time plots of effluent pH in "Attachment 2 Trend Analysis for Rock Humidity Cells" to "Attachment A Water Quality Modeling for Waste Rock and Pit Walls" to the Waste Characterization Data Package [PolyMet 2015q, as cited in the FEIS]). The 0.12% sulfide S threshold for defining non-acid-generating rock is supported by the results of these humidity-cell tests, in which none of the samples became acidic, as indicated by a trend of increasing sulfate release rate and decreasing pH.

A stockpiling operational error resulting in acid generation is a possibility. However, only one (0.2 wt% sulfur) of the 15 Category 2/3 rock samples with a sulfur concentration less than 0.3 wt% sulfur generated a net acidic leachate. Because the Category 2/3 rock is on average 0.21 wt% sulfur, misplacing the entirety of the Category 2/3 rock with the Category 1 rock would not result in a mass weighted sulfur concentration above 0.2 wt% sulfur (combined Category 1 and Category 2/3 rock would have an average sulfur concentration of about 0.1 wt%.

Subtheme WR 025-15

Theme Statement

Provide an independent example showing how the release rate of two constituents in waste rock (Cu and Ni) are altered from laboratory test results to values applied in the model in response to application of factors for fragment size, temperature, pH, time to onset of acidic conditions, and water contact.

Thematic Response

The release of copper and nickel are proportional to sulfide-mineral oxidation, where the rate under field conditions is rate measured in the multiplied by factors correcting for sulfide-mineral concentration, fragment size (Ksize), temperature (Ktemp). Once acidic conditions begin, rates increase and then decay, matching behavior seen in kinetic tests. Presented here is an example if metal leaching from ore (Duluth Complex).

- Ksize = 0.14: Average value of 0.14 is based on literature values (Table 1-1 of Barr 2012c and Section 8.2.3 of PolyMet 2015q, both as cited in the FEIS)
- Ktemp = 0.229: Ktemp = Kt = e^{[Ea/R] * [(1/Tlab) - (1/Tfield)]}, where:
    - Ea = 55 kj/mole (activation energy of pyrrhotite oxidation)
    - Tfield = 2.004 C (temperature in the field, annual average, =275.154 K)
    - Tlab = 20 C (temperature in laboratory humidity cell tests, = 293.15 K)
    - R= 0.008134 kj/mole-deg K (Gas constant)
    - Ktemp = exp{(55/0.008134)*[(1/275.154)-(1/293.15)]} = 0.229 [unitless]

(Equation 8-17 of PolyMet 2015q, as cited in the FEIS)

- Time to Acid Onset (field) = 24.8 years.
    - Time to Acid Onset in laboratory conditions = 5.67 years (Table 1-1 of Barr 2012c) and Figure 8.12 of PolyMet 2015q, both as cited in the FEIS) Correcting for the effect of field temperature; and
    - Time to acid onset (field) = 5.67 yrs lab * (1/0.229 yrs lab/yrs field) = 24.8 years.
- Sulfur_Conc = 0.608 %S (Average for ore: Table 1-1 of Barr 2012c, as cited in the FEIS)
- Oxidation_Rate_Regression = 13.92 mg SO4/kg-rock/week/%S (Slope of oxidation rate vs. Sulfide S, Table 1-27 of Barr 2012c, as cited in the FEIS)
- Sulfate Release Rate: At the end of year 1, leaching to percolating water oxidation is:
    - Sulfur_conc (%S) * Oxidation_Rate_Regression (mg SO4/kg/week/%S) * Ks [unitless] * Kt [unitless] = 0.608 * 13.92 * 0.14 * 0.229 = 0.194 mg SO4/kg rock/wk
    - Converting sulfur release from SO4 to S: 0.194 mg SO4/kg rock/wk * (32 mg S/96 mg SO4) = 0.0646 mg S/kg rock/wk
- Metal Release Rates: Copper and nickel are released in proportion to S (sulfide mineral oxidation), and additional nickel is also released in proportion magnesium release (olivine dissolution) in the following ratios (Table 1-27 of Barr 2012c, as cited in the FEIS):
    - Cu/S = 0.504 mg Cu/mg S;
    - Ni/S = 0.153 mg Ni/mg S
    - Mg/SO4 = 0.0729 mg Mg/mg SO4

    The metal-release rates are then:

    - Copper: (0.0646 mg S/kg rock/wk) * (0.504 mg Cu/mg S) = 0.0326 mg Cu/kg-rock/wk.

- Magnesium: (0.194 mg SO4/kg-rock/wk * 0.0729 mg Mg/mg SO4) = 0.0141 mg Mg/kg-rock/wk.
- Nickel: (0.0646 mgS/kg rock/wk * 0.153 mg Ni/mg S) + (0.194 mg SO4/kg-rock/wk * 0.0141 mg Mg/kg-rock/wk) = 0.0286 mg Ni/kg-rock/wk.

- After onset of acidic conditions: After 24.8 years of weathering, the ore is assumed to become acidic, and the oxidation rate (as SO4 release rate) is estimated using only the a0 and a1 parameters derived from observed increase and decay in reaction rates in kinetic tests: SO4(mg/kg-rock/wk) = 10^{((a1 * log(time)) + a0}, where (Table 1-1 of PolyMet 2015q, as cited in the FEIS—values are P50 used in GoldSim model of Mine Site):
  - Time = duration since onset of acidic conditions [in weeks since peak rate with acid onset]
  - a0 = 2.54 (sulfate production decay parameter [unitless])
  - a1 = -0.5875 (sulfate production decay parameter [unitless])

  For example, at the end of year 25, ore has aged 10.4 weeks beyond the time when acidic conditions begin (i.e., [25yrs -24.8 yrs]*52 wks/yr = 10.4 weeks).

  - SO4 (mg/kg-rock/wk) = Ktemp * Ksize * 10^{(a1 * log(time))+a0}
  - =0.1 * 0.229 * 10^[{(-0.5875*log(10.4)) + 2.54}
  - = 2.01 mg SO4/kg-rock/wk

  Thus the oxidation rate has increased at the onset of acidic conditions, but the rate decays after onset reflecting the observed decay as the remaining sulfide S is consumed.

The Co-lead Agencies conducted independent calculation to confirm that the scale factors, oxidation rates, and associated release of sulfate and metals before and after inundation by Mine Site pit water were applied in the GoldSim model as described in the Waste Characterization Data Package (NorthMet Mining Project GoldSim Water Quality Model - Phase 3 Quality Assurance, memo from ERM to Bill Johnson, MN DNR, February 25, 2013).

Subtheme WR 025-16

Theme Statement

Include the effect of rock dust (produced by blasting) on the quality of Mine-Site surface runoff to the Partridge R.

Thematic Response

Dust emissions from blasting in the NorthMet Project Proposed Action open pits are not assessed quantitatively in the GoldSim modeling, and are not included in air quality analysis because the air dispersion models employed are not suitable for this type of potential emission source. Instead, blasting and associated dust releases are limited under applicable permitting and safety requirements, including:

- The Fugitive Emission Control (FEC) Plan, which would require proper blast design and other procedures to minimize dust generation and transport beyond the mine pits;
- A "blast monitoring plan" in the Permit to Mine, which, in accordance with state regulations, requires that "Mining shall be managed to control avoidable dust," that "overpressure and ground vibrations from production blasts shall be kept at levels which would not be injurious to human health or welfare and property outside mining areas," and requires monitoring for "meteorological conditions, including temperature inversions, wind speed, and directions" (Minnesota Administrative Rules 6130.700 Air Pollution, Rule 6130.3800 Goal of Blasting, and Rule 6130.3900 Blasting Requirements, respectively); and
- The Mine Health and Safety Administration (MHSA) Rules and Regulations, which include requirements for drilling and blasting activities that protect worker safety, including exposure to dust.

Collectively, these require that that blasting be conducted in a manner that minimizes dust to a level that protects human health. Further, much of the ground closest to the pits is disturbed "contact area" (e.g., waste rock and haul roads), where all runoff water would be captured and treated prior to discharge. Based on these requirements and existing controls, it is assumed that dust release from blasting would be below a level that would adversely affect water quality.

Theme WR 026

Theme Statement

Given the inadequate geochemical characterization, the GoldSim models unrealistically minimize the uncertainty associated with predicting future chemical loading. The probabilistic and deterministic inputs used for geochemical parameters in the GoldSim models should compensate for this uncertainty by using more conservative mean values and larger standard deviations, or greater ranges of values. The FEIS should disclose the uncertainties and discuss what they mean in regard to impacts on water quality and quantity. Water quality modeling should also take into account changes in flow due to the NorthMet Project Proposed Action.

Thematic Response

The geochemical characterization of NorthMet rock is related primarily to its net acid-generating potential, as indicated by the concentration of sulfide S in the rock and tailings. The humidity cell samples (42 of Category 1, 26 of Category 2/3, and 21 of Category 4) were dispersed spatially across the deposit to include the different formations (see Large Table 2 of the Waste Characterization Data Package [PolyMet 2015q, as cited in the FEIS]), and covered the range of sulfide S concentrations (Table 4-1 [Matrix for Sample Selection in Waste Rock Types] [SRK 2007b, as cited in the FEIS]). The chemical behavior of non-acid generating rock (<0.12% sulfide S) is based on long-term (up to 5-year duration) humidity cell tests on NorthMet Category 1 waste rock (duration 186 to 284 weeks, listed in Large Table 1 of the Waste Characterization Data Package [PolyMet 2015q, as cited in the FEIS]). None of these Category 1 materials produced acidic leachate (see time plots of effluent pH in "Attachment 2 Trend Analysis for Rock Humidity Cells" to "Attachment A Water Quality Modeling for Waste Rock and Pit Walls" from the Waste Characterization Data Package [PolyMet 2015q, as cited in the FEIS]). For tailings, ore processing would produce non-acid generating material (sulfide S

<=0.12%), and solute releases are estimated from 21 humidity cells on NorthMet tailings and 4 on LTVSMC tailings (Large Table 5, Waste Characterization Data Package [PolyMet2015q, as cited in the FEIS]). The sulfide S distribution in NorthMet waste and ore is estimated from ~18,800 analyses of sulfide S in core samples, and an independent geostatistical evaluation found that these data adequately supported PolyMet's model of the deposit (Optitech 2012). These geochemical data are adequate for the NorthMet FEIS.

The parameters used to estimate solute release rates applied in the GoldSim models were developed by the Co-lead Agencies as part of the Impact Assessment Planning process, and parameters values were selected to bracket evenly the uncertainty in model parameters and avoid underestimating estimates of chemical loading (MDNR et. al. 2011, as cited in the FEIS). In a few instances, model parameters are selected to produce larger ranges than indicated by simple statistical application of test data (e.g., solute release rates from waste rock are based on the range in individual humidity-cell tests, not the range in the average; Section 8.1.2.1 of the Waste Characterization Data Package [PolyMet 2015q, as cited in the FEIS]) release rate from an entire waste rock stockpile.

Uncertainty in model parameters is described in Table 1-1 of Water Modeling Work Plan – Plant Site (Barr 2012d, as cited in the FEIS), and Table 1-1 of the Water Modeling Work Plan – Mine Site (Barr 2012c, as cited in the FEIS).

Regarding changes in flow, the GoldSim models track surface and groundwater flow at both the Mine Site and Plant Site, to make up in part the flow removed by the Plant Site groundwater containment system, and modeling accounts for the augmentation of Plant Site tributary stream flows (at +/- 20% of existing flows) with treated water from the Plant Site WWTP.

Theme WR 027

Theme Statement

For the Mine Site, the SDEIS does not discuss the addition of lime to waste rock or pits to control pH. It does not discuss lining the pits with bentonite. These options should be studied.

Thematic Response

The mine waste rock would be sorted into and stored as four categories based on its potential to contaminate water, with Category 1 waste rock having a low potential and Category 4 waste rock having a high potential. Category 1 waste rock would be stored in a permanent stockpile that would be surrounded by a seepage collection system encompassed by a water containment system to capture surface and groundwater from the stockpile and direct it to a water treatment facility, as well as a geomembrane cover to limit infiltration at closure. Because Category 1 waste rock has a low potential to generate acid or metal leachate, and because water from the stockpile would be captured and treated, lime is not anticipated to be needed for neutralization, and, therefore, the addition of lime for Category 1 waste rock is not proposed. Category 2/3 and 4 waste rock would be stored temporarily in stockpiles with underliners and seepage collection, and then used to backfill the East Pit following completion of mining there. Lime would be added to the waste rock during East Pit backfilling to maintain pH in the pit pore water as needed. The volume of lime required would be based on operations monitoring results. Waste rock characterization and categorization, as well as management and storage during operations and closure and water management at the stockpiles, is addressed in FEIS Sections 3.2.2.1.7, 3.2.2.1.8, 3.2.2.1.9, and 3.2.2.1.10. A low-permeability soil barrier could be constructed along the Ore Grade Material portions of the exposed West Pit wall and this may be considered as a contingency mitigation.

Theme WR 028

Theme Statement

The SDEIS does not consider leaching from the coal ash landfill at the Plant Site.

Thematic Response

The coal ash landfill would be removed and disposed in the Hydrometallurgical Residue Facility. This is described in FEIS Section 3.2.2.3.5.

Theme WR 029

Theme Statement

It is not clear in the SDEIS whether the waste rock from the stockpiles would simply be deposited in the East Pit in year 11 and remain partly exposed for 20 years while the water rises around it, or if the placement of the waste rock would occur in stages to ensure the rock is either still on the stockpile liner (and leachate is collected and treated) or entirely submerged within the East Pit to minimize acid production and metal leaching.

Thematic Response

As soon as excavation of the East Pit is complete in mine year 11, backfilling of the East Pit would begin, using waste rock from the temporary Category 2/3 and 4 Stockpiles, and freshly mined material from the West Pit. To reduce oxidation in the backfill and wall rock, the backfill would be flooded with excess water from the Central Pumping Station as quickly as practicable leaving only approximately 5 feet of exposed backfill above the water elevation at any point in time. To the extent practicable, the thickness of unsaturated waste rock in the East Pit would not be more than 5 feet during the reclamation/closure periods. Thus, the reactive Category 2/3 and 4 waste rock would either be in lined stockpile facilities, where leachate is captured, or in the East Pit as backfill, where it would be flooded to stop oxidation and the extracted pore water would be treated prior to discharge or recycling back to the East Pit. This is described in Section 6.1.2.2 and Figure 6-6 of PolyMet 2015m (as cited in the FEIS).

The rate of oxidation and associated release of acidity and metals from waste rock and wall rock after it is submerged under water was considered directly by the Co-lead Agencies as part of the Impact Assessment Planning Process (See Table 1 of MDNR et. al. 2011, as cited in the FEIS). Supporting analysis found that after the rock was submerged by a layer of oxygenated water, the rate of oxidation in the rock would decrease by at least a factor of ~800 relative to the oxidation rate when it was exposed directly to atmospheric oxygen (Day 2008, as cited in the FEIS). Based on this analysis, which is consistent with general results of studies on subaqueous disposal of sulfide-bearing mine waste, the GoldSim model assumed that oxidation in submerged wall rock and waste rock was negligible.

Theme WR 030

Theme Statement

The FEIS discussion of solute release from Tailings Basin should be based on site-specific materials and conditions, not other tailings basin sites.

Thematic Response

The solute release rates from tailings (proposed NorthMet and existing LTVSMC) were based directly on laboratory measurements conducted on representative samples of these two materials, including tailings generated as part of the proposer's processing and metallurgical pilot-testing. Specific measurements included total concentrations of metals and other elements in the tailings (e.g., based on elements extracted in dissolution by a strong acid "aqua regia" digest), or for the more soluble constituents, the rate at which they leach in multi-year humidity cell tests (Table 1-13 in the Plant Site Water Modeling Work Plan—Barr 2012d, as cited in the FEIS).

The oxidation rates measured under laboratory conditions were scaled so as to more accurately estimate weathering rates under site-specific field conditions in the NorthMet Project area -- a process that accounts for well-established effects on weathering rates due to temperature, fragment size, and pore-gas oxygen concentrations (Section 10.2 of the Waste Characterization Data Package [PolyMet 2015q, as cited in the FEIS]).

It is the concentration caps, applied in the GoldSim models to reflect chemical limits on the concentrations of some solutes in pore waters, that incorporated estimates from analogous mines (Table 1-15 in the Plant Site Water Modeling Work Plan). The decision to use effluent concentrations measured at analog mine sites and the selection of specific method of incorporating values from these analog sites to the NorthMet Project Proposed Action modeling was made by the Co-lead Agencies as part of the Impact Assessment Planning process (See Table 1 of MDNR et. al. 2011, as cited in the FEIS; the discussion of Waste Rock Solubility Caps for Category 1 rock is applied to tailings).

Analog site data were applied because the standard laboratory procedure used to measure oxidation rates and solute release in mine waste (humidity cells) used water to rock ratios hundreds of times higher than expected under some NorthMet Project area field conditions. Assuming that maximum concentrations in humidity-cell tests were "concentration caps" could thus underestimate solute caps in the Mine Site's GoldSim tailings model. The analog data were selected from mines with similar host rock and climate (e.g., Amax Stockpile, near the NorthMet Project area, and the Whistle Mine in Canada). The approach used in the FEIS to estimate solute release from tailings is valid.

Theme WR 031

Theme Statement

The FEIS discussion of solute release from waste rock at the Mine Site should be based on site-specific materials and conditions, not other mine sites.

Thematic Response

The solute release rates for NorthMet waste rock were based on laboratory measurements conducted on drill core samples of bedrock types that would ultimately become waste rock.

Specific measurements included total concentrations of metals and other elements (e.g., based on elements extracted in dissolution by a strong acid “aqua regia” digest, or direct analysis of mineral phases by electron microprobe), or for the more soluble constituents, the rate at which they leach in multi-year humidity cell tests (see Tables 1-24 through Table 1-27 of Barr 2012c, as cited in the FEIS). The oxidation rates measured under laboratory conditions were scaled so as to more accurately estimate weathering rates under site-specific field conditions at the Mine Site -- a process that accounts for well-established effects on weathering rates due to temperature, fragment size, and water contact (see Section 8.2 of PolyMet 2015q, as cited in the FEIS).

It is the concentration caps, applied in the GoldSim models to reflect chemical limits on the concentrations of some solutes in pore waters, that incorporated estimates from analogous mines (see Table 1-30 through Table 1-33 of Barr 2012c, as cited in the FEIS). The decision to use effluent concentrations measured at analog mine sites and the selection of specific method of incorporating values from these analog sites to the NorthMet Project Proposed Action modeling were made by the Co-lead Agencies as part of the Impact Assessment Planning process (See Table 1 of MDNR et. al. 2011, as cited in the FEIS).

Analog site data were applied because the standard laboratory procedure used to measure oxidation rates and solute release in mine waste (humidity cells) used water to rock ratios hundreds of times higher than expected under some field conditions in the NorthMet Project area. Assuming that maximum concentrations in humidity-cell tests were “concentration caps” could thus underestimate solute caps in the Mine Site’s GoldSim tailings model. Further, analog field data provided estimates of solute under longer-duration weathering, broader ranges in effluent pH than laboratory tests. The analog data were selected from mines with similar host rock and climate (e.g., Amax Stockpile, near the NorthMet Project area, and the Whistle Mine in Canada). The Co-lead Agencies stand behind the approach used in the FEIS to estimate solute release from tailings.

Theme WR 032

Theme Statement

The FEIS needs to consider increased nitrate and ammonia loading at the Mine Site due to blasting.

Thematic Response

Blasting would occur when pits are developing and being dewatered. The WWTF would treat mine pit water before being pumped to the Plant Site where it would be treated again by reverse osmosis before being discharged to the environment. The potential environmental effects to water resources due to blasting would be negligible.

Theme WR 033

Theme Statement

The SDEIS does not fully describe the technical basis for concentration caps. Concentrations caps should not be used. Concentrations caps for West Pit water quality obscure the duration of water treatment. To better reflect the measured and likely pH conditions of Category 1 Stockpile leachate, pH-dependent concentration caps should use AMAX pile leachate concentrations for pH values between 6.0 or 6.5 and pH 7.5.

Thematic Response

Laboratory humidity cell tests are not intended to directly represent field conditions, but are instead standardized tests that provide a reference for the environmental behavior of mine wastes that contains sulfide minerals. Humidity-cell tests have been conducted on rock samples from most existing mines, and there are many published studies that compare weathering results in these laboratory scale tests to solute release from full scale mine waste facilities. Details on how the humidity cell test results are "scaled up" from laboratory results to estimate solute release in NorthMet mine waste under field conditions are presented in the NorthMet Waste Characterization Data Package (PolyMet 2015q, as cited in the FEIS) (Section 8.2 describes for waste rock, and Section 10.2 for tailings).

Theme WR 034

Theme Statement

Laboratory humidity cell tests do not represent anticipated field conditions.

Thematic Response

Laboratory humidity cell tests are not intended to directly represent field conditions, but are instead standardized tests that provide a reference for the environmental behavior of mine wastes that contain sulfide minerals. Humidity-cell tests have been conducted on rock samples from most existing mines, and there are many published studies that compare weathering results in these laboratory tests to solute released from full-scale mine waste facilities. Details on how the humidity cell test results are "scaled up" from laboratory results to estimate solute release in NorthMet Project Proposed Action mine waste under field conditions are presented in the NorthMet Waste Characterization Data Package (PolyMet 2015q, as cited in the FEIS]) (Section 8.2 describes for waste rock, and Section 10.2 for tailings).

Theme WR 035

Theme Statement

The SDEIS states that water treatment at both the Mine Site and Plant Site would occur for "as long as necessary" to achieve applicable water quality criteria. There is no indication of whether this is decades, centuries, or is perpetual. A long-term water treatment plan is imperative to evaluate the environmental effects of this the NorthMet Project Proposed Action. Long-term treatment requires long-term monitoring. The need for perpetual augmentation requires the need for perpetual treatment. It is not clear which water quality parameter(s) drive the need for long-term treatment. Influent water quality to the WWTP and WWTF should be modeled and disclosed in the FEIS out to 500 years. The East Pit backfill would reduce treatment requirements over the long term.

Thematic Response

Water quality modeling performed in support indicates that water treatment systems in some form and at some scale would be needed indefinitely at the Mine Site and Plant Site. The water models constructed to assess the potential effects from the NorthMet Project Proposed Action were not designed to predict the duration of treatment nor do they capture all the factors that influence the duration of treatment (e.g., potential future regulatory and technological changes). Therefore, the models cannot be used to predict the year treatment would end. It is the sulfate wild rice standard of 10 mg/L that drives the need for long-term water treatment. Two hundred years of influent water quality predictions provide reasonable estimates of what can be expected over the long term.

Water monitoring would persist as long treatment is needed. Actual treatment requirements would be assessed on a reoccurring basis throughout operations and closure based on results of ongoing discharge, performance, and water resource monitoring, ensuring continuous protection of groundwater and surface water quality and compliance with applicable water quality standards. This reassessment process would rely on measured monitoring results (evaluated through modeling) rather than the results of the predictive modeling included in the FEIS. Regardless of the precise duration of effects or water treatment at either the Mine Site or Plant Site, there are measures available to address impacts to natural resources. Augmentation water would be treated for as long as necessary and augmentation would continue for a long as necessary.

Theme WR 036

Theme Statement

The FEIS should include a mathematical analysis to estimate the likely range of years that mechanical water treatment and monitoring would be required.

Thematic Response

Although precise estimates cannot be developed, the FEIS modeling indicates that the East Pit, West Pit, and Category 1 Stockpile would be permanent features that would provide solute-loading for a minimum of 200 years at the Mine Site. Similarly, the Tailings Basin is a permanent feature that would provide solute loading for a minimum of 500 years at the Plant Site. Monitoring would be required for the duration of permitted discharges. See Response WR35.

Theme WR 037

Theme Statement

The FEIS should acknowledge that the NorthMet Project Proposed Action would not be maintenance free at closure. This violates Minnesota Rules. Treatment would also be expensive especially in meeting the wild rice sulfate standard. Given the duration of site maintenance post-closure, which is on the order of hundreds of years, and PolyMet's current assets and liabilities, it would be difficult if not impossible for PolyMet to meet its obligations in closure. There are likely to be financial consequences for Minnesotans.

Thematic Response

It is acknowledged that operation, maintenance, and periodic replacement of environmental controls would be required during closure. *Minnesota Rules* 6132.3200 specifies that it is a goal for a mining area to be maintenance-free. Financial assurance would be required under *Minnesota Rules* 6132.1100 before the State's Permit to Mine can be issued. Permit conditions and financial assurance would be required to perform reclamation and closure activities for as long as these activities are needed. FEIS Section 3.2.2.4 describes the financial assurance process and requirements. See the response to theme WR 035 for more information on monitoring.

Theme WR 038

Theme Statement

The FEIS should predict how long chemical sources would contribute pollutants to discharge water that has concentrations above regulatory standards. The FEIS should acknowledge that treatment of the West Pit water would be necessary until West Pit water meets water quality standards.

Thematic Response

Water quality modeling performed in support indicates that water treatment systems in some form and at some scale would be needed at the Mine Site and Plant Site indefinitely. The water models used to assess the potential effects from the NorthMet Project Proposed Action were not designed to predict the duration of treatment nor do they capture all the factors that influence the duration of treatment (e.g., potential future regulatory and technological changes). Therefore, the models cannot be used to predict the year treatment would end. Actual treatment requirements would be assessed on a reoccurring basis throughout operations and closure based on results of ongoing discharge, performance, and water resource monitoring, ensuring continuous protection of groundwater and surface water quality and compliance with applicable water quality standards. This reassessment process would rely on measured monitoring data (evaluated through modeling) rather than solely on the results of the predictive modeling as was done in the FEIS. Regardless of the precise duration of effects or water treatment at either the Mine Site or Plant Site, there are measures available to address impacts to natural resources. All affected water, including that from West Pit surface water discharges, would be treated until the discharge met applicable standards without treatment.

Theme WR 039

Theme Statement

The FEIS should include monthly monitoring and reporting of water quality in city and residential wells and drainage areas surrounding the Mine Site. Sufficient and properly trained state agency staff should be used to accomplish this task. The location of groundwater monitoring wells at the Mine Site and Plant Site should be sufficiently upgradient from the PolyMet property boundary to allow for mitigation if and when groundwater quality does not meet standards.

Thematic Response

There are no municipal or residential wells surrounding the Mine Site that would be potentially impacted by the NorthMet Project Proposed Action. Water quality monitoring of the Partridge River is anticipated. The details of PolyMet's proposal are disclosed in the FEIS in Section 5.2.2.3. Existing groundwater wells are upgradient from residential wells, including those at the toe of the Tailings Basin. See Figures 4.2.2-14 and 4.2.2-15.

Theme WR 040

Theme Statement

The SDEIS does not provide a complete inventory of drinking water wells located near the Mine Site and Plant Site.

Thematic Response

There are no municipal or residential wells surrounding the Mine Site that would be potentially impacted by the NorthMet Project Proposed Action. There are 27 known domestic wells between the Tailings Basin and the Embarrass River, with the closest being approximately 1.6 miles from the toe of Cell 2E. Characteristics of the wells are presented in Table 4.2.2-25. Locations of all residential wells (sampled and unsampled) were added to Figure 4.2.2-15. Analytical results for water collected the 15 sampled residential wells are summarized in Table 4.2.2-24.

Theme WR 041

Theme Statement

The SDEIS does not evaluate how drinking water has been and would be impacted by mine-affected groundwater. Treating impacted water to meet drinking water regulations would be expensive.

Thematic Response

There are no municipal or residential wells surrounding the Mine Site that would be potentially impacted by the NorthMet Project Proposed Action. At the Plant Site, characterization data indicate that the bulk hydraulic conductivity of upper bedrock is two to three orders of magnitude lower than the hydraulic conductivity of the surficial aquifer. Thus, groundwater flow and transport at the Plant Site is dominated by the hydraulics of the surficial aquifer. Bedrock plays a negligible role in transporting site-derived chemicals to the Embarrass River. Therefore, domestic wells screened solely in the bedrock aquifer are not anticipated to be affected by the NorthMet Project Proposed Action. Wells that are within a surficial aquifer flowpath and screened in the alluvium would have water quality similar to the corresponding flowpath reported in Table 5.2.2-38. Finally, the NorthMet Project Proposed Action is predicted to meet groundwater evaluation criteria at the property boundary and thus significant impacts to residential wells beyond the property boundary are not expected.

Theme WR 042

Theme Statement

The FEIS should address the NorthMet Project Proposed Action's impacts and risks on drinking water throughout St. Louis River Watershed including the City of Duluth and the City of Superior. Cumulative effects on drinking water from other current and proposed mining and industrial projects within the watershed should also be analyzed. Mitigation for drinking water impacts should be identified.

Thematic Response

In Chapter 6, the discussion of cumulative impacts in the St. Louis River watershed was expanded and all relevant tables were modified (to the extent that there was information to make these revisions).

Groundwater and surface water quality model predicts that the NorthMet Project Proposed Action would have a minimal effect on drinking water standard-based groundwater evaluation criteria at the NorthMet Project area boundaries, in the Embarrass and Partridge rivers, and in Colby Lake (the locations at which drinking water standards apply). Evaluation criteria can be found in Section 5.2.2. Based on this, it is therefore expected that the NorthMet Project Proposed Action would not have any significant impacts on water quality downstream of the NorthMet Project area or significantly contribute to any cumulative effects on drinking water supplies. Given the downstream distance to the cities of Duluth or Superior, it is highly unlikely that the water supplies for these cities would be affected.

In the unlikely event that downstream water supplies were affected, mitigation would involve improving engineering controls at the NorthMet Project area and/or upgrading municipal water treatment plants to provide drinking water that meets applicable USEPA and state standards.

Theme WR 043

Theme Statement

The FEIS should specifically evaluate the NorthMet Project Proposed Action's effects on Colby Lake, which is used for domestic consumption by the City of Hoyt Lakes. The evaluation should include contributions of pollutants to Colby Lake from the NorthMet Project Proposed Action and water appropriations from Colby Lake. PolyMet should assist with water supply contingency planning for the City of Hoyt Lakes.

Thematic Response

The Mine Site water quality model was revised in the FEIS to more accurately reflect existing conditions and explicitly evaluate chemical concentrations in Colby Lake for the NorthMet Project Proposed Action. The primary modification was the addition and calibration of a new chemical source to the lake that accounted for non-NorthMet Project Proposed Action sources of chemical loading. For future conditions, the chemical concentrations in the lake were predicted by considering the mass loading of this new source and mass loading that enters the lake from the Partridge River (which may be affected by the NorthMet Project Proposed Action). The revised FEIS model provides a more accurate prediction of chemical concentrations in Colby Lake and a more accurate assessment of potential impacts related to the NorthMet Project Proposed Action.

Maximum P90 concentrations in Colby Lake were updated in Table 5.2.2-34 for the FEIS. Colby Lake is a Class 1B water. As such, primary and secondary drinking water standards apply. These standards are reported for comparison purposes in Table 5.2.2-34.

In the unlikely event that the NorthMet Project Proposed Action were to adversely affect drinking water quality in Colby Lake, mitigation would involve upgrading the City of Hoyt Lakes water treatment plant to provide drinking water that meets applicable USEPA and state standards. The Permit to Mine would specify the conditions under which PolyMet would be obligated to make improvements to the City's drinking water treatment plant.

Theme WR 044

Theme Statement

The Mine Site GoldSim model does not adequately predict existing chemical concentrations in the Partridge River, including trends of concentration versus downstream river distance.

Thematic Response

The FEIS Mine Site GoldSim model was recalibrated to provide a better correspondence between predicted and observed water chemistry in the Partridge River for existing conditions. This calibration considered new surface water chemistry data collected through the end of 2013. For Colby Lake, a new chemical source term was added to the Mine Site GoldSim model and calibrated to measured concentrations in the lake to ensure there was an adequate basis for assessing potential impacts from the NorthMet Project Proposed Action.

Theme WR 045

Theme Statement

The Plant Site GoldSim model does not adequately predict existing chemical concentrations in the Embarrass River.

Thematic Response

The FEIS Plant Site GoldSim model was recalibrated to provide a better correspondence between predicted and observed water chemistry in the Embarrass River for existing conditions. This calibration considered new surface water chemistry data collected through the end of 2013 to ensure there was an adequate basis for assessing potential impacts from the NorthMet Project Proposed Action.

Theme WR 046

Theme Statement

The Mine Site GoldSim model does not adequately predict existing chemical concentrations in Colby Lake.

Thematic Response

The Mine Site GoldSim model was modified for the FEIS to include a new chemical-loading source in Colby Lake that was calibrated to the measured chemical concentrations in the lake. The same chemical-loading source was applied to both the Continuation of Existing Conditions model and Propose Action model in GoldSim. The chemical-loading source was constant and did not exhibit seasonal or long-term variations for future conditions. Incorporation of the loading source addressed the issue by providing predicted chemical concentrations in Colby Lake for existing conditions that are similar to currently measured concentrations.

Theme WR 047

Theme Statement

The Mine Site GoldSim model does not adequately predict existing streamflow in the Partridge River.

Thematic Response

In the Mine Site GoldSim model, Partridge River streamflows are based on results of an XP-SWMM surface water flow model calibrated to 10 years of stream gaging data collected at location SW006 by the U.S. Geological Survey. The gaging data are considered high-quality and appropriate for assessing river flow characteristics. The flow analysis performed for the Partridge River and incorporated into the GoldSim model is appropriate for impact analysis.

Theme WR 048

Theme Statement

The Plant Site GoldSim model does not adequately predict existing streamflow in the Embarrass River.

Thematic Response

In the Plant Site GoldSim model, Embarrass River streamflows are based on 20 years of measured stream gaging data collected at a U.S. Geological Survey gaging station located downstream of the Plant Site. The gaging data are considered high-quality and appropriate for assessing river flow characteristics. The flow analysis performed for the Embarrass River and incorporated into the GoldSim model is appropriate for impact analysis.

Theme WR 049

Theme Statement

Because the GoldSim models do not adequately reproduce existing flow and water quality conditions, the models cannot reliably predict future conditions associated with the NorthMet Project Proposed Action.

Thematic Response

For the FEIS, both the Mine Site and Plant Site GoldSim models were recalibrated to provide better correspondence between predicted and observed water quality for existing conditions. This calibration considered new surface water chemistry data collected through the end of 2013.

Model calibrations, other model assumptions, and the resulting impact predictions provide a reasonable estimate of potential environmental effects for purposes of the EIS.

Theme WR 050

Theme Statement

The FEIS should include a scientific explanation of the calibration factors used for solutes leaving the former LTVSMC Tailings Basin.

Thematic Response

At the Plant Site are a number of monitoring wells in the surficial aquifer that have clearly been impacted by the existing LTVSMC tailings. The chemical concentrations in these wells are considered to be the direct result of chemical release from the existing tailings. Theoretical release rates from the existing LTVSMC tailings have been developed using humidity cell data and measurements made at other similar tailings facilities. Using the theoretical chemical release rates, the existing conditions GoldSim model simulates chemical release from the LTVSMC tailings and transport to the monitoring wells. When this simulation was first attempted, it was found that for tailings-related constituents, the predicted chemical concentrations at these monitoring wells were generally higher than the measured concentrations. To provide a better match between predicted and measured concentrations, a factor was applied to the theoretical chemical release rates for the LTVSMC tailings. Referred to as "calibration factors," these calibrated inputs reduce the rate of LTVSMC tailings chemical release so that the predicted concentrations in affected monitoring wells are similar to the measured concentrations. Depending on the chemical constituent, the values of the calibration factors range from 1 (no modification) to 0.0001 (large reduction). It is interpreted that the calibration factors account for geochemical and hydrological processes that tend to reduce chemical concentrations (e.g., mineral precipitation and adsorption), but which are not explicitly incorporated into the GoldSim model. Note that there is no field basis for calibrating the future tailings from the NorthMet Project Proposed Action, so no calibration factors are used to adjust the chemical release rates from these tailings.

Theme WR 051

Theme Statement

The Mine Site existing conditions model does not account for variable discharge from the Northshore Mine into the Partridge River. It is unclear whether the Northshore Mine appropriations permit would be transferred or if it is an approximation of the discharges expected for the East Pit and West Pit.

Thematic Response

The theme correctly notes that pumped discharges from the Northshore Mine are sporadic with a variable flow rate. The GoldSim model is not designed to simulate flow/chemical conditions in the Partridge River when the Northshore Mine is actively pumping and its discharge dominates the river flow. There are two sources of Northshore inputs to the Partridge River that are more continuous and with less variable flow rates: seepage from the Western Pond and storage/release from wetlands (of previously discharged water). GoldSim consolidates these flows into a single integrated Partridge River input that has a constant flow rate and uniform chemical concentrations. Based on calibration to existing Partridge River water quality, the Northshore discharge flow rate used in the FEIS GoldSim model is 2.6 cfs and has a sulfate concentration of 28 mg/L. For the impact assessment, this constant rate input to the river adequately characterizes flow inputs from the Northshore Mine when it is not actively pumping. See FEIS Section 5.2.2.3.2 for more information.

Note that the Northshore Mine is expected to end operations about calendar year 2070 and this would result in cessation of mine-related flow inputs into the Partridge River. The FEIS GoldSim models for Project Conditions and Continuation of Existing Conditions incorporate the ending of Northshore inputs in calendar year 2070 (mine year 55).

The Northshore Mine permit would not be transferred to PolyMet, but could be transferred to new owners of the Northshore Mine (in the event that the ownership changes), although no such transfer is currently anticipated.

Pit inflows and pit discharges from the NorthMet Project Proposed Action are estimated from site-specific data and analyses. Current Northshore discharges are not used to approximate potential discharges from the future NorthMet Project Proposed Action-related mine pits.

Theme WR 052

Theme Statement

Due to underestimated baseflow at the Plant Site, the GoldSim model's recharge and surficial deposit hydraulic conductivities are too low. This results in underestimated chemical loading to the Embarrass River.

Thematic Response

Groundwater baseflows used in the SDEIS and FEIS Plant Site GoldSim model are best-estimate values based on reliable stream gaging data. Areal recharge and surficial aquifer hydraulic conductivity are tied to groundwater baseflows, so at the Plant Site, these are best estimates, as well. See FEIS Section 5.2.2.2.3 for more information.

For the Partridge River at the Mine Site, a detailed GoldSim sensitivity analysis was conducted using groundwater baseflows four times larger than the best-estimate values. As part of the sensitivity analysis, appropriate modifications were made to surficial aquifer hydraulic conductivities and aerial recharge based on a recalibration of the Mine Site MODFLOW model. In addition, a recalibration was performed for surface water runoff concentrations. Results of the high groundwater baseflow rate scenario were compared with the best-estimate scenario to evaluate the degree to which predicted NorthMet Project Proposed Action impacts are sensitive to groundwater baseflow and related inputs. The FEIS reports the results of the sensitivity analysis in FEIS Section 5.2.2.3.2. The Mine Site sensitivity analysis indicates that modeled groundwater and surface water concentrations are sensitive to changes in baseflow. However, the NorthMet Project Proposed Action's ability to meet groundwater quality and surface water quality evaluation criteria is not sensitive to changes in baseflow. Evaluation criteria can be found in Section 5.2.2.

In addition, because the Plant Site GoldSim model uses similar equations and inputs pertaining to groundwater baseflow and related flow/transport processes, it is expected that the results of conducting similar sensitivity analyses would show that groundwater and Embarrass River chemical concentrations would also have little sensitivity to assumed groundwater baseflows.

Theme WR 053

Theme Statement

The Plant Site GoldSim model does not account for the hydraulic connection between groundwater in surficial deposits and overlying wetlands; it incorrectly assumes that they are hydrologically disconnected. The GoldSim model also incorrectly assumes that areal recharge is the only flow connection between ground surface and surficial aquifer groundwater.

Thematic Response

Using an observational approach based on data from similar nearby mine sites (i.e., analog method), drawdowns in the surficial aquifer are not expected to extend very far from the mine pits. This is explained by the following factors: 1) the surficial aquifer is thin and moderately permeable, 2) the surficial aquifer is subject to aerial recharge, and 3) the surficial aquifer is underlain by low-permeability bedrock that limits downward leakage from the surficial unit. These factors support the conclusion that some degree of hydraulic connection between the surficial aquifer and wetlands did not need to be included in the GoldSim model. See FEIS Section 5.2.2.3.2 for more information.

Theme WR 054

Theme Statement

With regard to the east side of the Tailings Basin, the GoldSim model does not provide a groundwater flowpath, incorrectly assumes a no-low boundary condition at the embankment toe, and does not provide a transport analysis for tailings water that leaves the Tailings Basin.

Thematic Response

The theme correctly notes that there would likely be subsurface flow below the East Embankment from west to east and that surface seepage may occur at the toe. The FEIS Plant Site MODFLOW model was modified from the SDEIS to include: 1) the presence of surficial deposits below the East Embankment, 2) boundary conditions (drain and/or river cells) along the embankment toe to allow the potential for surface seepage, and 3) hydrologic inputs to account for the presence of the proposed drainage swale. See FEIS Section 5.2.2.3.3 and PolyMet 2015j and PolyMet 2015i, as cited in the FEIS, for more information.

Similar to other locations along the perimeter of the Tailings Basin, the NorthMet Project Proposed Action was modified to include installation of a containment system along the East Embankment where it is underlain by surficial deposits. Given the hydrogeology of the area east of the Tailings Basin and the proposed swale to be constructed there, this containment system would have higher hydraulic head on the east side compared to the west (tailings) side where a pumped trench would depress the groundwater level. This would create hydraulic gradients in the slurry wall and in shallow bedrock that would drive (low) flows from east to west across the containment system. This set of hydraulics would result in complete capture of all tailings water approaching the containment system from the Tailings Basin. Because the system would achieve complete capture of tailings water, an east side chemical transport flowpath is not needed in the Plant Site GoldSim model. There is no hydrologic reason to expect that impacted water from the Tailings Basin would migrate east of the containment system.

Theme WR 055

Theme Statement

The FEIS should analyze the effects of water and soil contamination from copper smelting. There is considerable evidence that leaching from the slag waste piles at smelting facilities may extract and concentrate soluble radioactive materials, potentially affecting drinking water supplies.

Thematic Response

The NorthMet Project Proposed Action would not use smelting to produce metal concentrate. The Project Proposer plans to use chemical flotation and an autoclave as described in FEIS Section 3.1.1.6.

Theme WR 056

Theme Statement

There are numerous general concerns about the Plant Site GoldSim model. Two critical issues are that the model does not include a flow/transport analysis on the south side of Tailings Basin (including the SD-026) and that it does not include any bedrock flowpaths. In addition, the SDEIS does not show important GoldSim results including process makeup water requirements, Colby Lake pumping over time, and flow rates of treated and untreated water sent to or received from the Mine Site. The GoldSim model needs to consider lower capture efficiencies, more conservative assumptions in general, the effects of buried channels on flow/transport, and more accurate Tailings Basin runoff estimates. Due to incorrect assumptions about baseflow, the model underestimates chemical load to the Embarrass River. Inputs to the model do not consider all the available data, and model results would be different if all data had been used.

Thematic Response

PolyMet committed to upgrading and/or installing containment systems at the south side of the Tailings Basin (near SD0026) to achieve 100% capture of tailings water that migrates beyond the basin perimeter as groundwater or surface water. In conjunction with containment systems installed by Cliffs, PolyMet would be required to upgrade the performance of existing containment systems and/or construct additional controls to achieve this performance specification. Because 100% capture of tailings water would occur at the SD0026 location, there is no need to include a south groundwater flowpath in the Plant Site GoldSim model.

Additional information and modeling results is reported in the FEIS including process makeup water requirements, Colby Lake pumping over time for process makeup, surface water augmentation, and flow rates of treated/untreated water sent to (or received from) the Mine Site.

As discussed in the responses to themes WR 018, WR 019, WR 020, and WR 022, the assumed capture efficiencies of the groundwater containment systems are justified and supported by modeling.

As discussed in the responses to themes WR 003 and WR 052, the groundwater baseflows used for the Embarrass River are reliable and based on good-quality stream gaging data.

Inputs to the Plant Site GoldSim model are based on all site data collected through the end of 2013. Data not directly used to develop model inputs was either unreliable or not relevant.

Theme WR 057

Theme Statement

With regard to the Tailings Basin pond water balance, the GoldSim model is incomplete, does not justify the hydraulic conductivity value or calculations used to compute 6.5 in/yr of leakage, and does not evaluate Tailings Basin pond overflow during extreme storm events. There is no explanation of how the Tailings Basin pond size or chemistry affects water concentrations at the Tailings Basin toes or why the Tailings Basin must remain saturated. The FEIS should acknowledge that the Tailings Basin pond would increase the leakage of impacted water to groundwater. Pond water would be toxic.

Thematic Response

Water from the Tailings Basin currently seeps and would continue to seep at its toe. The chemical makeup of this water is affected by the reactions with tailings materials as it moves through the Tailings Basin. These chemical reactions are minimized if the tailings remain saturated, thus removing oxygen from the chemical equation. Under the NorthMet Project Proposed Action, the tailings would remain saturated during operations as new tailings (saturated with process water) were added to the Tailings Basin. In post-closure, the Tailings Basin pond seepage would be managed by placing a bentonite layer at the bottom of the pond to reduce this seepage. Fluctuation in pond size would occur during operations and post-closure, which would affect the volume of water entering the underlying tailings. A containment system would be built around the Tailings Basin to capture all surface seepage and nearly all groundwater seepage from the Tailings Basin.

The FEIS contains new text describing pond leakage and how the chemistry of this leakage would affect chemical concentrations at the Tailings Basin toes. In general, the chemistry of water at the Tailings Basin toes results from a combination of chemical-loading from pond leakage, meteoric infiltration, chemical release from currently existing LTVSMC tailings, and chemical release from future NorthMet Project Proposed Action-related tailings. See FEIS Sections 5.2.2.2.1 for additional information.

The 6.5-inches-per-year pond leakage flux is not computed, but is a stated engineering performance specification. The hydraulic conductivity that achieves this leakage flux is computed using a credible Darcy's law calculation.

The GoldSim model contains algorithms that can allow the pond to overflow during periods of high rainfall, so the model does in fact evaluate pond overflow. The pond size and design are such that the GoldSim model predicts that the pond never overflows during the 500-year simulation period.

The FEIS acknowledges that there would be future leakage from the Tailings Basin pond and the GoldSim model performs calculations to estimate the flow rate and chemical loading associated with this leakage.

Theme WR 058

Theme Statement

There are numerous issues associated with how surficial groundwater flowpaths are modeled in GoldSim. Issues include the inappropriate assumption of constant saturated thickness; flowpath orientations that are inconsistent with MODFLOW results; failure to consider heterogeneity or the presence of high permeability features; failure to consider lateral and vertical dispersion; and the lack of a rationale for the assumption that groundwater can migrate long distances without discharging to wetlands. With regard to hydraulic conductivity, the assumed input probability distribution is not justified and does not include the full range of measured values; it is unclear whether different values are applied to different flowpaths for each simulation. The assumed longitudinal dispersivity values are highly speculative. The assumed sorption coefficients are speculative, not sufficiently conservative and do not account for the saturation of adsorbed solutes within flowpaths or fractures. The FEIS should acknowledge that other constituents would be affected by sorption. With regard to capture system bypass, the calculated best-estimate flow rate of 21 gpm is too small for a facility this size, and even this flow rate represents too much chemical load leaving the site.

Thematic Response

The surficial groundwater flowpaths in the Plant Site GoldSim model were set up with one-dimensional uniform flow and were considered reasonable approximations to the site conditions for the purpose of evaluating groundwater chemical transport. Important inputs to the GoldSim transport analysis were flowpath length, width, saturated thickness, hydraulic conductivity, recharge, hydraulic gradient, porosity, and sorption. The input values used in GoldSim were reasonable given the one-dimensional nature of the transport analysis.

Longitudinal dispersivity is a scale dependent parameter (rather than a fixed material property) and the values used in the GoldSim surficial flowpaths were reasonable given their physical lengths. Neglecting lateral and vertical dispersivity was conservative and would tend to overestimate chemical concentrations within the flowpaths.

Treating the flowpaths as homogeneous was reasonable in that the purpose transport analysis was to estimate average groundwater travel times to the evaluation locations for impact assessment.

Most sorption values used for selected chemical constituents were based on USEPA guidance documents. The mean and max antimony values were based on the lowest two values from site-specific sorption test work. Due to the low absolute concentrations of constituents modeled with adsorption, it was reasonable (and standard practice) to assume that adsorption sites would not become "saturated." This was also a reasonable assumption for fractured bedrock, because diffusion can transport chemicals from fractures into the rock matrix, which greatly increases the available adsorption sites. For constituents not modeled with adsorption, the approach was conservative in that groundwater concentrations and travel times would both tend to be underestimated in the transport analysis.

In GoldSim, the distribution used for hydraulic conductivity was meant to represent the uncertainty in the "mean" or a really averaged hydraulic conductivity within the flowpath. As such, the range of the input hydraulic conductivity did not need to cover the full range of measured values. For the GoldSim Plant Site model, the same hydraulic conductivity was used in all three flowpaths, but the value was statistically changed for each realization of the Monte Carlo simulation.

The capture systems along the Tailings Basin perimeter would collect (for treatment) groundwater, surface water, and wetland water on the inside (tailings side) of the containment system alignment and these water sources were incorporated into the GoldSim model. The assumed capture efficiency (90%) and bypass flow rates were conservatively low based on a series of vertical-section MODFLOW models presented in Attachment A of the Water Modeling Data Package - Plant Site (PolyMet 2015j, as cited in the FEIS).

It is acknowledged that the FEIS GoldSim model did not explicitly simulate groundwater upwelling into wetlands between the containment systems and the Embarrass River (if any). No attempt was made to model this highly uncertain process, but instead the FEIS relies on long-term monitoring of the wetlands and implementation of adaptive mitigation measures (if necessary) in the event that wetlands are affected in the future.

In response to SDEIS comments, the FEIS Plant Site MODFLOW model was modified and recalibrated for the FEIS as follows: 1) updated areal distribution of surficial deposits and bedrock outcrops, 2) established surficial deposits below and adjacent to the East Embankment, 3) used drain or river cells along the East Embankment to allow surface seepage of tailings water, 4) incorporated the hydrologic effects of the future swale to drain surface water from the East Embankment area, 5) recalibrated model material properties and boundary conditions using all available site data through 2013 (this is mostly new hydraulic head information), and 6) expanded the use river and drain cells to provide a more accurate representation of wetlands outside the Tailings Basin. As a result of these changes, the FEIS Plant Site MODFLOW model no longer has no-flow boundary condition at the toe of the East Embankment, and river and/or drain cells in surficial deposits are in place to allow the potential for surface seepage ("upwelling") were added. The model was calibrated to insure that hydraulic heads in the tailings and adjacent surficial deposits were not well above ground surface. In the FEIS Plant Site MODFLOW model, storage coefficients for the surficial deposits and bedrock outcrops were assigned and/or calibrated to be more in line with literature values for these types of materials.

Theme WR 059

Theme Statement

Based on the Plant Site GoldSim model, the FEIS should show groundwater concentration profiles along flowpaths at different points in time and groundwater concentrations up to 500 years. The FEIS should acknowledge that lead loading would increase compared to existing conditions. Concentrations of selenium are above the standard, and that constituents treated as non-absorbed would have migration velocities less than or equal to the simulated velocity. The FEIS should better describe the "dilution effect" on aluminum.

Thematic Response

Potential groundwater impacts are assessed at specific evaluation locations defined for each flowpath. This methodology satisfies both federal and state environmental review requirements to inform regulators, the project proponent, and public of the type, extent, and reversibility of impacts. Monitoring would typically occur at the source origins to document whether flowpath water quality predictions are being satisfied. If not, then contingency and/or adaptive measures would be applied to address potential concerns. See FEIS Section 5.2.2.1.1 for information on evaluation locations.

The FEIS Section 5.2.6 Aquatic Species, Table 5.2.6-5, indicates that under the NorthMet Project Proposed Action, lead concentrations (maximum P90 values) are higher at Plant Site surface water stations than under Continuation of Existing Conditions (Stations MLC-2, PM-11, PM13, and PM-19). The load rates for lead in each of the Plant Site surface water stations are listed in the Water Modeling Data Package Vol. 2 – Plant Site (PolyMet 2015j, as cited in the FEIS), Attachment K Median Loading Rates to the Surface Water Evaluation Locations (Culpability Analysis).

Regarding constituents assumed to be non-attenuated in groundwater, the FEIS has been modified and now states that one the constituents modeled as unattenuated in the GoldSim model may in fact exhibit some attenuation due to adsorption onto surfaces in the surficial and bedrock aquifer. The peak concentrations of these solutes would arrive at the evaluation points later than estimated in the GoldSim model, though the peak concentrations of such late-arriving solutes would be lower than the concentrations estimated under the assumption in the FEIS of un-attenuated transport (FEIS Section 5.2.2.3.2 Partridge River Watershed, subheading “Contaminant Transport in Groundwater from Waste Rock).

The FEIS Section 5.2.2.3.3, Embarrass River Watershed (subsection Aluminum in Surface Waters of the Embarrass River Watershed), has been revised as follows to clarify the meaning of the “dilution effect” on aluminum: Because the aluminum concentration in the Tailings Basin seepage (5 to 20 μg/L) is lower than the aluminum concentration in the ambient groundwater (50 to 90 μg/L), the net effect of mixing these two waters is that the aluminum concentration in the ambient groundwater is decreases relative to what it was before mixing.

Theme WR 060

Theme Statement

The Plant Site GoldSim model as described in the SDEIS has numerous deficiencies. These include inadequate explanation and justification of general geochemical inputs, calibration factors, and concentration caps. GoldSim model inputs also do not capture the full range of possible chemical loadings, and do not account for increased leaching due to acidic conditions. The FEIS should include a better geochemical discussion of sulfate and the dilution factors applied in the model. The model underestimates seepage through the Tailings Basin and underestimates chemical loading to groundwater due to the unreasonable assumptions about high capture efficiency. In addition, the FEIS should report the following GoldSim information:

- Source concentrations over time;

- Chemical loading over time and a comparison to existing conditions;

- Long-term residual concentrations at chemical sources during closure; and

- P90 flow rates and chemical concentrations.

Thematic Response

Specific values for geochemical parameters, including calibration factors (applied only to the existing LTVSMC tailings) and concentration caps, were developed during the Impact Assessment Planning process for Geochemistry (MDNR et. al. 2011, as cited in the FEIS). These are presented in the Water Modeling Data Package Vol 2 - Plant Site (PolyMet 2015a, as cited in the FEIS), and in the Waste Characterization Data Package (PolyMet 2015q, as cited in the FEIS). The calibration factors applied to the LTV SMC tailings model were approved for use in the EIS during review of the model Waste Characterization Data Package (PolyMet 2015q, as cited in the FEIS). The geochemical parameters were selected based on direct measurements on material from the NorthMet and LTVSMC facilities, and where appropriate, from empirical studies at analogous mine sites, and the review of the technical studies deemed the selected and presentation of these values to be appropriate and sufficient for the FEIS.

The geochemical behavior of NorthMet rock is related primarily to its net acid-generating potential, as indicated by the concentration of sulfide S in the rock and tailings. The humidity cell samples (42 of Category 1, 26 of Category 2/3, and 21 of Category 4) were dispersed spatially across the deposit to include the different formations (see Large Table 2 of the Waste Characterization Data Package [PolyMet 2015q, as cited in the FEIS]), and covered the range of sulfide S concentrations (Table 4-1 [Matrix for Sample Selection in Waste Rock Types] in SRK 2007b, as cited in the FEIS). The accuracy of PolyMet's ability to categorize the waste rock in the NorthMet deposit was assessed by a comparison of the chemical data set (approximately 18,800 sulfide S analyses) to their geostatistical model of sulfide S in ore and waste. Results of this statistical audit found that the number and spatial distribution of these sulfide analyzes supported adequately the geologic block model developed to describe the ore and waste rock distribution in the deposit (Optitech 2012). Based on these results, and other supporting data, the Co-lead Agencies believe that the existing data is sufficient to support water quality modeling for the FEIS.

The increase in oxidation rate and solute release in response to the onset of acidic conditions is included explicitly in the GoldSim Mine Site model, as described in the Waste Characterization Plan, Section 9.4 Acidification and Long-Term Decay in Constituent Release.

The discussion of sulfate release from mine waste and its transport in surface and groundwater, as described in the FEIS and Waste Characterization Data Package (PolyMet 2015q, as cited in the FEIS), is complete, as required to support the FEIS water quality modeling.

Seepage rates in the Tailings Basin (and hydraulic conductivity of the underlying surficial aquifer) are based on a calibration of the Plant Site MODFLOW model to past measurements of flow rates during drain down of the LTVSMC tailings. This model has been recalibrated and rerun for the FEIS to incorporate new data and input assumptions, and it is the results of the calibrated hydraulic model that produces the values of solute dilution between sources and the evaluation locations in surface and groundwater.

The assumed capture efficiencies in water quality modeling were provided by the Proponent in memorandum that is referenced in the FEIS. Cross-section MODFLOW models of the tailings basin capture systems indicate that very high capture (greater than 90%) would be achieved in both the surficial deposits and underlying upper bedrock. Containment on the south side of the

Tailings Basin (near SD0026) was presented as an adaptive mitigation approach. If there is leakage from the tailings basin into bedrock, it would be collected by the capture systems and by-pass (if any) would be sufficiently small to not cause impacts that exceed water quality criteria. Further, the project Proponent has committed to upgrading existing containment systems and/or constructing new systems as necessary to achieve 100% capture. The estimates for tailings seepage and tailings basin capture system are sufficient for the NorthMet FEIS.

Estimates for mass loading and effluent concentrations from Mine Site facilities over the model simulation period are presented in Attachment I and J of PolyMet 2015m, as cited in the FEIS; and for Plant Site tailings facility, values for these model results are presented in Attachments D through I of PolyMet 2015j (as cited in the FEIS).

Subtheme WR 060-1

Theme Statement

Provide values for volumetric flow rates and solute concentration estimates for the water released from each source and in each waste-water stream, with concentrations shown before and after application of concentration caps and adsorption and reported in units comparable to water quality standards.

Thematic Response

Estimates for mass loading and concentrations from the Plant Site Tailings Basin are presented in the attachments to the Plant Site Water Modeling Data Package (PolyMet 2015j, as cited in the FEIS).

The NorthMet GoldSim water quality has not been run without concentration caps in source materials or adsorption-related attenuation in groundwater because these are widely observed effects in mine environments. Thus eliminating these effects from the GoldSim model would not be realistic, and such a model would not improve the assessment of environmental effects.

The effect of concentration caps can be seen in measured composition of effluent from the Amax Stockpiles, in this case showing their dependence on pH (Large Figures 23 through 27, PolyMet 2015q, as cited in the FEIS).

The selection of specific values for concentration caps was considered by the Co-lead Agencies (see Table 1, MDNR et al. 2011, as cited in the FEIS). The specific ranges for concentration caps were estimated from mineral solubilities (for those solutes commonly found as secondary minerals in mine wastes) or observed in effluent from field-scale mine wastes (see Table 1-30 through 1-33 in the NorthMet Mine Site Water Modeling Work Plan [Barr 2012c, as cited in the FEIS] and Table 1-15 in the NorthMet Plant Site Water Modeling Work Plan [Barr 2012d, as cited in the FEIS]). Concentration caps were based on field studies rather than laboratory studies so that the rock-to-water ratios would be similar to conditions expected at the Mine Site and Plant Site, and thus would avoid the higher rock to water ratios in humidity-cell tests that could underestimate caps. The use of concentration caps is described in Section 5.2.2.2.3, Water Quality Modeling (GoldSim), in the FEIS. The antimony concentration cap was in part based off of lab data.

Regarding adsorption, the values are from USEPA guidance intended to support exposure assessments, and the specific values applied in the NorthMet GoldSim model are from the low end of the ranges, (i.e., tend to produce estimates of rapid transport; PolyMet 2015j, as cited in the FEIS), with the exception of antimony which relied upon site-specific material testing data to establish an adsorption probabilistic input range .

Subtheme WR 060-2

Theme Statement

Provide substantiation for reduction in reaction rate in tailings produced by bentonite-amended layers.

Thematic Response

The proposal to blend bentonite clay into tailings layers is intended to reduce hydraulic conductivity and thus the rate of water flux, and to increase moisture retention in the amended layer and thus reduce the rate of oxygen diffusion and associated sulfate release. The effectiveness of a properly installed bentonite-amended layer of tailings to reduce oxygen diffusion and associated sulfate release was evaluated quantitatively as part of the QA review of the GoldSim model of water and solute flow in the Plant Site. Although this review did not match exactly the GoldSim results, it did find that the discrepancies were "not large compared to the higher sulfur generation rates in other subareas of the FTB," and "did not recommend modifying the current model for this QA audit" (ERM 2013, as cited in the FEIS).

The amendment approach at the Plant Site is discussed in Barr 2010. Published field-scale tests of bentonite amendment found that bentonite layers remain effective through freeze-thaw cycles, and, in one specific test, a 0.46-meter thick layer of sand (range 3% to 8% bentonite by weight) found that the amendment could reduce oxygen diffusion by ~90%. However, these publications indicate that uniform blending is important, so that amendments would probably be applied in multiple layers, and that site-specific field tests would be required prior to full-scale application to tailings surfaces or the tailings pond bottom.

The current bentonite amendment plan for the Tailings Basin dam and beaches can be found in the Flotation Tailings Management Plan, Section 7 (PolyMet 2014k, as cited in the FEIS). The plan would be updated as necessary as part of facility permitting, with future in-laboratory material testing performed to confirm% bentonite addition requirements, and with in-field test plots constructed preceding initial cover construction activities to confirm material placement procedures. The specific methods for bentonite amendment at the Tailings Basin, including a material testing program and construction quality control plan would require approval by the facility engineer of record and PolyMet prior transitioning to full-scale implementation.

Subtheme WR 060-3

Theme Statement

Expand model analysis to consider solute transport in groundwater with no retardation effect.

Thematic Response

Adsorption is widely observed in studies of metal transport in groundwater, and is an important enough effect that the USEPA provides guidance documents with screening level values for adsorption (as “Kd”) to support estimates of exposure to solutes migrating in groundwater (USEPA 2005, as cited in the FEIS). This literature review by the USEPA indicates that Kd for the four metals assumed to be affected by adsorption in the NorthMet Project area surficial aquifer (arsenic, antimony, copper, and nickel) vary widely across different sites. In response, the GoldSim modeling selected values from the low end of this range, with the exception of antimony (i.e., values that produce rapid transport in groundwater, and thus earlier arrival at groundwater evaluation points [PolyMet 2015j, as cited in the FEIS, Section 5.2.1.3.3 Sorption, Table 5-7 Sediment Sorption Factor (Kd)]. Antimony which relied upon site-specific material testing data to establish an adsorption probabilistic input range. But eliminating entirely the effect of adsorption from the GoldSim model would not improve the assessment of environmental effects. The Co-lead Agencies thus do not believe that the GoldSim water quality model needs to be re-run without adsorption-related attenuation in groundwater.

Subtheme WR 060-4

Theme Statement

Provide estimates for pH, sulfate, and alkalinity predicted in the PolyMet pit lakes and tailings effluent, and compare these to the values observed in natural and mine-produced lakes in the region.

Thematic Response

Estimates for the concentration of all modeled solutes in the West Pit Lake are presented in the Attachment H of the Mine Site Water Modeling Data Package (PolyMet 2015m, as cited in the FEIS). For the tailings basin effluent, estimated concentrations are presented in Attachment G of the Plant Site Water Modeling Data Package (PolyMet 2015j, as cited in the FEIS).

The pH and alkalinity of water is a dynamic parameter that reflects chemical equilibrium condition, and is not predicted explicitly by the GoldSim model for any of the NorthMet Project area waters, including the West Pit Lake and the tailings effluent. However, the West Pit Lake is a component of the active water management and treatment system during and after the 20-year operating life of the mine, and its water quality would be monitored as part of the NorthMet Project Proposed Action (PolyMet 2015d, as cited in the FEIS, Large Figure 1, Water Treatment Overall Flow Sheet-Operations, and Large Figure 3, Water Treatment Overall Flow Sheet- Long-Term Closure.)

Water quality in the West Pit lake would thus be controlled by pumping and, where necessary, treatment. Most of the effluent from the Tailings Basin would be captured and treated, and the GoldSim model results and associated effects presented in the FEIS account for some bypass of the capture system. Because the environmental effect of the West Pit Lake and Tailings Basin are not dependent on water quality of other lakes, the Co-lead Agencies do not plan to compare model results for the West Pit Lake to a compilation of water quality in other lakes in the region.

The acid-generation potential (as defined by the sulfide S concentration) in NorthMet floatation tailings would be low enough to ensure that these never produce acidic leachate. Specifically, the sulfide S concentration in the tailings , which would be controlled by the flotation process, would have a maximum value of 0.12%. Multi-year synthetic weathering tests (humidity cells) on NorthMet tailings demonstrated that the sulfide-mineral oxidation rate (and associated acid production) in the tailings decreases over time (Attachments C and A of the Waste

Characterization Data Package [PolyMet 2015q, as cited in the FEIS]). Further, at some time between ~100 and 200 weeks after they start weathering under atmospheric conditions, the pH of the effluents reaches a minimum, and thereafter the pH becomes steady or increases slightly (Attachment F of the Waste Characterization Data Package).

Based on these weathering tests on tailings (and also results from tests on Category 1 waste rock, which is also <0.12% sulfide S), and incorporating a small correction for the possibility that CO_2 pressure may be higher in the tailings than in the atmosphere, the PolyMet tailing effluent should range between pH of ~ 7.1 and 7.7. Over the long-term (i.e., 50 to 100 years, and beyond), the general trend should be for pH to increase from the low end to the high end of this range (PolyMet 2015q, as cited in the FEIS).

Subtheme WR 060-5

Theme Statement

Provide details on field studies (e.g., monitoring results from existing mines and water treatment facilities) demonstrating that effluent from the NorthMet Project would not violate water quality criteria.

Thematic Response

The GoldSim model water quality predictions relied heavily on field-scale observations of water quality at analog mine sites, including the Dunka and Amax rock piles, which are located near the NorthMet Project area and are comprised of Duluth Complex rock.

The Amax Shaft Test Piles are six, 1,000-ton test piles constructed from rock removed from a test shaft sunk into the Babbitt Deposit in 1977 by AMAX, Inc. (Lapakko 1993, Lapakko et. al. 2002, and MDNR 2004). The rock contained sulfur concentrations varying from 0.64% to 1.41%, copper concentration of 0.3% to 0.4%, and nickel concentrations of 0.08% to 0.09%. The copper and nickel content were comparable to the NorthMet Project area but sulfur concentrations were much higher than would be expected for most waste rock at Mine Site. The piles were constructed on lined pads, and some of the rock surfaces were reclaimed with soils and glacial tills, and, in select cases, vegetated. Drainage from the piles was monitored from 1977 to 1994, after which the piles were dismantled and the rock encapsulated in concrete (SRK 2007b, as cited in the FEIS).

The Dunka Pit Stockpile is Duluth Complex rock that was removed to access underlying iron formation at the Dunka Pit, beginning in the 1960s (MDNR 1994 and MDNR 1996). Eight stockpiles varying in quantity from 0.1 to 21 million tons were constructed of which five contained mixed iron formation and Duluth Complex and three contained mainly Duluth Complex rock. Sulfur, nickel, and copper concentrations were determined on the rock. Treatment of the drainage from the stockpiles using wetlands has been investigated (Eger and Lapakko 1980, Eger and Lapakko 1988, and Eger et al. 2000). The ratio of solute release from stockpiles at the Dunka Mine relative to MDNR kinetic tests on Dunka Rock was used as the basis for the scale-up of solute release from NorthMet kinetic tests to estimate NorthMet Category 1 waste rock under field conditions (Section 8.2.8 of PolyMet 2015q, as cited in the FEIS).

The estimates for the concentration caps in NorthMet Project Proposed Action waste rock and tailings that drew from the analog-site effluent quality are described in Section 4.1.3.1 and Section 8.3 of PolyMet 2015q (as cited in the FEIS).

In tailings, resulting cap values are in the Water Modeling Work Plan – Plant Site, Table 1-15 Category 1 Concentration Cap Distributions. In waste rock, resulting caps values that are drawn from analog mines are listed in the Water Modeling Work Plan – Mine Site, Tables 1-30 (Category 1 rock), Table 1-31 (Category 2/3 Duluth complex rock and ore, non-acidic), Table 1-31 (Category 2/3 Duluth Complex rock and ore, acidic conditions), and Table 1-33 (Virginia Formation, acidic conditions).

Finally, the reliability of the GoldSim model used for NorthMet Project Proposed Action acid-generating waste rock was checked by applying the model to observed effluent from the existing Amax waste rock piles (sulfide S concentration between 0.64 and 1.41 % sulfide S). The comparison applied laboratory-scale humidity-cell test results and the model factors for temperature, fragment size, and oxidation rate change following the onset of acidification. Results found that the model fit well to median sulfate-release rates, but that 95th percentile model concentrations exceeded observed sulfate-release rates (Table 8-6 of PolyMet 2015q, as cited in the FEIS).

Theme WR 061

Theme Statement

The Plant Site GoldSim model has the following critical deficiencies pertaining to bedrock:

- The model has no bedrock groundwater flowpaths;

- The model assumes without justification that bedrock flow and transport are negligible;

- The model does not consider vertical flow or vertical dispersion of chemicals from surficial deposits into bedrock; and

- The model does not consider the likely presence of high permeability structures and fault zones.

Thematic Response

Field-testing at the Plant Site indicates that upper bedrock hydraulic conductivity is about two orders of magnitude lower than the hydraulic conductivity of surficial deposits. Given this difference, calculations show that groundwater flow and chemical transport between the Tailings Basin and Embarrass River are dominated by the surficial aquifer and the bedrock system can be safely neglected in the impacts analysis. As a consequence, bedrock flowpaths are not needed in the Plant Site GoldSim model. If bedrock flowpaths were included, the model would show that they would have minimal effect on chemical concentrations in the Embarrass River.

Vertical dispersion from the surficial aquifer into bedrock is not considered in the GoldSim model because chemical migration in bedrock can be shown to have minimal effect on chemical concentrations in the Embarrass River.

The FEIS indicates that structural faults may exist between mine facilities and perennial streams that receive groundwater discharge. Because the landscape is covered with surficial deposits and there are limited bedrock outcrops, the existence of faults is conjectural and locations at best can only be inferred. It is unknown if faults (if and where they exist) behave as conduits or barriers to groundwater flow. Given these uncertainties, it is unlikely that a new, practical field program, with a goal to identify faults, would provide data to reasonably inform the impact assessments. The management approach is to set up a robust monitoring program during operations and closure to provide direct or indirect evidence on the existence of hydrologically significant faults. If significant faults are identified (i.e., faults that could lead to violation of water quality standards), then adaptive measures would be employed to mitigate the fault-related effects. See FEIS Sections 4.2.2.2.1 and 5.2.2.2.1 for further information.

Theme WR 062

Theme Statement

The FEIS should discuss differences between the Myers flow/transport model and modeling performed for the SDEIS. The Myers model predicts generally higher groundwater concentrations, higher concentrations in the Embarrass River, and greater flow effects on the Embarrass River. The FEIS should also discuss the higher recharge rates and hydraulic conductivities used in the Myers model, and it should acknowledge that the Myers model allows for lateral and vertical dispersion while the SDEIS model did not.

Thematic Response

The differences between the Myers model and the FEIS models can be compared/contrasted as follows:

- The Myers model considers higher groundwater baseflows in perennial streams and this leads to higher recharge and higher hydraulic conductivities for surficial deposits. Reliable gaging data for the Partridge and Embarrass Rivers justify the lower baseflows and associated lower recharge and hydraulic conductivities used in the FEIS models.

- The Myers model generally assigns higher hydraulic conductivities to bedrock units. These values are higher than what can be justified by field-testing at the NorthMet Project area or indicated in (Barr 2014b, as cited in the FEIS).

- The Myers model does not include all groundwater capture systems presented in the FEIS Project Description.

- The Myers model does not use concentration caps, so that computed chemical concentrations in some mine-related chemical sources are much higher than what is reasonable or observed at other similar mine sites.

- The Myers model uses lateral and vertical dispersion, while the FEIS models do not. These uncertain processes would tend to reduce chemical concentrations in the surficial aquifer, which is the dominating hydrogeologic unit that transports chemicals from mine facilities to the perennial rivers. With regard to dispersion, the Myers model would tend to compute lower chemical concentrations in the surficial aquifer compared to the FEIS models. By not considering lateral and vertical dispersion, the FEIS models tend to be conservative (i.e., more likely to overestimate impacts) compared to the Myers model.

These issues are discussed in more detail in the memorandum titled: "Comparison of the Myers Groundwater Flow/Transport model with the FEIS Impacts Analysis Models" (ERM 2015).

Given the above deficiencies of the Myers model, it is not considered a reliable basis for evaluating future impacts associated with the NorthMet Project Proposed Action.

Theme WR 063

Theme Statement

The FEIS should present WWTF and WWTP flow rates and influent concentrations over time, justify assumed effluent concentrations, and describe treated water discharge locations, including flows and timing. Some figures show that treated water would be discharged in a diffuse manner from a pipe that parallels and is close to the Tailings Basin groundwater capture system; however, the GoldSim model assumes that treated water is discharged at tributary streams close to the Embarrass River. The FEIS should explain this discrepancy.

Thematic Response

The FEIS contains 5.2.2-27, influent flows for WWTF, 5.2.2-41, outflows from WWTP for stream augmentation and 5.2.2-28 which reports effluent target concentrations for the WWTF. The assumed effluent concentrations are based on pilot-testing conducted by PolyMet and these results are summarized in the FEIS.

At the Mine Site, water balance modeling estimates are that discharge would begin in mine year 53, which is when the West Pit is predicted to be completely flooded by the combination of natural inflow (groundwater inflow and surface runoff) and the addition of treated water pumped into the pit from the Plant Site. Prior to discharging Mine Site water, the WWTF would be upgraded with a reverse osmosis or similar treatment system to meet the 10 mg/L sulfate standard for wild rice. The WWTF effluent would be discharged into an existing wetland via a culvert under Dunka Road, and eventually into the Partridge River via an existing tributary. This is described in the NorthMet Project Description (Section 4.4.2.1 Mine Pit Reclamation, and Large Figure 30), and in FEIS Section 5.2.2.3.2.

At the Plant Site, treated effluent would be discharged to either tributary streams feeding the Embarrass River or as diffuse flow from a discharge pipe that parallels the containment and is located on the north and west sides. As an acceptable approximation, the Plant Site GoldSim model only considers effluent discharges to tributary streams of the Embarrass River. With regard to groundwater concentrations, this is considered conservative because it does not consider the dilution effect that would occur if treated water were to discharge and infiltrate into the surficial aquifer just north and west of the Tailings Basin containment systems. Detailed design of the discharge would be addressed during water quality permitting.

Theme WR 064

Theme Statement

The evaluation locations in the Plant Site GoldSim model are not adequate to assess all potential groundwater and surface water effects, do not acknowledge that impacted groundwater may affect wetlands, do not consider the closest locations where impacted groundwater could discharge to surface water, do not consider the area in which groundwater emerges into surface water, and do not consider that impacted groundwater could affect drinking water wells. The

FEIS should acknowledge that groundwater concentrations would violate surface water quality standards at the point of discharge to surface water, that water quality in the Embarrass River would be degraded, that sulfate concentrations in groundwater and surface water are likely underestimated, and that there would be increased (or decreased) loading of lead and aluminum to groundwater and surface water. In addition, the GoldSim model does not evaluate specific conductance (a state water quality parameter with a standard). There needs to be more detailed discussion of chemical travel times to evaluation locations that are underestimated and a more detailed comparison of NorthMet Project Proposed Action-related effects on existing conditions. In addition to water quality criteria, effects should also be assessed using Health Risk Limits. The FEIS should also discuss the vertical extent of groundwater effects and the potential for chemicals migrating into bedrock.

Thematic Response

The groundwater quality criteria used in the FEIS are intended to be used to assess for impacts to groundwater at the Mine Site and Plant Site property boundaries, not within the NorthMet Project Proposed Action footprint. This approach is typically used in EISs for mining and industrial facilities, and the evaluation locations used in the NorthMet Mining Project and Land Exchange FEIS are consistent with this approach.

At the Plant Site, evaluation locations for surface water (other than the Embarrass River) are based on locations where groundwater is known to be released to perennial tributaries of the Embarrass River including Trimble Creek, Mud Lake Creek, and Unnamed Creek. These are verified groundwater release locations. To consider locations where groundwater release "could" occur would be speculative.

The groundwater capture system at the Plant Site would greatly minimize the potential for seepage to discharge to or otherwise affect downgradient wetlands. A comprehensive monitoring approach is recommended during operations, reclamation, and closure to identify such affects (if any). If effects are identified, adaptive mitigation measures would be invoked to remediate the situation and assure that water quality criteria are met.

Because the GoldSim models predict that water quality criteria would be met at the property boundary, it is highly unlikely that water wells (all located downgradient of the property boundary) could be impacted. This is because natural groundwater transport processes always lead to a reduction in chemical concentrations. The Co-lead Agencies would recommend a comprehensive groundwater monitoring program during operations, reclamation, and closure to evaluate groundwater chemistry outside the NorthMet Project area boundaries. In the unlikely event that groundwater was affected, adaptive mitigation measures would be invoked to remediate the situation and assure that water quality criteria are met.

Groundwater evaluation criteria apply to groundwater at the NorthMet Project area boundary and the GoldSim models predicts that these criteria would be met. Surface water quality criteria apply instream after the groundwater discharge has mixed with ambient surface water (independent of proximity to the NorthMet Project area boundary); the GoldSim models predict that these criteria would be met, as well. Evaluation criteria can be found in Section 5.2.2.

The Co-lead Agencies acknowledge that there would be increased loading of lead, aluminum, and sulfate in certain portions of the groundwater and surface water systems at the Mine Site and

Plant Site, but these would not cause exceedances of water quality evaluation criteria at the applicable evaluation locations.

Some of the comments attached to this theme state that concentrations of some constituents have been underestimated by the GoldSim model, but do not provide technical explanations for this claim. Without technical explanations, the Co-lead Agencies cannot provide a more comprehensive response to these comments.

For the different flowpaths, groundwater travel times to groundwater evaluation locations and surface water discharge points are presented in the FEIS, including the times for initial change in chemical concentrations and the times to reach peak concentrations. Once chemicals discharge from groundwater to surface water, it is assumed that migration is instantaneous to surface water evaluation locations.

The water quality evaluation criteria used in the FEIS are based on a combination of health-based water quality standards for drinking water sources (such as groundwater and Colby Lake) and mercury in surface water (fish consumption) and on aquatic life-based standards for surface waters.

Desktop calculations and GoldSim results clearly show that chemical migration in bedrock is negligible compared to migration in the surficial aquifer. Chemical migration in bedrock is not sufficient to affect chemical concentrations in surface water.

Electrical conductance provides an estimate for TDS and is used if there are no direct measurements of TDS. There are TDS standards for surface water (700 mg/L) and groundwater (500 mg/L), and at the request of the MPCA, GoldSim results include estimates for TDS at each time-step, calculated by summing major solutes (Water Modeling Data Package Vol 1 – Mine Site; PolyMet 2015m, as cited in the FEIS). In the FEIS, TDS has precedence over electrical conductance as a water quality criterion.

Theme WR 065

Theme Statement

The Plant Site GoldSim model does not account for seasonal effects, including variable recharge.

Thematic Response

Estimates of monthly and annual rainfall amounts were based on best available data obtained from weather stations near the NorthMet Project area. In both GoldSim models, these parameters were treated as uncertain inputs and assigned probability distributions to capture the range of conditions.

Theme WR 066

Theme Statement

The SDEIS does not adequately describe the design, performance, monitoring, and long-term operation of the Hydrometallurgical Residue Facility. Water would flow from the Tailings Basin to the Hydrometallurgical Residue Facility and this has not been analyzed.

Thematic Response

Text in FEIS Sections 3.2.2.3 and 5.2.14.2.3 discusses the design and construction of the Hydrometallurgical Residue Facility, and the Geotechnical Data Package Volume 2 (PolyMet 2014c, as cited in the FEIS) indicates the design would meet all factors of safety as required. The Hydrometallurgical Residue Facility would be constructed over the LTVSMC emergency basin. During operations, the double liner system for the Hydrometallurgical Residue Facility would minimize release of residue leachate, and any collected leakage would be pumped back to the Hydrometallurgical Residue Facility pond. During reclamation and closure and long-term maintenance, leakage would be routed and cycled through the Plant Site WWTP.

Seeps have been observed along the southern edge of the LTVSMC Tailings Basin Cell 2W. These seeps have diminished since the termination of the LTVSMC operations and are expected to remain minimal as Cell 2W is not proposed for use as part of the NorthMet Project Proposed Action. The design of the Hydrometallurgical Residue Facility acknowledges the presence of these seeps by including a collection drain that would collect water from the seeps below the proposed constructed embankment and liner systems to transmit the collected seepage away from the Hydrometallurgical Residue Facility. This seepage collection system would consist of a layer of free-draining soil that would reduce the potential for phreatic build-up below the liner.

The two liner layers on the Hydrometallurgical Residue Facility would be separated by a leakage collection system designed to collect any potential leakage. Each liner layer would consist of a geomembrane layer above a geosynthetic clay layer. A drainage collection system would also be installed during reclamation to collect drainage above the upper liner. The cap would consist of a geotextile fabric, overlain by a clay barrier layer, and a 40-mil low-density polyethylene layer. This would be covered with additional LTVSMC tailings or local till soils to sustain a vegetated cover. The FEIS includes available details from the updated Residue Management Plan (PolyMet 2014r, as cited in the FEIS).

Theme WR 067

Theme Statement

The assumed performance of the Hydrometallurgical Residue Facility liner system is not realistic for long-term closure and likely underestimates the amount of downward leakage from the Hydrometallurgical Residue Facility into groundwater and surface water. Leakage should be probabilistic input to the model. Seepage quality should be disclosed.

Thematic Response

The Hydrometallurgical Residue Facility would be double-lined to minimize release of water that has contacted the hydrometallurgical residue. The double liner would consist of a composite liner system utilizing a geomembrane liner above a geosynthetic clay liner with a second liner placed above the first, separated by a leakage collection system. This would substantially remove all hydraulic head from the lower liner and thereby virtually eliminate leakage from the Hydrometallurgical Residue Facility. It is expected that no water would be released directly from the Hydrometallurgical Residue Facility, so, appropriately, leakage from the Hydrometallurgical Residue Facility is not included in modeling.

PolyMet initiated laboratory testing to consider the chemical compatibility of the potential geosynthetic liner to be used with leakage from residue (PolyMet 2014r, as cited in the FEIS). Results indicated that a polymer-treated geosynthetic liner should be used that is manufactured specifically in anticipation of the chemical characteristics of the liquid and the pore water that would be contained within the facility. The hydraulic conductivity of the soil leakage collection system is not expected to degrade over time. Typical liner performance assumes a 500-year service life of the geomembrane; therefore, hydraulic conductivity of the liner is not expected to degrade over that time. Specific attributes would be determined during the geosynthetic clay layer development to achieve the desired performance before final installation. Findings of studies on geosynthetic liners indicate that performance is minimally affected by freeze-thaw cycles (PolyMet 2014c, as cited in the FEIS). At the Hydrometallurgical Residue Facility, the majority of the geosynthetic liner system would be below the water elevation, and therefore not exposed to freeze-thaw cycles.

Theme WR 068

Theme Statement

The SDEIS does not show the composition and flow of Hydrometallurgical Residue Facility pore water over time. Hydrometallurgical Residue Facility waste needs to be re-evaluated based upon the change to the hydrometallurgical process.

Thematic Response

The Hydrometallurgical Residue Facility would be double-lined to minimize release of water containing the hydrometallurgical residue. The double liner would consist of a composite liner system utilizing a geomembrane liner above a geosynthetic clay liner with a second liner placed above the first, separated by a leakage collection system. This would substantially remove all hydraulic head from the lower liner and thereby virtually eliminate leakage from the Hydrometallurgical Residue Facility. It is expected that no water would be released directly from the Hydrometallurgical Residue Facility. The purpose is to assess effects on the environment; thus, it is not relevant to evaluate the flow of pore water within the Hydrometallurgical Residue Facility. A description of the hydrometallurgical waste material is provided in FEIS Section 3.2.2.3.7; also refer to the response to HAZ002 for more information.

Theme WR 069

Theme Statement

The SDEIS does not describe the fate and transport of impacted water that leaks from the Hydrometallurgical Residue Facility.

Thematic Response

The Hydrometallurgical Residue Facility would be double-lined to minimize release of water that has contacted the hydrometallurgical residue. The double liner would consist of a composite liner system utilizing a geomembrane liner above a geosynthetic clay liner with a second liner placed above the first, separated by a leakage collection system. This would substantially remove all hydraulic head from the lower liner and thereby virtually eliminate leakage from the

Hydrometallurgical Residue Facility. It is expected that no water would be released directly from the Hydrometallurgical Residue Facility.

Theme WR 070

Theme Statement

The SDEIS does not address leaks and seeps of untreated, contaminated water. Possible discharges from the Tailings Basin emergency overflow is one example. The former LTVSMC Tailings Basin seeps and exceeds water quality standards for some parameters. Millions of gallons of polluted, untreated seepage would leave the Plant Site and Mine Site annually. The ground may filter this water. Clean-up may be needed and may not be possible.

Thematic Response

The FEIS identifies several features at the Mine Site and Plant Site where seeps may enter into surface water or groundwater, as well as environmental controls to eliminate or reduce and treat seepage exiting the NorthMet Project area. Discussion of seeps occurs throughout FEIS Section 5.2.2 in numerous subsections. During operations and in the initial portion of the closure and long-term maintenance period, the Tailings Basin would have substantial freeboard to accommodate large rainfall events, including precipitation from up to the 72-hour Probable Maximum Precipitation event (PMP). The PMP does not have an assigned return period, but it is usually assumed by hydrologists to be on the order of 100 million to 10 billion years. Tailings Basin pond water level would also be managed by pumping it to the WWTP. In the unlikely event that the pond fills, water would be directed to a constructed overflow channel that would manage water in order to maintain dam integrity.

Theme WR 071

Theme Statement

Field data for characterization is inadequate. The analysis has selectively used data, omitted important data, and failed to use recent data. Groundwater hydrology is not adequately characterized, and fractures are incorrectly characterized. Better hydraulic and water chemistry information would improve conceptual models for the prediction of solute transport and improve predictions of potential impacts to groundwater, engineering of containment systems, and design of monitoring systems. The FEIS is not credible because it misquotes cited references and assumptions on geology and hydrogeology go unsupported. The FEIS should depict the spatial relationship between the lowest rock quality designation values and fault zones and lineament trends mapped using LIDAR data.

Thematic Response

The FEIS relied on data collected through the end of 2013, which included 12 new monitoring wells at the Mine Site. In addition, the FEIS made use of new geotechnical data collected in 2014 along the northern, northwestern, and western perimeters of the Tailings Basin, which included geologic logs, 10 new surficial aquifer piezometers, slug tests in the piezometers, and 10 bedrock packer tests performed in five coreholes advanced into upper bedrock. Hydrogeologic site characterization was sufficient for purpose of environmental impact analysis.

All publically available and relevant studies were considered in developing the FEIS. These include technical reports prepared by the Proposer, reports from state and federal agencies, technical papers in peer-reviewed journals, and technical reports associated with other mine sites. The FEIS preparers drew on these information sources to the degree that they were reliable and relevant to the assessment of potential impacts from the NorthMet Project Proposed Action.

The FEIS provided a description of data used to assess impacts. An explanation was provided regarding any data used and not used in finalizing the FEIS MODFLOW and GoldSim models.

It is well-known that unexplained sampling/laboratory issues can cause occasional chemical results to be incorrect and unusable for site characterization. This happens to some extent on all large projects where sampling is conducted at many locations and for long periods of time. When an occasional data value is clearly anomalous and does not fit in any reasonable way with the bulk of the related data, it is an acceptable practice to not use the anomalous value for characterization to develop a more accurate site characterization.

During winter 2013-2014, an investigation of bedrock was conducted along the northern, northwestern, and western perimeters of the Tailings Basin. The investigation included five boreholes advanced into upper bedrock and 10 packer tests conducted in these holes. The investigation provided rock core, RQD data, and hydraulic conductivity of discrete intervals within the upper bedrock. The results of this investigation are reported in Barr 2014b, as cited in the FEIS) and in FEIS section 4.2.2.3.1.

It is correct that there are currently no bedrock monitoring wells at the Plant Site. Installation of bedrock monitoring wells would be specified as part of the permitting process, with the results used to assess the NorthMet Project Proposed Action performance on an ongoing basis.

The MODFLOW and GoldSim models for the Mine Site and Plant Site were modified and recalibrated using groundwater level and sampling data collected through the end of 2013. At the Mine Site, this included all 24 monitoring wells, including data from 12 newer wells.

Stream gaging data used in the SDEIS and FEIS are adequate to characterize groundwater baseflow, seasonal flow, and storm runoff in the Partridge and Embarrass rivers.

See the responses to themes WR 011 and WR 012 for additional discussions of fracture flow and hydrology.

Theme WR 072

Theme Statement

The FEIS should provide specific justification for the data that were collected (or not collected), as well as justification for any data excluded from the modeling.

Thematic Response

FEIS Chapter 4 contains a new table showing the categories of hydrology and water quality data collected. The table indicates the data were used and not used in the FEIS evaluation. Explanations are provided for data not used.

The SDEIS water quality modeling predicted that there would be no substantial flow/chemistry impacts to the Partridge River at downstream evaluation point SW-005, or to the Embarrass

River at downstream evaluation point PM-13, both of which are downstream of all NorthMet Project Proposed Action-related effects. These results not conducting extensive characterization or impact assessment of the St. Louis River watershed downstream of these evaluation points. The FEIS impacts analysis corroborates the SDEIS predictions of minimal impacts at SW-005 and PM-13.

Theme WR 073

Theme Statement

The FEIS should justify where assumed or extrapolated input values are used instead of field measurements.

Thematic Response

The Co-lead Agencies are responsible for determining the requirements and adequacy of data used for the EIS. Where field measurements were not available, model assumptions were reviewed and approved for use in impact analyses.

Theme WR 074

Theme Statement

The FEIS should acknowledge that the overall characterization of the Mine Site and Plant Site is less detailed than what is typically found in EISs for similar mines.

Thematic Response

Data collection and site characterization for any project's environmental review is unique based upon potential environmental impacts and applicable state regulations or guidance. The Mine Site characterization is adequate to assess the NorthMet Project Proposed Action impacts and measures available to avoid or minimize those potential impacts.

Theme WR 075

Theme Statement

The water resources analysis in the SDEIS includes no water samples from lakes near the Tailings Basin.

Thematic Response

Sampling these lakes would not have added substantially to the overall Plant Site characterization for the purpose of impacts assessment. Note that Spring Mine Lake is located upstream of the eastern side of the Tailings Basin and has been sampled for water quality.

Theme WR 076

Theme Statement

The FEIS needs to address why the SDEIS did not use sampling data from PM-11, nine sampling events from PM-12.1, and sampling data from wells GW-008, GW-009 and GW-010.

Thematic Response

Sample data from wells GW-008, GW-009, and GW-010 (FEIS Figure 4.2.2-13) are used in the FEIS. Analyses of water from wells GW-009 and GW-010 (and GW-011) are used to estimate existing groundwater quality in the surficial aquifer downgradient of the existing LTVSMC Tailings Basin (FEIS Table 4.2.2-24, Summary of Existing Groundwater Quality Monitoring Data Downgradient from the Existing LTVSMC Tailings Basin), and well GW-008 is one of the wells used to estimate existing water quality in the surficial Plant Site aquifer at the toe of the existing LTVSMC Tailings Basin (FEIS Table 4.2.2-23, Existing Pond Water and Groundwater Quality at the Tailings Basin).

Surface water sampling location PM-11 is on Unnamed Creek, which is downgradient from the existing LTVSMC Tailings Basin (FEIS Figure 4.2.2-1, Watersheds, Streams and Data Collection Sites). Sampling results from PM-11 include measured flows and water quality (Table 4-6 Summary of Recent Observed Flow Data Around the Tailings Basin, and Large Table 4 Surface Water Data Summary Embarrass River Watershed, Plant Site Water Modeling Data Package—PolyMet 2015j, as cited in the FEIS). These monitoring results from PM-11, along with results at other surface water locations (PM-19, MLC-2, and PM-13), "were used to validate or corroborate other model inputs and assumptions," and "the calibration of the No Action Model was approved by the Co-lead Agencies before modeling of the Project was conducted" (Section 5.2.1.4.5 of PolyMet 2015j, as cited in the FEIS).

Surface water sampling location PM-12.1 is on Spring Mine Creek, which receives discharge from Pit 5NW outflow (FEIS Figure 4.2.2-1 Watersheds, Streams and Data Collection Sites). It discharges upstream on the Embarrass River from where the existing LTVSMC tailings seepage reaches the Embarrass River, but samples at PM-12.1 were collected and analyzed (FEIS Chapter 4, Table 4.2.2-29), and results were used to assess dilution in the water quality model based on sulfate downstream of the Pit 5NW outflow (Section 4.4.3.3 of PolyMet 2015j, as cited in the FEIS).

Theme WR 077

Theme Statement

Climate inputs to the models did not fully account for variation in precipitation, given recent conditions. The FEIS should explain how water dependent aspects of the NorthMet Project Proposed Action, such as the storage of waste rock under water to limit the production of toxic leachate as well as groundwater and surface water resources in the NorthMet Project Proposed Action area, would be affected during severe droughts or flooding.

Thematic Response

The SDEIS was based on data generally collected through October 2012. The FEIS relied on new data collected through the end of 2013, which included 12 new monitoring wells at the Mine Site. In addition, the FEIS made use of new geotechnical data collected in 2014 along the northern, northwestern, and western perimeters of the Tailings Basin, and included geologic logs, 10 new surficial aquifer piezometers, slug tests in the piezometers, and 10 bedrock packer tests performed in five coreholes advanced into upper bedrock. Hydrogeologic site characterization was sufficient for purposes of environmental review.

All publically available and relevant studies were considered in developing the SDEIS and FEIS. These include technical reports prepared by the Proposer, reports from state and federal agencies, technical papers in peer-reviewed journals, and technical reports associated with other mine sites. The SDEIS and FEIS preparers drew on these information sources to the degree that they were reliable and relevant to the assessment of potential impacts from the NorthMet Project Proposed Action.

For the Mine Site, a GoldSim sensitivity analysis was conducted to assess the possible effects of future climate change on groundwater and surface water. It was concluded that reasonably foreseeable climate change would have little effect on pit inflows, pit lake water quality, groundwater chemical concentrations, and surface water chemical concentrations. These results are reported in the Mine Site Water Modeling Data Package (PolyMet 2015m, as cited in the FEIS). By analogy, the Plant Site is also expected to be minimally affected by possible future climate change.

Estimates of monthly and annual rainfall amounts were based at a minimum on the 30-year climatic normal data obtained from weather stations near the NorthMet Project area. In the GoldSim models, annual precipitation is treated as an uncertain input and assigned a probability distribution to capture the range of possible future conditions. While climate change may occur in the future, it cannot be stated at this time if rainfall would increase or decrease over the long term. Uncertain inputs to the GoldSim Model translate to a 50% probability that annual precipitation would be greater than 27.8 inches, a 15.7% probability that annual precipitation would be greater than 32.2 inches, and 2.3% probability that annual precipitation would be greater than 36.9 inches. Note that there are additional uncertain inputs to GoldSim for evaporation, runoff, and meteoric infiltration. Thus, the probabilistic approach to rainfall and associated climate parameters used in GoldSim represents a reasonable method for dealing with possible future climate change.

Severe drought conditions are not expected to affect the subaqueous storage of the tailings (under the pond) or the waste rock disposed of in the East Pit because a positive water balance is predicted for these facilities, making it unlikely that drought conditions would result in a long-term negative water balance that would affect constituents in those areas. The NorthMet Project Proposed Action facilities would be designed with excess storage to handle large storm events. If climate change gradually increased the frequency and size of storms, there would be ample time to identify the issue and increase storage and treatment requirements at the site.

Theme WR 078

Theme Statement

The number of monitoring wells at the Mine Site is insufficient and the deep groundwater wells should include continuous electrical conductivity monitoring to detect salinity changes as it is likely saline water would be encountered during the development of the East Pit and West Pit. The FEIS should disclose that exploratory drillings do not have to be sealed for 10 years and the possible impacts at these locations, especially to ubiquitous briny water formations. All monitoring wells should be hydraulically tested.

Thematic Response

The number and spatial distribution of monitoring wells installed and sampled at the Mine Site (24 wells in the surficial aquifer and 9 wells in bedrock; see FEIS Figure 4.2.2-7) was recommended by the Co-lead Agencies in consultation with the USEPA. The USEPA's specific recommendations included the number of wells to install, the total number of samples to collect, and the statistical method to evaluate the adequacy of the dataset for reliably indicating baseline water quality (Westlake 2011). A statistical summary of the groundwater quality data set that responded to these sampling requirements is presented in Large Table 5 (surficial aquifer) and Large Table 6 (bedrock) in PolyMet 2015m (as cited in the FEIS).

Regarding monitoring for salinity in bedrock groundwater, the Impact Assessment Planning review of groundwater quality concluded that "the Co-lead Agencies believe that the [sampling] data the from 5 wells provide sufficient data to characterize the baseline groundwater quality of the bedrock groundwater at the Mine Site" (MDNR et al. 2011, as cited in the FEIS). Continuous electrical conductivity monitoring is required to measure conductivity and salinity. As the mine pits are excavated to greater depths, the groundwater inflows would be sampled on a frequent basis for salinity and other chemical parameters. While unlikely, if saline water were encountered, mitigation measures would be invoked to deal with it. This would likely involve modifications to the WWTF to handle water with higher TDS. Under any conditions, the WWTF would produce effluent that meets regulatory standards for discharge to surface water.

Regarding hydraulic conductivity in bedrock, the SDEIS was based on data generally collected through October 2012 and no additional hydraulic testing was performed after that time. The FEIS was updated to use sampling data collected through the end of 2013, which included 12 new monitoring wells at the Mine Site. The Co-lead Agencies further evaluated the possibility of fractures and faults at the Mine Site and Plant Site to determine what (if any) changes needed to be made to model assumptions to accurately predict potential environmental effects for purposes of environmental review. The results of the analysis are included in FEIS Sections 4.2.2.2.1 and 4.2.2.3.1. The MODFLOW and GoldSim models for the Mine Site and Plant Site were modified and recalibrated using groundwater level and sampling data collected through the end of 2013, which included all 24 Mine Site surficial-aquifer monitoring wells. Contaminant transport considerations applied in GoldSim are addressed in FEIS Section 5.2.2.2.3 and results are provided in Section 5.2.2.3.2 for the Partridge River watershed and Section 5.2.2.3.3 for the Embarrass River watershed.

Theme WR 079

Theme Statement

The number of existing surface and groundwater monitoring wells and data at the Mine Site is insufficient, and there is no bedrock monitoring at the Plant Site.

Thematic Response

At the direction of the USEPA, additional monitoring wells were installed at the Mine Site after the DEIS. There are now 24 monitoring wells installed between proposed mine facilities and the Partridge River. These wells were sampled on a monthly basis for at least one year after installation and continue to be sampled on a less frequent basis. The current Mine Site groundwater monitoring network is adequate for developing the FEIS.

The number of monitoring wells at the Plant Site is adequate for preforming the impact analysis and developing the FEIS. The Co-lead Agencies acknowledge that there are no monitoring wells installed in bedrock at the Plant Site. Available information indicates that the bulk hydraulic conductivity of upper bedrock is about two orders of magnitude lower than the hydraulic conductivity of the overlying surficial deposits, so flow in the overall groundwater system is dominated by flow in the surficial aquifer and not bedrock. For this reason, the focus of groundwater monitoring is on the surficial aquifer. The installation of additional monitoring wells at the Plant Site, including bedrock wells, would be assessed as part of the permitting process.

Theme WR 080

Theme Statement

Hydrologic interpretation of the One Hundred Mile Swamp is not adequate and does not consider flow to other watersheds. The correctly delineated boundary of the One Hundred Mile Swamp should be included in the FEIS. A comparative government map of the swamp area, available at www.nationalatlas.gov/streamer, shows the swamp to be considerably larger. PolyMet should include time prior to the commencement of operations to plan and execute water flowage tests within and out of the One Hundred Mile Swamp.

Thematic Response

A National Atlas shows a single wetland complex (referred to as One Hundred Mile Swamp) as straddling the major watershed divide separating the Superior Basin from the Rainy River Basin. This appears to indicate that this wetland complex creates a conduit for water originating from the Mine Site to reach the Dunka River and, ultimately, the BWCAW. This single wetland complex shown on the National Atlas is not a delineated wetland; it does not meet the definition in accordance with the Manual (USACE 1987, as cited in the FEIS). The One Hundred Mile Swamp has not been delineated. The FEIS shows the approximate boundary of this complex. Wetlands are delineated using many factors in addition to hydrology; the boundary of One Hundred Mile Swamp, shown on the National Atlas as continuous, does not equate to a hydrologic connection. There are two hydrologic barriers between the Mine Site and the Rainy River Basin, including: 1) high ground north of the Partridge River that creates a watershed divide separating the Superior and Rainy River Basins, and prevents surface water from passing between the two. This major watershed divide is included in the National Atlas, as well as USGS and MDNR data sets. This divide is accurately presented in the FEIS Figures 4.2.2-2 and 5.2.2-22. 2). The second barrier is Yelp Creek and the Partridge River which encircle the northern, eastern, and southern sides of the Mine Site. These streams create a hydrologic "sink" for sources of water originating at the Mine Site. Surface runoff or groundwater seepage leaving the Mine Site would follow a gradient into Yelp Creek or the Partridge River, as opposed to continuing uphill towards the watershed divide (see FEIS Figure 5.2.2-4). Yelp Creek and the Partridge River extend farther west (i.e., more fully encompassing the Mine Site) than is shown on the map in question.

Theme WR 081

Theme Statement

The SDEIS does not accurately study the flow of water leaving the Mine Site to other surface water features. The FEIS should consider flows and water quality to and from other surface water features including Birch Lake, Unnamed Creek, Wetlegs Creek, Longnose Creek, Wyman Creek, Yelp Creek, Langley Creek, Dunka River, St. Louis River, Harris Lake, Lake Vermillion, Lake Superior, Hudson Bay, and the BWCAW. The SDEIS also does not analyze historical creeks beneath the Tailings Basin.

Thematic Response

Sampling of and impact analysis for surface waterbodies near the NorthMet Project area was sufficient for the purpose of impact analysis in FEIS (Sections 4.2.2 and 5.2.2). Most of the surface water features named in theme WR 081 are located in areas that have essentially no possibility of being affected by NorthMet Project Proposed Action-related activities, or for some features are outside the Lake Superior watershed (within which the NorthMet Project area is located). The FEIS impacts analysis predicts minimal impacts downstream of SW006 on the Partridge River and PM-13 on the Embarrass River, so watersheds downstream of these evaluation points would not experience NorthMet Project Proposed Action-related impacts. The FEIS analysis predicts essentially no impacts north of the Mine Site or south of the Partridge River. The FEIS analysis predicts essentially no impacts north or west of the Embarrass River. The historic creeks beneath the Tailings Basin no longer exists, but are considered in the Plant Site MODFLOW model by an increased thickness of surficial deposits below the tailings in this area.

Theme WR 082

Theme Statement

The discussion of current lead and aluminum exceedances in the Embarrass River is misleading. The NorthMet Project Proposed Action should not be allowed to result in or contribute to an exceedance of lead or aluminum. For pollutants that are based on hardness, such as lead, the WWTP effluent may meet the evaluation criteria but fail to do so in-stream where hardness is diluted by rainwater and groundwater. No analysis of the headwaters was done, so no conclusion can be drawn regarding lead and copper.

Thematic Response

FEIS Sections 4.2.2.3.2 and 5.2.2.3.3 discuss lead concentrations in the Embarrass River. New text is provided to avoid misinterpretation.

For surface water constituents with hardness-based evaluation criteria (including lead), a modified screening procedure was developed in the FEIS that, based on GoldSim results, predicted the frequency at which the NorthMet Project Proposed Action would exceed the criterion when Continuation of Existing Conditions (CEC) would not exceed for the same month. The constituent was retained for further evaluation if the frequency for this condition was greater than 5% of all monthly timesteps and realizations used in the GoldSim models. At the Mine Site and Plant Site, the only constituent/location that exceeded the 5% frequency was lead and PM-

11. The FEIS contains text that fully explains this procedure and summarizes the initial screening results.

The GoldSim models predict that aluminum commonly exceeds its evaluation criterion of 125 ug/L in surface water at the Mine Site and Plant Site. A more detailed evaluation of GoldSim results indicated that at surface water locations where aluminum exceeds the criterion, the magnitude and frequency of exceedance for the NorthMet Project Proposed Action was approximately equal to or less than the frequency or magnitude of exceedance for CEC conditions. It was concluded that the NorthMet Project Proposed Action would not cause significant additional exceedances of aluminum above and beyond what would occur without it. It was also concluded that predicted aluminum concentrations under the NorthMet Project Proposed Action would generally not be higher than predicted CEC concentrations. The FEIS contains text that describes this evaluation and summarizes the associated results.

Chemical impacts to surface water were analyzed at designated evaluation locations on the Partridge River, Embarrass River, and Embarrass River tributaries. The evaluation locations were surface water locations that were either upstream of the NorthMet Project area or could potentially be impacted by the NorthMet Project Proposed Action. Evaluations were not performed at other locations that were unlikely to be impacted..

Theme WR 083

Theme Statement

The discussion of current sulfate exceedances in the Partridge River is misleading. This is in part due to the continuation of existing conditions modeling scenario.

Thematic Response

FEIS Section 4.2.2.1.3 discusses current sulfate concentrations in the Partridge River. New text has been provided to avoid misinterpretation.

The wild rice sulfate standard of 10 mg/L only applies to waters determined by the MPCA to be waters used for production of wild rice, which, for the NorthMet Project Proposed Action, corresponds to downstream of Upper Partridge River Station SW-005 and downstream of Embarrass River station PM-13. Other upstream surface water monitoring stations might have sulfate values greater than 10 mg/L, but as these have not been designed wild rice waters, the standard does not apply at these locations. Additionally, as part of wild rice surveys conducted in 2009-2011, several monitoring stations reported relatively high concentrations of sulfate downstream of Colby Lake. Some of these stations were located in waters recommended by the MPCA to be waters used for the production of wild rice, and therefore the sulfate values reported for those locations exceeded the current 10 mg/L wild rice sulfate water quality standard.

Surface water sampling data indicate that under existing conditions, the 10 mg/L wild rice standard is exceeded about 50% of the time at SW-005 on the Partridge River, which is largely attributed to discharges into the river from the Northshore Mine located upstream of the NorthMet Project area. At PM-13 on the Embarrass River, the 10 mg/L sulfate standard is exceeded 94% of the time, and this is attributed to Pit 5NW that discharges to the Embarrass River upstream of the NorthMet Plant Site. These conclusions are based on sampling data and are not related to predictions CEC modeling scenario.

Theme WR 084

Theme Statement

The SDEIS fails to include water wells listed in the Minnesota County Well Index database. Any unused or unsealed wells found during an inventory of wells could be conduits for contaminant transport and therefore need to be sealed.

Thematic Response

The Minnesota County Well Index Database was searched to identify domestic or other water supply wells near the NorthMet Project area as part of the 2008 draft EIS, and "This search found that no domestic wells are located up- or down-gradient between the Mine Site and the Partridge River" (FEIS Section 4.1.1.9, Existing Wells, subsection Local Wells Outside the Project Area, in MDNR and USACE 2008). All wells identified in the search were presented in this 2008 CDEIS (Table 4.1-20. Existing Wells Located Between the PolyMet Tailings Area and Embarrass River). Another search was undertaken in January 2015 to identify groundwater wells near the NorthMet Project area. Two additional wells were identified both approximately 2 miles north of the Tailings Basin. Wells listed in the Minnesota County Well Index are shown in FEIS Figure 4.2.2-12.

Theme WR 085

Theme Statement

The SDEIS does not provide characterization of the Rainy River Watershed.

Thematic Response

The Rainy Lake Watershed is located on the opposite side of the Laurentian Divide (the major watershed divide between the Rainy River and Lake Superior watersheds) from the NorthMet Project area. As such, the Rainy Lake watershed would not be impacted by the NorthMet Project Proposed Action and therefore is not included in the FEIS. See FEIS Section 4.2.2.1 for more information.

Theme WR 086

Theme Statement

The Mine Site MODFLOW model should be rerun and the FEIS should be revised to address the following issues:

- The FEIS should provide a better description of layers, boundary conditions, and material properties;

- The model should be probabilistic, and the automated calibration procedure should be better described;

- The model is not sufficiently accurate for effects evaluation, is not representative of actual hydrologic conditions, is not adequately calibrated to heads and river baseflows, and does not demonstrate that groundwater would not migrate into other watersheds;

- The model results are not clearly presented, and the SDEIS does not show all the groundwater flowpaths; and

- The model computes unconfined hydraulic heads next to the perennial Partridge River that are well above or below the river level, which is not reasonable, and does not reproduce known flow losses along some reaches of the river.

- The FEIS should explain and list the baseflow calibration targets, and compare these with the model results. The FEIS should also acknowledge that the NorthMet Project Proposed Action would cause a permanent loss or drawdown of groundwater resources. In contrast to the SDEIS modeling, the Myers MODFLOW model predicts more extensive drawdown between the pits and the Partridge River and more flow loss from the river into groundwater flowing toward the dewatered pits. The FEIS should explain these discrepancies.

Thematic Response

Attachment B of the Mine Site Water Modeling Data Package (PolyMet 2015m, as cited in the FEIS) has been updated to provide a complete description of the Mine Site MODFLOW model. The attachment no longer references earlier documents to provide basic information about the model and provides justifications for the layers, boundary conditions, material properties, and areal recharge. The model has been recalibrated and rerun using all head data through 2013 and groundwater baseflows used in the SDEIS (and carried forward into the FEIS). Calibration targets are fully described in Attachment B.

The revised Mine Site MODFLOW model is well-calibrated and sufficiently accurate for impacts evaluation for the EIS.

An additional calibration step in the MODFLOW model was to ensure that computed heads in the surficial aquifer were not unrealistically above ground surface or above the level of the Partridge River.

It is noted that an independent flow/transport model developed by Myers uses higher bedrock hydraulic conductivities and predicts greater pit inflows and more extensive bedrock drawdown than the Mine Site MODFLOW model. In addition, the Myers model is calibrated to Partridge River groundwater baseflows that are too high and uses bedrock hydraulic conductivities that are higher than what is indicated by field-testing results.

The purpose of the Mine Site MODFLOW model was to: estimate pit inflows, define groundwater flowpaths between the Mine Site and the Partridge River, and provide refinement of surficial aquifer hydraulic conductivity and areal recharge. The parameters obtained from the MODFLOW model are considered best estimates that are carried forward to the GoldSim water quality model. Uncertainties associated with these best estimates are dealt with in the probabilistic GoldSim model.

Theme WR 087

Theme Statement

The FEIS should be revised to address the following deficiencies in the Mine Site MODFLOW regarding bedrock:

- The model's hydraulic conductivity is too low;

- The model does not consider that upper bedrock is likely more permeable than deeper bedrock;

- The calibrated hydraulic conductivities are not reasonable given hydrogeologic information from other nearby sites;

- The model is biased in using the Duluth Complex as the basis for very low hydraulic conductivity for all bedrock;

- The model uses an incorrect top of bedrock surface and does not explicitly consider the effects of fractures and faults on groundwater flow directions and quantities;

- The FEIS should present a map showing the areal distribution of bedrock types used in the model;

- Table 4.2.2-5 should provide the actual test results rather than ranges;

- The conceptual model for bedrock does not consider the possibility of artesian flow conditions as has occurred at the Minnamax site; and

- In comparison to the SDEIS model, the Myers MODFLOW model uses higher bedrock hydraulic conductivities and provides different results; the FEIS should acknowledge and explain these discrepancies.

Thematic Response

In Barr 2014b, as cited in the FEIS, bedrock hydraulic conductivities used in the Mine Site MODFLOW model are consistent with the results of site-specific field testing and information obtained from other similar mine sites. The MODFLOW model does not consider the presence of an upper zone of more permeable bedrock because if overall measured transmissivity is retained, this approach would tend to underestimate pit inflow, which is a primary purpose that the model. The Duluth Complex justifies the low bedrock hydraulic conductivity used in much of the model domain because the mine pits are excavated in Duluth Complex rocks and the bedrock flowpaths used on the GoldSim model are also in Duluth Complex rocks. Higher-permeability Virginia Formation is modeled in the northern portion of the model and this affects inflows from the north wall of the East Pit, which is excavated into the Virginia Formation. The top of bedrock surface used in the model is reasonable given site-specific information. The effects of faults and fractures are considered in developing the bulk hydraulic conductivities used for the bedrock units. The model treats bedrock as an equivalent porous medium, which is a standard approach in large-scale groundwater flow models.

The FEIS references an appendix in revised Mine Site Water Modeling Data Package that provides a map showing the distribution of bedrock types in the Mine Site MODFLOW model.

The FEIS references a new table in the Mine Site Water Modeling Data Package that summarizes the results of all borehole tests performed in bedrock at the Mine Site.

The bedrock conceptual model for the Mine Site does not consider artesian conditions because bedrock boreholes at the site have not consistently exhibited artesian flow at ground surface.

Differences between the Myers model and the SDEIS Mine Site MODFLOW model are also discussed in the response to theme WR 062.

Theme WR 088

Theme Statement

The FEIS should be revised to address the following deficiencies in the Mine Site MODFLOW model:

- Mine pits, waste rock stockpiles, and WWTF ponds are not correctly incorporated into the Mine Site model;

- Pit water quality should be disclosed through the life of the mine.

- The physical models for the mine pits are fundamentally incorrect;

- The capture system surrounding the Category 1 Stockpile and the East Pit backfill are not explicitly incorporated into the model;

- The model does not demonstrate that the capture system would work or that pump-and-treat of the East Pit backfill is technically feasible;

- The model does not demonstrate that the East Pit backfill can be maintained in a saturated condition; and

- The FEIS should present model results to estimate the West Pit pumping rate required to prevent overflow during closure.

Thematic Response

The mine pits would be pumped dry during the operations to allow for safe access.

Attachment B of the Mine Site Water Modeling Data package (PolyMet 2015m) has been updated to provide a complete description of the Mine Site MODFLOW model. The attachment no longer references earlier documents to provide basic information about the model and provides justifications for the layers, boundary conditions, material properties, and areal recharge. The model has been recalibrated and rerun using all head data through 2013 and groundwater baseflows used in the SDEIS (and carried forward into the FEIS). Calibration targets are fully described in Attachment B.

The revised Mine Site MODFLOW model is well-calibrated and sufficiently accurate for impacts evaluation for the EIS.

An additional calibration step in the MODFLOW model was to ensure that computed heads in the surficial aquifer were not unrealistically above ground surface or above the level of the Partridge River.

It is noted that an independent flow/transport model developed by Myers uses higher bedrock hydraulic conductivities and predicts greater pit inflows and more extensive bedrock drawdown than the Mine Site MODFLOW model. In addition, the Myers model is calibrated to Partridge River groundwater baseflows that are too high and uses bedrock hydraulic conductivities that are higher than what is indicated by field-testing results.

The purpose of the Mine Site MODFLOW model was to: estimate pit inflows, define groundwater flowpaths between the Mine Site and the Partridge River, and provide refinement of surficial aquifer hydraulic conductivity and areal recharge. The parameters obtained from the MODFLOW model are considered best estimates that are carried forward to the GoldSim water quality model. Uncertainties associated with these best-estimates are dealt with in the probabilistic GoldSim model.

Theme WR 089

Theme Statement

Groundwater flowpaths associated with the Mine Site MODFLOW model are inaccurate and incorrectly interpreted from the model results. The FEIS should acknowledge that the model predicts northward flowpaths from the Category 1 Stockpile and the East Pit areas, and these flowpaths must be incorporated into the effects analysis. The flow trajectories predicted by the model are not accurately transferred to the GoldSim water quality model and grossly oversimplify the actual groundwater flow patterns. In contract to the SDEIS model, the Myers MODFLOW model has different flowpaths, and the FEIS should explain the discrepancies between these two models. The FEIS model cannot provide accurate flowpaths if it does not incorporate the Category 1 Stockpile containment system, the East Pit backfill, and East Pit pump and treat.

Thematic Response

The groundwater flowpaths in the Mine Site GoldSim model are set up with uniform linear groundwater flow. The surficial deposit and bedrock material properties used in the these streamtubes are based on a combination of the Mine Site MODFLOW model calibration results, site-specific borehole testing, and information obtained from other similar mine sites. While the linear flowpath streamtubes do not exactly line up with flow trajectories predicted by the Mine Site MODFLOW Model, the streamtubes have hydraulic gradients, recharge, flow directions, and flowpath distances that are similar to those generated by the MODFLOW model. It is the Co-lead Agency position that difference between the GoldSim flowpaths and results of the MODFLOW model are of secondary importance and do not diminish the reliability of the GoldSim predictions of groundwater transport from mine facilities to the Partridge River.

Results of the Mine Site MODFLOW model, the Category 1 3D MODFLOW model, and hydrogeologic interpretations indicate that northward flow from the Category 1 Stockpile and East Pit during operations and closure would be non-existent or of sufficiently low-flow rates to not cause impacts to groundwater or surface water at or beyond the property boundary. For this reason, northward groundwater flowpaths are not developed in the Mine Site GoldSim model.

Hydraulics and capture efficiency of the Category 1 containment system is evaluated in a separate groundwater model referred to as the Category 1 3D MODFLOW model, which is reported in an appendix in the Water Management Plan. Hydraulics of the East Pit pump-and-treat system is evaluated using analytical calculations in the Water Management Plan.

Differences between the Myers model and the SDEIS Mine Site MODFLOW model are also discussed in the response to theme WR 062.

Theme WR 090

Theme Statement

The SDEIS does not mention testing, mitigation, or monitoring procedures or duration of these activities for the transfer of pollutants and contaminants. Transfer could occur through fractures, surface water, aquifers, soils, or watersheds, among other vectors.

Thematic Response

PolyMet has developed an Adaptive Water Management Plan (AWMP) (PolyMet 2015d, as cited in the FEIS) that includes adaptive engineering controls and contingency mitigation measures. Additionally, the NorthMet Project Proposed Action includes a water quality and quantity monitoring plan that would be finalized in permitting and updated as required. Overviews of the water monitoring plans at the Mine Site and Plant Site, with PolyMet recommended monitoring locations and frequencies, are presented in Tables 5.2.2-53 and 5.2.2-54. The specifics of monitoring—including specific locations, frequencies, and parameters—would be finalized during the NPDES/SDS permitting process. Monitoring and maintenance activities would continue for as long as needed to ensure permit water quality criteria are met.

Theme WR 091

Theme Statement

Calibration of the Mine Site MODFLOW model to erroneously low Partridge River baseflow targets leads to underestimates of areal recharge and surficial deposit hydraulic conductivity and may result in incorrect groundwater flowpaths. Use of incorrect baseflow calibration targets invalidates the MODFLOW results. The model must be recalibrated to the correct baseflow values. The FEIS should also include a baseflow sensitivity analysis. The Myers MODFLOW model considers higher Partridge River baseflow, which leads to results that are different from the SDEIS model. The FEIS should discuss and explain the discrepancies between the two models.

Thematic Response

The estimates for groundwater baseflow derived from the surficial aquifer applied in the SDEIS and FEIS are based on best available information (see the response to theme WR 003). Thus, the MODFLOW inputs related to groundwater baseflow did not change significantly in the FEIS (except for general recalibrations based on new water level and water quality data). It should be noted that an independent flow/transport model developed by Myers uses higher rates of surficial recharge and Partridge River groundwater baseflow than the Mine Site MODFLOW model. The revised Mine Site MODFLOW model is well-calibrated and sufficiently accurate for impacts evaluation, and that the Myers model is calibrated to Partridge River groundwater baseflows that are too high.

Attachment B of the Mine Site Water Modeling Data package (PolyMet 2015m, as cited in the FEIS) has been updated to provide a complete description of the Mine Site MODFLOW model. The attachment no longer references earlier documents to provide basic information about the model, but instead provides directly the justifications for the layers, boundary conditions, material properties, and areal recharge. Calibration targets are also fully described in Attachment B. The model has been recalibrated using all head data through 2013 and groundwater baseflows used in the SDEIS (and carried forward into the FEIS). The surficial- and bedrock-aquifer flowpaths used to estimate solute transport in Mine Site groundwater are consistent with the calibrated MODFLOW model.

To address comments on the relationship between groundwater baseflow and the impact assessment, a sensitivity analysis was conducted for the Mine Site to evaluate if predicted NorthMet Project Proposed Action impacts are sensitive to groundwater baseflow values. The sensitivity analysis considered the relationship of various model inputs to groundwater baseflow including hydraulic conductivity, recharge, and surface runoff chemical concentrations. The results of the sensitivity analysis are reported in FEIS Section 5.2.2.3.2.

Theme WR 092

Theme Statement

With regard to surficial deposits, the Mine Site MODFLOW model uses erroneously low hydraulic conductivity (due to the baseflow issue) and at the Plant Site does not consider the known presence of buried stream channels that likely have higher hydraulic conductivity. Table 4.2.2-5 should present all test results rather than ranges.

Thematic Response

The SDEIS groundwater baseflow values developed for the Partridge River are reasonable best estimates and are retained in the FEIS. Because the FEIS Mine Site MODFLOW model is calibrated to the SDEIS/FEIS groundwater baseflows, the calibrated recharge rates and hydraulic conductivities of surficial deposits are also appropriate best estimates. See FEIS Sections 5.2.2.2.1 and 5.2.2.3.2 for more information.

It is acknowledged that buried stream channels could exist in surficial deposits at the Mine Site, but given that the average thickness of surficial deposits is only 5 to 10 meters, it is unlikely that buried channels (if any) would have materials much higher in permeability than adjacent materials. Variation in the hydraulic conductivity of surficial deposits is accounted for by the probabilistic approach used in the GoldSim model, where hydraulic conductivity is input as a probability distribution rather than as a fixed, deterministic value.

Based on a pre-construction topographic map of the Tailings Basin area and an interpreted map for the top of bedrock, the thickness of surficial deposits varies below the Tailings Basin and this may reflect the presence of buried stream channels. This aspect has been incorporated into the FEIS model.

Theme WR 093

Theme Statement

The Plant Site MODFLOW model needs to be corrected and rerun. In particular, the model incorrectly treats the embankment outer surfaces as no-flow boundaries; where there are no drain cells or modeled wetlands, the model incorrectly treats ground surface adjacent to the embankment toes as no-flow boundaries. Both of these assumptions are theoretically incorrect for an unconfined groundwater system. The incorrect use of no-flow boundaries artificially shows a lack of surface seepage, rather than allowing the model to determine if surface seepage would occur. There are insufficient drain cells placed at the toes of the Tailings Basin perimeter to provide a credible evaluation of where seepage may or may not occur during and after operations. The placement of a small number of drain cells biases the model to allow surface seepage only at pre-determined locations and to underestimate total surface seepage. The model does not explicitly incorporate the groundwater capture system or the adjacent treated-water discharge pipe that are components of the Project Description. There are insufficient drain or river cells to simulate the known wetland areas. The FEIS should disclose where the model predicts upwelling of groundwater into wetlands and other surface water features. The FEIS should disclose capture system design details so modeling assumptions can be assessed.

Thematic Response

In response to these issues, the Plant Site MODFLOW model was modified and recalibrated as follows: 1) Updated areal distribution of surficial deposits and bedrock outcrops, 2) established surficial deposits below and adjacent to the East Embankment, 3) used drain or river cells along the East Embankment to allow surface seepage of tailings water, 4) incorporated the hydrologic effects of the future swale to drain surface water from the East Embankment area, 5) recalibrated model material properties and boundary conditions using all available site data through 2013 (this is mostly new hydraulic head information), and 6) expanded the use river and drain cells to provide a more accurate representation of wetlands outside the Tailings Basin.

As a result of these changes, the FEIS Plant Site MODFLOW model no longer has a no-flow boundary condition at the toe of the East Embankment, and river and/or drain cells in surficial deposits are in place to allow the potential for surface seepage along the embankment toes (Reference: Attachment A, Plant Site Water Modeling Data Package—PolyMet 2015j, as cited in the FEIS).The model was checked to ensure that hydraulic heads in the tailings and adjacent surficial deposits were not well above ground surface. In the FEIS Plant Site MODFLOW model, storage coefficients for the surficial deposits and bedrock outcrops were assigned and/or calibrated to be more in line with literature values for these types of materials.

As discussed in the responses to themes WR 018, WR 019, WR 020, and WR 022, the assumed capture efficiencies of the groundwater containment systems are justified and supported by modeling. FEIS Section 5.2.2 appropriately summarizes the methodology and results of the water impact analysis. Full technical details on modeling including the assumptions made with regards to the capture system design are provided in the Water Modeling Data Packages for the Mine Site and Plant Site (PolyMet 2015m and 2015j, respectively, as cited in the FEIS).

Theme WR 094

Theme Statement

The Plant Site MODFLOW model used an incorrect and outdated Tailings Basin design and footprint.

Thematic Response

The Tailings Basin design and footprint used in the FEIS Plant Site MODFLOW model was updated from the version used in the SDEIS to address the theme.

Theme WR 095

Theme Statement

The Plant Site MODFLOW model applies unreasonable storage coefficients and/or specific yields to surficial deposits and bedrock outcrops. The supporting documents mislead the reader into thinking that that the storage parameters were fully determined by calibration.

Thematic Response

In the FEIS Plant Site MODFLOW model, storage coefficients for the surficial deposits and bedrock outcrops were assigned and/or calibrated to be more in line with literature values for these types of materials.

Theme WR 096

Theme Statement

The Plant Site MODFLOW model uses the hydraulic conductivity rates for surficial deposits that are much greater than values used in the GoldSim and Seep-W models, and greater than values indicated by field testing. The FEIS should provide an explanation for these discrepancies. The hydraulic conductivity of surficial deposits should be reduced to more reasonable levels, or a justification provided for the higher values used. Inappropriate no-flow boundary conditions used in the model lead to unrealistic calibrated hydraulic conductivity values for the surficial deposits. The model does not consider the hydraulic effects of known buried channels that exist in surficial deposits below the Tailings Basin.

Thematic Response

The Co-lead Agencies acknowledge that the calibrated hydraulic conductivity of surficial deposits in the FEIS Plant Site MODFLOW model (approximately 70 feet per day) is greater than the hydraulic conductivities of surficial deposits used in the FEIS Plant Site GoldSim model (lognormal distribution with mean of 13 feet per day and standard deviation of 5.2 feet per day).

The GoldSim hydraulic conductivity distribution is based on the results of field tests and calculations showing that the values are reasonable given recharge, saturated thickness, and hydraulic gradients between the Tailings Basin and the Partridge River. It is the Co-lead Agencies' opinion that the hydraulic conductivity distribution used in the GoldSim model is reasonable given the purpose of the model, which is to evaluate groundwater flow and transport in flowpaths to the Embarrass River.

The main purpose of the MODFLOW model is to evaluate the distribution of tailings water flow from the interior of the Tailings Basin to the toes and this is an entirely different focus and area of interest from the GoldSim model. The hydraulic conductivity in the FEIS Plant Site MODFLOW model is a calibrated value that achieves a reasonable model match to measured hydraulic heads below the Tailings Basin and estimated leakage rates from the Tailings Basin ponds. For the purpose of the MODFLOW model, the higher calibrated hydraulic conductivity of surficial deposits allows that model to function in a more credible manner.

It is the Co-lead Agency position that the different surficial deposit hydraulic conductivities used in the Plant Site GoldSim model and Plant Site MODFLOW model allow each model to function more appropriately for its intended purpose. To force the hydraulic conductivities of the two models to be similar would be artificial and would detract from each model's ability to fulfill its purpose. Accordingly, the Co-lead Agencies recognize the difference between the two models, but do not recommend that the values be changed.

The extensive no-flow boundary condition used in the SDEIS Plant Site MODFLOW model has been corrected in the FEIS model by assigning a greater distribution of drain and river cells along the perimeter of the Tailings Basin. This is where significant wetlands are observed between the Tailings Basin and the Embarrass River. Drain and river cells allow the potential for groundwater discharge to ground surface, which is prevented by “no-flow” cells in MODFLOW.

Based on a pre-construction topographic map of the Tailings Basin area and an interpreted map for the top of bedrock, the thickness of surficial deposits varies below the Tailings Basin and this may reflect the presence of buried stream channels. This aspect has been incorporated into the FEIS model.

Theme WR 097

Theme Statement

At some locations in the Plant Site MODFLOW model, the predicted hydraulic heads are well above ground surface, which is not possible for unconfined groundwater conditions.

Thematic Response

The FEIS Plant Site MODFLOW model has been modified using different boundary conditions (drain and river cells) and calibrated with new hydraulic conductivities so that predicted hydraulic heads are below or just slightly above ground surface, but not well above ground surface as was the case in portions of the SDEIS model.

Theme WR 098

Theme Statement

In the Plant Site MODFLOW model, the areal distribution of surficial deposits and bedrock outcrops is inconsistent with geologic information. Use of the RS13 (2007) areal distribution map is incorrect and should be replaced with the revised RS13b (2008) distribution map.

Thematic Response

In the FEIS Plant Site MODFLOW model, storage coefficients for the surficial deposits and bedrock outcrops were assigned and/or calibrated to be more in line with literature values for these types of materials.

Theme WR 099

Theme Statement

The Plant Site MODFLOW model does not consider the presence of bedrock below the surficial deposits (as is the case in the Mine Site MODFLOW model). Except for outcrop areas, deeper bedrock is incorrectly assumed to be impermeable and excluded from model. The model does not consider known faults and fractures in bedrock. MODFLOW does not consider the effect of low pH water on bedrock hydraulic conductivity or capture system. In contrast to the SDEIS model, the Myers MODFLOW model does include deeper bedrock and assigns this material reasonable hydraulic conductivity values. The Myers model shows that groundwater flow in bedrock cannot be ignored. The FEIS should address the discrepancies between these models.

Thematic Response

The Co-lead Agencies acknowledge that the calibrated hydraulic conductivity of surficial deposits in the FEIS Plant Site MODFLOW model (approximately 70 feet per day) is greater than the hydraulic conductivities of surficial deposits used in the FEIS Plant Site GoldSim model (lognormal distribution with mean of 13 feet per day and standard deviation of 5.2 feet per day).

The GoldSim hydraulic conductivity distribution is based on the results of field tests and calculations showing that the values are reasonable given recharge, saturated thickness, and hydraulic gradients between the Tailings Basin and the Partridge River. It is the Co-lead Agencies' opinion that the hydraulic conductivity distribution used in the GoldSim model is reasonable given the purpose of the model, which is to evaluate groundwater flow and transport in flowpaths to the Embarrass River.

The main purpose of the MODFLOW model is to evaluate the distribution of tailings water flow from the interior of the Tailings Basin to the toes and this is an entirely different focus and area of interest from the GoldSim model. The hydraulic conductivity in the FEIS Plant Site MODFLOW model is a calibrated value that achieves a reasonable model match to measured hydraulic heads below the Tailings Basin and estimated leakage rates from the Tailings Basin ponds. For the purpose of the MODFLOW model, the higher calibrated hydraulic conductivity of surficial deposits allows that model to function in a more credible manner.

It is the Co-lead Agencies' position that the different surficial deposit hydraulic conductivities used in the Plant Site GoldSim model and Plant Site MODFLOW model allow each model to function more appropriately for its intended purpose. To force the hydraulic conductivities of the two models to be similar would be artificial and would detract from each model's ability to fulfill its purpose. Accordingly, the Co-lead Agencies recognize the difference between the two models, but do not recommend that the values be changed.

The extensive no-flow boundary condition used in the SDEIS Plant Site MODFLOW model has been corrected in the FEIS model by assigning a greater distribution of drain and river cells along the perimeter of the Tailings Basin. This is where significant wetlands are observed between the Tailings Basin and the Embarrass River. Drain and river cells allow the potential for groundwater discharge to ground surface, which is prevented by "no-flow" cells in MODFLOW.

Based on a pre-construction topographic map of the Tailings Basin area and an interpreted map for the top of bedrock, the thickness of surficial deposits varies below the Tailings Basin and this may reflect the presence of buried stream channels. This aspect has been incorporated into the FEIS model.

MODFLOW is a groundwater hydraulics model and does not specifically consider water chemistry. Site characterization studies and water quality modeling do not predict that low pH groundwater would be generated by the Tailings Basin. As a consequence, the possible effects of low pH groundwater on hydraulic conductivity of surficial deposits or bedrock are not considered in the FEIS.

Theme WR 100

Theme Statement

The Plant Site MODFLOW model needs to include the groundwater capture system and adjacent treated-water discharge pipe on the north and west sides of the Tailings Basin. A groundwater capture system on the east side of the Tailings Basin is also required.

Thematic Response

The FEIS Plant Site MODFLOW model has been modified using different boundary conditions (drain and river cells) and calibrated with new hydraulic conductivities so that predicted hydraulic heads are below or just slightly above ground surface, but not well above ground surface as was the case in portions of the SDEIS model.

Theme WR 101

Theme Statement

The Plant Site MODFLOW model does not include a south groundwater flowpath and does not allow for potential surface seepage along most of the south side of the Tailings Basin.

Thematic Response

Local topography influences the behavior of seepage at the southern end of the Tailings Basin. It is expected that seepage at this part of the facility emerges as surface seepage within a short distance of the Tailings Basin toe rather than being transported via subsurface flow. The effectiveness of the recent improvements to the existing seepage management system, which include a dam, are currently being assessed by Cliffs Erie and PolyMet through water quality monitoring downstream of the existing system. PolyMet has committed to collecting essentially all of the seepage from the Tailings Basin in this area (Plant Site Water Management Plant, Section 4.1.3—PolyMet 2015i, as cited in the FEIS), and would implement additional improvements to the seepage management system if necessary. Potential measures that could bring the capture efficiency of the seepage management system to 100% include improvements to the existing in-stream dam such as lining the upstream dam face with bentonite and injecting grout into the dam. If seepage were observed to bypass the existing dam, a second structure could be constructed approximately 500 feet downstream of the existing system, in an area where the Second Creek headwaters valley is more constricted and any remaining subsurface seepage would have surfaced. This potential second structure could be constructed as an earthen dam with a clay or concrete cutoff wall (extending to bedrock if necessary) in order to achieve 100% capture of the Tailings Basin surface seepage. Based on PolyMet's commitment to collect essentially all seepage to the south, the proposed South Surface Seepage Management System is assumed for the GoldSim modeling to capture 100% of the surface water and that there is no groundwater flow or seepage.

Theme WR 102

Theme Statement

At the east embankment of the Tailings Basin, the Plant Site MODFLOW model uses incorrect no-flow boundary conditions that prevent any possibility of surface seepage. The incorrect assumed distribution of surficial deposits also prevents the model from potentially showing significant eastward groundwater flow away from the Tailing Basin. The model should be revised to include the correct distribution of surficial deposits and to apply drain cells along the toe of the east embankment, which is the theoretically correct boundary condition for an unconfined groundwater system. The model materials and boundary conditions used in the MODFLOW model should be consistent with the hydrogeologic conceptual model for the east embankment area, including the Spring Mine Lake and Spring Mine Creek.

Thematic Response

The Plant Site MODFLOW model was modified for the FEIS to better represent natural and NorthMet Project Proposed Action-related conditions. These include: 1) more accurate representation of surficial deposits and bedrock outcrops around the perimeter of the Tailings Basin, 2) more extensive distribution of drain and/or river cells to provide for potential surface seepage and distribution of wetlands, 3) more appropriate storage coefficients, and 4) steady-state and transient calibrations using new data extending through the end of 2013. Many of the improvements pertained to the East Embankment area of the Tailings Basin, where it is acknowledged that tailings water seepage would be likely to occur and model changes were made to simulate this seepage more accurately. These changes in response to the theme improve the SDEIS MODFLOW model that limited tailings seepage on the east side of the Tailings Basin.

Theme WR 103

Theme Statement

The groundwater flow trajectories predicted by the Plant Site MODFLOW model are not accurately transferred to the GoldSim model to create flowpaths. The areal recharge used in the model is too low, which might lead to incorrect flowpaths. The model does not demonstrate that groundwater would not migrate into other watersheds.

Thematic Response

The Plant Site MODFLOW model was modified for the FEIS to better represent natural and NorthMet Project Proposed Action-related conditions. These modifications include: 1) more accurate representation of surficial deposits and bedrock outcrops around the perimeter of the Tailings Basin, 2) more extensive distribution of drain and/or river cells to provide for potential surface seepage and distribution of wetlands, 3) more appropriate storage coefficients, and 4) steady-state and transient calibrations using new data extending through the end of 2013. Many of the improvements pertained to the East Embankment area of the Tailings Basin, where it is the acknowledged that tailings water seepage would be likely to occur and model changes were made to simulate this seepage more accurately. These changes correct deficiencies in the SDEIS MODFLOW model that limited tailings seepage on the eastern side of the Tailings Basin. With these modifications, the FEIS MODFLOW model provides reliable groundwater flow directions away from the Tailings Basin to the north, northwest, and west. Note that on eastern side of the Tailings Basin, current groundwater flows are from east to west -- i.e., toward and not away from the Tailings Basin.

The Plant Site GoldSim model uses one-dimensional flow/transport to simulate the migration of affected groundwater away from the Tailings Basin in the northern, northwestern, and western directions. For these analyses to be accurate, flow/transport parameters from the MODFLOW model were transferred to each GoldSim flowpath including average linear flow direction and hydraulic gradient. Saturated thickness, hydraulic conductivity, and porosity values used in the GoldSim flowpaths were based on field data and generic information, not the MODFLOW model. Recharge in the GoldSim flowpaths was based on Embarrass River baseflow analysis and not on the MODFLOW model.

The main purpose of the Plant Site MODFLOW model was to evaluate groundwater flows beneath the Tailings Basin and groundwater flows away from the Basin in the northern, northwestern, western, and eastern directions. The model was generally local to the Tailings Basin area and was not intended to evaluate the potential for groundwater flows outside the Embarrass River watershed.

Theme WR 104

Theme Statement

The Plant Site MODFLOW model does not account for known buried stream channels, with potentially higher hydraulic conductivity, below the Tailings Basin.

Thematic Response

The thickness of surficial deposits at the Plant Site is interpreted to vary below and adjacent to the Tailings Basin. The interpretation relies upon: 1) a preconstruction topographic map of the area, 2) a 2014 geotechnical investigation conducted along the Tailings Basin perimeter, and 3) an interpreted map for the top of the underlying bedrock. This allows for the model to at least partially reflect the presence of buried stream channels. The interpreted variable thickness of surficial deposits is incorporated into the Plant Site MODFLOW model. This is of interest because surficial deposit thickness affects transmissivity such that enhanced groundwater flow occurs in portions of the model having thicker surficial deposits. See FEIS Section 5.2.2.2.1 for more information.

Theme WR 105

Theme Statement

The Plant Site MODFLOW model should be re-run to address numerous general issues. Two critical issues are that all known wetlands and seepage areas are not modeled, and drain/river cells are based on current wetlands and seeps and do not account for future conditions. In addition, the SDEIS does not adequately explain the general model setup. The model does not conform to the known hydrogeology, is not adequately calibrated to steady-state and transient heads, predicts incorrect baseflows to the Embarrass River, and does not adequately show all groundwater flowpaths. The site hydrogeology is not sufficiently understood to develop a reliable model, and the model is therefore not sufficiently accurate for effects evaluation. The model should be probabilistic. Based on the model results, the FEIS should describe mounding below the Tailings Basin, present estimates of leakage from the unlined tailings into the surficial and bedrock groundwater systems, and provide estimates of groundwater discharge into wetlands upstream of surface water evaluation locations. The results of the Myers MODFLOW model are different from the SDEIS model. The FEIS should explain the discrepancies between the two models.

Thematic Response

The Plant Site MODFLOW model was modified for the FEIS to better represent natural and NorthMet Project Proposed Action-related conditions. These include: 1) more accurate representation of surficial deposits and bedrock outcrops around the perimeter of the Tailings Basin, 2) more extensive distribution of drain and/or river cells to provide for potential surface seepage and distribution of wetlands, 3) more appropriate storage coefficients, and 4) steady-state and transient calibrations using new data extending through the end of 2013. Many of the improvements pertained to the East Embankment area of the Tailings Basin, where it is acknowledged that tailings water seepage would be likely to occur and model changes were made to simulate this seepage more accurately. These changes correct deficiencies in the SDEIS MODFLOW model that limited tailings seepage on the east side of the Tailings Basin. With the modifications described above, the FEIS MODFLOW model has provided reliable flow directions in this area.

See the response to theme WR 003.

Rather than conduct probabilistic flow modeling, a detailed sensitivity analysis of baseflow was conducted to evaluate if impacts to groundwater and surface water are sensitive to baseflow values used in the water quality (GoldSim) models. The sensitivity analysis fully considered the relationship of various model inputs to baseflow including hydraulic conductivity, recharge, and surface runoff chemical concentrations.

It is also acknowledged that the Myers model provides some results that are different from the FEIS Plant Site MODFLOW model. A major difference is that the Myers model considers higher groundwater baseflows in the Embarrass River and this leads to higher hydraulic conductivities and recharge at the Plant Site. As stated in other theme responses, the FEIS groundwater baseflows for the Embarrass River are reasonable and represent a better estimate than what is assumed in the Myers model. In addition, the Myers model does not use concentration caps so that chemical concentrations and mass loading associated with tailings is unrealistically high. Due to these differences, it is thought the Myers model unrealistically overestimates NorthMet Project Proposed Action-related flow and chemical impacts at the Plant Site.

Theme WR 106

Theme Statement

The water modeling (XP-SWMM, MODFLOW, and GoldSim) in the SDEIS does not incorporate known hydrology, is not calibrated to correct baseflows and heads, and gives different results from Myers MODFLOW model; therefore, it is not sufficiently accurate for evaluation of effects. The modeling needs to be redone and should use probabilistic methodology. Most of the available data was used in calibrating the model and thus is not usable to validate it.

Thematic Response

The inputs and assumptions of the water models used to predict the potential effects of the NorthMet Project Proposed Action have been subject to rigorous review over the course of the EIS. The Myers model was independently developed and its conclusions have been considered in the development of the FEIS.

It is acknowledged that the Myers model provides some results that are different from the FEIS Plant Site MODFLOW model. A major difference is that the Myers model considers higher groundwater baseflows in the Embarrass River and this leads to higher hydraulic conductivities and recharge at the Plant Site. As stated in other theme responses, FEIS groundwater baseflows for the Embarrass River are reasonable and represent a better estimate than what is assumed in the Myers model. In addition, the Myers model does not use concentration caps so that chemical concentrations and mass loading associated with tailings is unrealistic.

See the response to theme WR091.

Development of the site models used all available data for calibration in accordance with accepted industry practice. Validations would be performed as new data become available.

The models used for FEIS development are complete and sufficiently accurate for impact evaluation. There is no need to redo any of the FEIS models. Probabilistic analyses are performed by the GoldSim models and are not needed in the MODFLOW models.

Theme WR 107

Theme Statement

For the Mine Site, the FEIS should acknowledge that the NorthMet Project Proposed Action would increase chemical loading of contaminants, including fibers to groundwater and surface water compared to current existing conditions. Water quality standards would not be met.

Thematic Response

The FEIS reports that the NorthMet Project Proposed Action facilities would release solutes and cause an increase in loading of some solutes to surface water and groundwater relative to the continuation of existing conditions; See FEIS Section 5.2.2.3 for more detail and consideration of these results with respect to water quality criteria. Estimates for mass loading from the Plant Site tailings facility are presented in the Water Modeling Data Package Vol 2 - Plant Site, Attachment G (PolyMet 2015j, as cited in the FEIS).

There is no technical reason to believe that groundwater affected by the Tailings Basin would have unacceptably high concentrations of fibers. The generally fine-grained nature of tailings materials would effectively filter suspended solids including fibers.

Based on modeling results, the Co-lead Agencies conclude that water quality evaluation criteria would be met to an acceptable level. Evaluation criteria can be found in Section 5.2.2.

Theme WR 108

Theme Statement

For the Plant Site, the FEIS should acknowledge that the NorthMet Project Proposed Action would increase chemical loading of contaminants including fibers to groundwater and surface water compared to current existing conditions, as well as to no-action conditions that properly account for future mitigations associated with the Cliffs Erie Consent Decree.

Thematic Response

The Co-lead Agencies acknowledge in FEIS Section 5.2.2.3.3 that concentrations of some parameters at some evaluation location would increase at the P90 level as result of the NorthMet Project Proposed Action in comparison to the continuation of existing conditions modeling scenario. See response to theme ALT014.

There is no technical reason to believe that groundwater affected by the Tailings Basin would have unacceptably high concentrations of fibers. The generally fine-grained nature of tailings materials would effectively filter suspended solids including fibers.

Theme WR 109

Theme Statement

At some compliance locations, the NorthMet Project Proposed Action would cause exceedances or increase the chemical concentrations of constituents that already exceed water quality standards such as mercury. Thus, the FEIS should evaluate whether or not the NorthMet Project Proposed Action would comply with Minnesota nondegradation rules. Metals are toxic to aquatic life and would threaten public health.

Thematic Response

The evaluation and decision of whether or not the NorthMet Project Proposed Action could discharge into surface waters where water quality standards are exceeded is a permit decision.

The FEIS reports that the NorthMet Project Proposed Action facilities would release solutes and cause an increase in loading of some solutes to surface water and groundwater relative to the continuation of existing conditions. See FEIS Section 5.2.2.3 for more detail and consideration of these results with respect to water quality criteria. The FEIS identifies potential impacts on water resources and measures available to anticipate and control these same impacts. Potential effects on aquatic resources are addressed in FEIS Section 5.2.6. Public health considerations are summarized in FEIS Section 7.3.4.

Theme WR 110

Theme Statement

The SDEIS uses the wrong criteria used for assessing water quality effects, and underestimates effects by using criteria that are not risk-based; thus, factors of safety are not appropriate. P90 is an unacceptable level of significance. The FEIS should use P99.

Thematic Response

Evaluation criteria are based on applicable water quality standards. Evaluation criteria can be found in Section 5.2.2. Where a waterbody is classified as Domestic Consumption (1B) or for groundwater, USEPA primary drinking water standards apply. The USEPA primary drinking water standards set mandatory maximum contaminant levels for drinking water to protect the public from consuming water that presents a risk to human health.

As described in FEIS Section 5.2.2.2.3, the P90 threshold is deemed appropriate for the EIS and has been adopted for other mining NEPA documents where probabilistic modeling was used (e.g., Idaho Cobalt Project—USFS 2009b, as cited in the FEIS). The use of the P90 criterion for determining whether or not evaluation criteria are being met is not equivalent to how WQBELs would be developed for NPDES permitting. Appropriate WQBELs would be derived based on water quality standards and implemented in the permit. Discharges would be evaluated during the NPDES permitting stage and WQBELs applied according to 40 CFR 122.44(d).

Theme WR 111

Theme Statement

NorthMet Project Proposed Action discharges would put at risk and potentially degrade water quality far beyond the mine, including Colby Lake, the BWCAW, St. Louis River, Lake Superior, Superior National Forest, the entire State of Minnesota, the Great Lakes, and Atlantic Ocean. No level of risk to these resources is acceptable. More analysis is necessary. Increased federal scrutiny is needed. Mining has already impacted the St. Louis River and efforts have been made to clean it up.

Thematic Response

As addressed in FEIS Section 5.2.2, the NorthMet Project Proposed Action would have the potential to affect groundwater and surface water hydrology and quality in both the Partridge River and Embarrass River watersheds. These two rivers are both tributaries to the St. Louis River and within the Lake Superior Basin. FEIS Section 6.2.2 identifies that the NorthMet Project Proposed Action is not considered to have the potential for cumulative effects on hydrology and water quality in the St. Louis River or Lake Superior.

The BWCAW and the Rainy Lake Watershed is located on the opposite side of the Laurentian Divide (the major watershed divide between the Rainy River and Lake Superior watersheds) from the NorthMet Project Proposed Action, and as such would not be impacted by it; therefore, this is not included in the FEIS.

Theme WR 112

Theme Statement

The SDEIS does not adequately evaluate the water quality effects of drying up or inundating thousands of acres of wetlands, nor the water quality effects of dredging and filling wetlands or water discharges to wetlands that are likely to result in violations of wetland water quality standards.

Thematic Response

The hydrology of the wetlands outside the Tailings Basin containment system would be maintained within an established range through flow augmentation so that wetlands would not experience substantial inundation or desiccation. Wetland hydrology is a complex mix of precipitation, surface runoff, and, in some cases, groundwater. The indirect effects analyses performed for the EIS were not performed to characterize impacts but were done to inform where monitoring should take place for those areas that were identified as having a potential for indirect wetland effects. The Co-lead Agencies agree that multiple factors can affect whether a wetland would experience indirect effects due to a project. The direct and potential indirect effects from the NorthMet Project Proposed Action, as well as the proposed monitoring and mitigation, are described in detail in FEIS Section 5.2.3.

Theme WR 113

Theme Statement

The SDEIS does not adequately evaluate the water quality and fisheries effects of acid generation.

Thematic Response

The FEIS considers the release of acidity from proposed NorthMet facilities in that leachate from all acid-generating material (Waste Rock and pit wall rock composed of Category 2/3 and Category 4 material) would be captured and treated prior to discharge. The permanent surficial waste facilities (Category 1 stockpile and tailings basin) would contain material that is not expected to would never produce acidic leachate. The non-acid generating waste was identified using multi-year kinetic tests (humidity cells) on NorthMet rock samples, in which alkalinity released (by dissolution of the silicate minerals) exceeded acidity production (by sulfide-mineral oxidation) in all rock and tailings that contained less than 0.12% sulfide S. This <0.12 Waste rock with 0.12% sulfide S or less is the threshold for selecting non-acid generation mine waste is further supported by long-term humidity cell tests on NorthMet waste (i.e., 42 samples of Category 1 waste rock, with tests now run for over 450 weeks; and 33 humidity cell tests run between 84 and 304 weeks [Waste Characterization Data Package v10, Section 4.3 and Attachment E, respectively]). These tests demonstrate that tailings and Category 1 waste rock materials do not generate acidic leachate, and acid generation rates decreases over time as sulfide S minerals are depleted. The NorthMet Project design thus prevents the introduction of acidic leachate to surface water that could affect fisheries.

Theme WR 114

Theme Statement

The SDEIS does not adequately evaluate the loss of stream headwaters and its effect on fisheries and wildlife.

Thematic Response

The SDEIS and FEIS acknowledge a possibility that habitat could be affected from water chemistry changes resulting from the Land Exchange Proposed Action. Habitat loss from flow changes or riparian activities is not expected as a result of the NorthMet Project Proposed Action.

It is noted that under the Land Exchange Proposed Action, the federal estate would have a slight loss to first-order stream spawning habitat.

Theme WR 115

Theme Statement

The NorthMet Project Proposed Action would cause detrimental and irreversible effects on water resources at and near the Mine Site and Plant Site and in other non-designated areas. These effects include chemical effects, loss of water resources, loss of wild rice and loss of wetlands. The SDEIS does not provide assurance that chemical concentrations in groundwater and surface water would continue to meet water quality standards. The detrimental effects cause by the NorthMet Project Proposed Action would persist for hundreds of years and mining would last only 20 years.

Thematic Response

The FEIS acknowledges that the NorthMet Project Proposed Action would cause adverse effects. FEIS modeling indicates that water quality impacts would not be significant as measured against FEIS evaluation criteria. It is also acknowledged that water quality modeling performed in support indicates that water treatment systems in some form and at some scale would be needed indefinitely at the Mine Site and Plant Site. This long-term treatment is proposed as part of the NorthMet Project Proposed Action. As described in FEIS Section 3.2.2.4, *Minnesota Rules* 6132.1200, require that before a Permit to Mine can be issued, financial assurance instruments covering the estimated cost of reclamation must be submitted and approved by the MDNR. Irreversible effects are disclosed in FEIS Section 7.3.1.

Theme WR 116

Theme Statement

Assumed leakage from WWTF ponds is lower than values cited in literature.

Thematic Response

The WWTF equalization basins have a single geomembrane liner. During the summer months (April through September), when water is expected to be in the basins, the liner leakage rate is 5 gallons/acre/day as determined in the Mine Site Water Modeling Data Package (PolyMet 2015m, as cited in the FEIS). The USEPA HELP model was used to estimate this value. This is a reasonable value for ponds installed with good site preparation and installation practices. It is unclear in the comments which literature values are being cited.

Theme WR 117

Theme Statement

The FEIS should acknowledge that current mitigation at the south end of the Tailings Basin does not capture all seepage, and that some of the tailings water is being released to Second Creek. A topographic map figure should be included in the FEIS to demonstrate this finding. This discharge would continue with the NorthMet Project Proposed Action. Additional details on the location of the cut-off berm and trench, groundwater contours, and water quality should be disclosed.

Thematic Response

It is acknowledged that there is currently incomplete capture of impacted water at SD026. Cliffs Erie is currently addressing this issue by upgrading the performance of the existing capture system and, if necessary, constructing new systems to enhance capture. If 100% capture is not attained by the Cliffs Erie upgrades, the Proposer has committed, under the NorthMet Project Proposed Action, to installing additional systems in Second Creek to achieve this level of performance regardless of the types of measures required. A summary of the southern seepage collection system is provided in FEIS Section 3.2.2.3.10; details are available in the Plant Site Water Management Plan (PolyMet 2015i, as cited in the FEIS).

Theme WR 118

Theme Statement

The FEIS should describe how the south Tailings Basin capture system would be modified to achieve acceptable capture efficiency. Designs should aim for 100% capture.

Thematic Response

The Project Proposer has committed to collecting all of the south seepage from the Tailings Basin that makes its way to Second Creek by implementing additional improvements to the existing seepage management system, if necessary. Potential measures that could bring the capture efficiency of the system to 100% include improvements to the existing dam such as lining the upstream dam face with bentonite and injecting grout into the dam. If seepage were observed to bypass the existing dam, a second dam could be constructed approximately 500 feet downstream of the existing system, in an area where the Second Creek headwaters valley is more constricted and any remaining subsurface seepage would have come to the surface. This potential second dam could be constructed as an earthen dam with a clay or concrete cutoff wall (extending to bedrock if necessary) in order to achieve 100% capture of the surface seepage. See FEIS Section 5.2.2.3.2 for more information.

Theme WR 119

Theme Statement

The "analog method" used in the SDEIS is not acceptable for evaluating wetland effects associated with mine pit dewatering; this issue must be evaluated using a mathematical analysis that considers site-specific geology and hydrologic conditions. Alternatively, the analog method should be based not on the Canisteo Mine, but instead on the Soudan Mine in Soudan Underground Mine State Park, which is overlain by till similar in thickness and composition to that found at the NorthMet Mine Site, so the results would not be as overestimated.

Thematic Response

FEIS Section 5.2.2.3.2 summarizes the analog approach and its use in evaluating the extent of pit drawdown. The complex mix of bedrock, glacial till, and wetland soils at the Mine Site makes it difficult to accurately quantify drawdown at any specific location; thus, the use of the analog method was utilized in lieu of MODFLOW to estimate pit drawdown. Additionally, there is a general lack of connectivity between the shallow water table in the wetlands and the deeper bedrock aquifer.

The analog approach was developed using available well data from the Canisteo Mine Pit, which is the only mine pit within the Mesabi Iron Range that has an associated water balance study with well data that could be used to assess potential drawdown effects. Additionally, the Canisteo Mine Pit data are believed to provide a reasonably conservative estimate of the maximum extent of surficial groundwater drawdown that would result from the proposed PolyMet mine pits. Insufficient data exists for the Soudan Mine to be useful as an analog.

The Co-lead Agencies are not relying solely on the potential impact zones determined in the analog method for the EIS but are monitoring wetlands for potential indirect effects. In the event that the required wetland monitoring identifies additional indirect effects, permit conditions would likely include a plan for adaptive management practices to be implemented. Additional compensatory mitigation would be required if indirect wetland impacts were identified during monitoring and annual reporting.

The Co-lead Agencies believe that the use of the analog approach and the use of 20% metric described in FEIS Section 5.2.3 as factors considered in identifying potential indirect effects to wetlands is a credible and reasonable approach consistent with the requirements of NEPA.

Theme WR 120

Theme Statement

The SDEIS assumption that wetlands have limited hydraulic connectivity to the underlying surficial aquifer is not supported by site information. There are no data to suggest that wetlands are perched or semi-perched waterbodies. The SDEIS does not indicate the closest locations where impacted surficial aquifer groundwater or impacted surface water could affect wetlands.

Thematic Response

The FEIS evaluates drawdown effects on wetlands and associated surface water features using observations made at other Iron Range mine sites with open pits and similar geology (i.e., analog method). See FEIS Sections 5.2.2.3.2 and 5.2.3 and responses to themes WR 119, WET 08, and WET 09 for additional information.

Theme WR 121

Theme Statement

Information from the Minnamax project was not used to evaluate wetland dewatering effects.

Thematic Response

FEIS Section 5.2.2.3.2 summarizes the analog approach used to evaluate dewatering effects. Available well data from the Canisteo Mine Pit near the Cities of Coleraine and Bovey, Minnesota -- which is the only mine pit within the Mesabi Iron Range that has an associated water balance study with well data -- was used to evaluate dewatering effects. Please refer to the responses to themes WET 08 and WET 09 and FEIS Section 5.2.3 for more information on the potential for wetland drawdown.

Theme WR 122

Theme Statement

Constructed wetlands for water treatment require substantial acreage and are not feasible if the wild rice standard is applied year-round (that is, not seasonally) due to cold weather.

Thematic Response

Non-mechanical treatment systems (e.g., constructed wetlands) are not part of the NorthMet Project Proposed Action, which relies solely on mechanical treatment. Non-mechanical treatment as an adaptive management measure may be considered during operations and closure if pilot studies demonstrate their utility and cost-effectiveness for water treatment and water disposal, and, if eventually proposed, would be addressed in future permitting.

Theme WR 123

Theme Statement

The FEIS should acknowledge that certain constituents in Colby Lake currently exceed water quality standards and arsenic concentrations are elevated and the NorthMet Project Proposed Action would increase these concentrations. A TMDL study on Colby Lake is needed.

Thematic Response

The water quality results of Colby Lake are reported in FEIS Section 5.2.2.3.2.

The Co-lead Agencies acknowledge that arsenic currently exceeds the water quality criterion of 2 μg/L in Colby Lake and is predicted to do so under the NorthMet Project Proposed Action. However, it is also predicted that Colby Lake arsenic would continue to exceed the criterion under the Continuation of Existing Conditions (CEC) scenario (i.e., without the NorthMet Project Proposed Action). As predicted by the water quality model, the NorthMet Project Proposed Action arsenic concentrations are virtually identical to the CEC concentrations up to mine year 52. After that time, the NorthMet Project Proposed Action concentrations are slightly higher than the CEC concentrations; however, the difference is not more than 0.05 μg/L. The Co-lead Agencies conclude that this small increase above CEC concentrations does not constitute an unacceptable impact associated with the NorthMet Project Proposed Action.

A TMDL study is not required to assess impacts in the FEIS.

Theme WR 124

Theme Statement

Colby Lake water used for augmentation is higher in sulfates than existing tributary stream water, and would result in damage to downstream wild rice beds. The use of Colby Lake water for augmentation would require reverse osmosis treatment prior to discharge to surface water. Table 6.2-6 does not include NorthMet augmentation flow from Colby Lake to Embarrass River tributaries. This source has a higher sulfate concentration than the Waste WWTF effluent, and should be included in the Table.

Thematic Response

The NorthMet Project Proposed Action has been modified since the SDEIS to address this issue. The Project Description in the FEIS indicates that no Colby Lake water would be used for direct surface water augmentation. All water used for stream augmentation would be treated prior to being added to hydrologically affected waters.

Theme WR 125

Theme Statement

The FEIS should acknowledge that use of Colby Lake water for augmentation would increase mercury loading to the Embarrass River.

Thematic Response

The Project Description in the FEIS indicates that no Colby Lake water would be used for direct surface water augmentation. All water used for augmentation would be treated by the WWTP prior to discharge. See FEIS Section 5.2.2.3.2 for more information.

Theme WR 126

Theme Statement

Based on case history information, the SDEIS consistently underestimates liner leakage rates for waste rock stockpiles, WWTF equalization basin and the Hydrometallurgical Residue Facility. The FEIS should provide clear justification for assumptions and inputs used to estimate liner leakage. Liner leakage would pollute groundwater.

Thematic Response

The assumed liner leakage rates are based on a combination of literature values, experience at mine sites, experience at other types of industrial facilities, manufacturer documentation, and information provided in standard engineering guidance documents (Section 5.2.2.3 in the Mine Site Water Modeling Data Package [PolyMet 2015m]). Liner leakage rates were estimated using the USEPA-approved HELP model, where simulations combined NorthMet Project Proposed Action design values for slopes and subgrade design with the published values for average liner defects per acre.

It is acknowledged that there have been historical instances where poor-quality liner installations have failed or leaked at relatively high rates. However, for the high-quality liner installations to be used for the NorthMet Project Proposed Action, the assumed liner leakage rates are reasonable and consistent with industry standards. While solid waste landfills may typically be smaller than the project facilities, the liner leakage rates are expressed on a unit area basis, so the results can be scaled to larger facilities. Further, the waste rock stockpiles where liners would be used are only temporary and monitoring would provide early warning if they are not functioning properly.

Theme WR 127

Theme Statement

The assumed effectiveness of the Category 1 Stockpile cover is not supported and may be over-estimated. Cover effectiveness should be a probabilistic input. The FEIS should address deterioration in liner and cover performance and the need for periodic cover replacement. These assumptions should be reviewed to determine whether the FEIS should assume an increase in liner leakage over time as the membranes deteriorate. The FEIS should describe the replacement schedule for the Category 1 Stockpile cover membrane, as well as contingencies if leakage below the Hydrometallurgical Residue Facility liner causes unacceptable effects on groundwater.

Thematic Response

Some water is predicted to leak through the liners as a result of tears or defects in the geomembrane liners and this potential effect is included in the GoldSim model. The quantity of water leaking through the liners is determined by the liner design and effectiveness.

The Hydrologic Evaluation of Landfill Performance model was used to estimate liner leakage, including the use of uncertainty analysis. Leakage rates are summarized in FEIS Table 5.2.2-26 and Section 5.2.2.5.4, and are included in the Mine Site and Plant Site Water Modeling Data Packages (PolyMet 2015m and 2015j, respectively, as cited in the FEIS).

Water mitigation measures are summarized in Section 5.2.2.3.5.

It should be noted that the liners used for the Category 2/3 and 4 Stockpiles would be temporary and only be used for a maximum of 20 years. It is unlikely liner replacement would be required in this timeframe if the liner were installed properly.

For the Category 1 Stockpile geomembrane cover, which would be overlain by a vegetative soil cover, maintenance would be required to ensure its effectiveness. The Adaptive Water Management Plan (AWMP) (PolyMet 2015d, as cited in the FEIS) describes modification to the cover system in Section 3.4.3.2 that could also be made before and after installation. This is also summarized in FEIS Section 5.2.2.3.5. Despite maintenance and modifications, if deterioration of the liner were indicated, either visually or by systematic increases in flows to the containment system, then mitigative actions would be undertaken that may include liner repair/replacement and replacing soil that may have been eroded. If full depletion of constituents from the stockpile required more than 1,000 years, the geomembrane could need to be replaced.

The Hydrometallurgical Residue Facility would be double-lined at the bottom to facilitate collection of water that has contacted the hydrometallurgical residue. More specific, the double liner would consist of a composite liner system utilizing a geomembrane liner above a geosynthetic clay liner with a second liner placed above the first, separated by a leakage collection system, substantially removing all hydraulic head from the lower liner. This design would virtually eliminate leakage from the Hydrometallurgical Residue Facility to groundwater resources. The collection system capture rate was calculated and included in Section 5.2.2.5.4 of the document Plant Site Water Modeling Data Package (PolyMet 2015j, as cited in the FEIS). The Residue Management Plan (PolyMet 2014r, as cited in the FEIS) includes a description of the operating plans, monitoring procedures, and adaptive management approaches for the Hydrometallurgical Residue Facility. Information on the design of the Hydrometallurgical Residue Facility is in the FEIS in Section 3.2.2.3.7 and 3.2.2.3.10, and further detailed with respect to geotechnical stability in Section 5.2.14.2.3.

Theme WR 128

Theme Statement

The SDEIS places too much reliance on untested and unproven engineered mitigation measures and technologies, such as reverse osmosis, that must work flawlessly for very long periods of time to reduce pollutants from entering surface waterways and groundwater. There is no acknowledgement that many of these measures would degrade over time and require constant monitoring, periodic replacement, and financial assurance to pay for their upkeep. It is unclear what mitigation PolyMet has committed to, and who and by what means NorthMet Project Proposed Action performance would be enforced.

Thematic Response

It is the Co-lead Agencies' opinion that engineered systems can operate successfully over long periods of time is they are property monitored and maintained. The FEIS provides a comprehensive description of proposed water treatment and seep collection systems including groundwater containment and synthetic liners/covers. This includes conceptual designs and discussions of the types of monitoring used to assess performance. Detailed designs are provided in supporting documents, which are fully referenced in the FEIS. The FEIS also discusses long-term operation, maintenance, and periodic replacement of engineered systems. It is acknowledged that certain components of the engineered systems would need to be replaced when monitoring indicated that performance is marginal and not readily compensated for by adaptive mitigation measures.

A detailed financial assurance analysis would be part of the permitting phase and is not a required component. The financial assurance process would fully consider long-term monitoring and periodic replacement of equipment including, but not limited to, water treatment hardware and synthetic liners/covers. The Financial Assurance package for the NorthMet Project Proposed Action would insure that future funding would be available if and when adaptive mitigation measures or component replacements are needed to achieve performance specifications.

Mitigation measures have been adopted into the NorthMet Project Proposed Action through engineering design and management. An overview of the evolution of the NorthMet Project Proposed Action with respect to alternatives analysis is provided in FEIS Section 3.2.3.3. PolyMet commits to monitoring and management through application of management plans that form the NorthMet Project Proposed Action; these plans are listed at the start of FEIS Section 3.2.2. Specific mitigation and monitoring measures relating to water are described in FEIS Sections 5.2.2.3.5 and 5.2.2.3.6.

Theme WR 129

Theme Statement

Over timeframes of hundreds of years, it is likely that some mitigation measures would fail and release contaminated water to the environment before corrective actions can be taken.

Thematic Response

Provided that financial assurance and long-term management is in place, engineering controls could be operated within performance specifications for as long as necessary to meet environmental objectives. Monitoring would allow potential failures to be recognized and corrected before there is a release of impacted water to the environment. With appropriate monitoring and pre-planned contingency actions, and adequate financial assurance, it is technically feasible to maintain the operation of engineered systems indefinitely into the future.

Theme WR 130

Theme Statement

The NorthMet Project Proposed Action does not incorporate adequate mitigation. The SDEIS does not adequately discuss the adaptive mitigation measures that would be used to control unexpected water releases that could impact water chemistry, hydrologic or thermal regimes from the NorthMet Project Proposed Action sites to waterbodies such as the St. Louis River and its tributaries. In many cases, the SDEIS states that mitigation measures would be implemented if needed, but does not describe what those measures would be. What has been committed to by PolyMet is unclear. Triggers for potential changes to designs to collect and manage polluted drainage should be outlined in the FEIS, including why or how underdrains would be added to certain stockpiles should be fully described.

Thematic Response

Mitigation measures have been adopted into the NorthMet Project Proposed Action through engineering design and management. An overview of the evolution of the NorthMet Project Proposed Action with respect to alternatives analysis is provided in Section 3.2.3.3. PolyMet commits to monitoring and management through application of management plans that form the NorthMet Project Proposed Action; these plans are listed at the start of FEIS Section 3.2.2.

FEIS Section 5.2.2.3.5 describes Mine Site and Plant Site adaptive water management measures and under what circumstances they would be triggered and implemented. These adaptive measures would be adjusted accordingly during the construction and operation of the NorthMet Project Proposed Action, based on monitoring results, performance modeling, and engineering assessments. Examples include improving WWTP performance and Tailings Basin pond cover performance.

With regards to the use of foundation underdrains in stockpiles, these would be used to provide gravity drainage should elevated groundwater be encountered, to prevent or minimize the potential for excess pore pressures adversely affecting the performance of the liner system as the stockpile is loaded. As stated in FEIS Section5.2.2.3.2, all temporary stockpiles (Category 2/3, Category 4, and Ore Surge Pile) would have an underdrain system of minimum grade of 0.5%.

Theme WR 131

Theme Statement

The SDEIS does not discuss monitoring or contingencies for failure of pumps, the Colby Lake pipeline, the tailings pipeline, or pipelines between the Plant Site to the Mine Site, despite the fact that these systems may need to run and be funded for centuries after the mine closes. What water is piped where and when is confusing.

Thematic Response

As discussed in the FEIS, financial assurance and long-term management would be in place to assure that engineering controls could be operated within performance specifications for as long as necessary to meet environmental objectives. The Permit to Mine, which would be required before the NorthMet Proposed Action Project could begin, would describe the monitoring required to comply with discharge requirements.

The monitoring would allow potential failures to be recognized and corrected before a release of impacted water to the environment. With appropriate monitoring and pre-planned contingency actions, it is technically feasible to maintain the operation of engineered systems indefinitely into the future. Financial assurance adequate to: 1) monitor/inspect the engineered systems, 2) repair or replace components as necessary, and 3) apply adaptive mitigation measures that are shown to be cost-effective would be required under the Permit to Mine. Financial assurance is described in FEIS Section 3.2.2.4.

FEIS Figures 3.2-5 through 3.2-8 show the proposed water management features, infrastructure, and flow at NorthMet Project area.

Theme WR 132

Theme Statement

The SDEIS provides no contingencies for tailings embankment failure.

Thematic Response

The Project Description in the FEIS indicates that the Tailings Basin design would meet appropriate Factors of Safety and that Tailings Basin embankments would be monitored and inspected on a routine basis and repaired or strengthened on an as-needed basis. Financial assurance would be in place to perform these activities indefinitely into the future.

Theme WR 133

Theme Statement

The SDEIS includes no discussion of the installation of the south Tailings Basin seepage capture system and the proposed seepage capture system has not been designed to collect any seepage from the east side of the Tailings Basin.

Thematic Response

The Project Proposer has committed to collecting all of the south seepage from the Tailings Basin that makes its way to Second Creek by implementing additional improvements to the existing seepage management system if necessary. Potential measures that could bring the capture efficiency of the system to 100% include improvements to the existing dam such as lining the upstream dam face with bentonite and injecting grout into the dam. If seepage is observed to bypass the existing dam, a second dam could be constructed approximately 500 feet downstream of the existing system. This is an area where the Second Creek headwaters valley is more constricted and any remaining subsurface seepage would have come to the surface. This potential second dam could be constructed as an earthen dam with a clay or concrete cutoff wall (extending to bedrock if necessary) in order to achieve 100% capture of the surface seepage.

The east side seepage containment system is designed in the same manner as the groundwater containment system on the northern and western sides of the Tailings Basin. The east side seepage containment system would be designed to efficiently collect the Tailings Basin seepage while minimizing the collection of unimpacted water that would continue to flow from east to west towards the Tailings Basin. The unimpacted water flowing towards the Tailings Basin would be directed to the swale that would be constructed north of the East Dam consistent with the NorthMet Project Proposed Action as described in the SDEIS and FEIS, while the seepage collection system on the interior of the groundwater containment system would be constructed at an elevation lower than the swale to maintain an inward gradient across the containment system.

Theme WR 134

Theme Statement

The SDEIS provides no technical justification for the finding that waste rock segregation would be effective. It is unclear why Category 1 Stockpile seepage capture and treatment is necessary given its percentage of sulfur and the predictions that it would not generated acidic leachate. Why doesn't PolyMet stockpile the higher sulfur rock from the Category 1 stockpile in the Category 2/3 stockpile? This would potentially lower post-closure costs if it would eliminate the need to treat water that comes in contact with the Category 1 stockpile.

Thematic Response

Rock segregation by chemical properties is the primary purpose of mining operations. The designation of rock as waste and ore is a universally applied method for directing material excavated from hard rock mines. There is a long history of rock segregation on the Iron Range and regulatory agencies annually review the placement of rock. Technology like GPS has improved segregation practices. Moreover, calculations show if all Category 2/3 Stockpile rock were to be placed in the Category 1 Stockpile, the average rock sulfur concentration would be 0.10 weight-percent sulfide S. This is less than the 0.12 weight-percent sulfide cut-off that defines the rock at the Category 1 Stockpile. While acid generation is not expected, the proposed containment system that would be constructed around the Category 1 Stockpile to capture water coming from the stockpile would ensure that water is managed in the event of unexpected constituent-loading from the stockpile.

To support the environmental classification of waste rock, 89 rock samples were subjected to kinetic tests (synthetic weathering). The samples were pre-selected to be spatially dispersed across the deposit, included rock from each of the major lithologic units, and captured the range in metal and sulfide S concentrations (see Table 4-1 in SRK 2007b, as cited in the FEIS). Non-acid-generating material (Category 1 waste rock samples defined as having no more than 0.12 weight-percent sulfide S) was identified through the results of 13 long-term (greater-than 420 weeks) kinetic tests. These tests found that all Category 1 rock samples, "...yielded pH above 6 throughout the program, typically fluctuating between 6.5 and 7.5 after an initial decline" (Section 4.1.4 and Large Table 1 in PolyMet 2015q, as cited in the FEIS). Although leachate from the Category 1 Stockpile is not predicted to be acidic, water quality model predictions indicate the need for mitigation.

To support mine planning and waste-rock handling, PolyMet developed a geologic "block model," which is a three-dimensional grid that represents the deposit and that provides an estimate for ore grade and sulfide S concentration in each grid block. The estimates of sulfide S in all of NorthMet waste and ore are based on interpolation of sulfide S analyzed in recovered drill core (~18,800 analyzed samples). To ensure that the estimates of sulfide S concentration in the waste rock are accurate, the Co-lead Agencies commissioned an independent review of the geostatistical analysis used to develop the sulfide S distribution in the block model. For this, the reviewer obtained the entire dataset of sulfide S analyses on core samples. This audit found that the number and spatial distribution of the sulfide analyzed supported the geologic block model, which was developed to describe the ore and waste rock distribution in the deposit (Optitech 2012).

Theme WR 135

Theme Statement

Groundwater mapping is incomplete. The FEIS should address the flow and seepage of groundwater and should include information related to the stability of aquifers.

Thematic Response

Groundwater mapping has been performed by a combination of water levels measured in monitoring wells and calibrated groundwater flow models that predict hydraulic head distributions between the measurement locations. The calibration procedure refines the estimated hydrologic properties (e.g., hydraulic conductivity) of hydrogeologic units. The hydraulic head maps and refined properties developed in this manner are considered sufficiently reliable and accurate for impacts analysis and design of mitigation measures.

Theme WR 136

Theme Statement

The SDEIS provides no technical justification for the assumed effectiveness of land application of impacted waters.

Thematic Response

The NorthMet Project Proposed Action would not rely upon land application of impacted waters as a means for treatment.

Theme WR 137

Theme Statement

The SDEIS provides no technical description of potential non-mechanical water treatment systems. The SDEIS provides no technical justification of its effectiveness, details on when it would be implemented, nor does it describe how the commitment to transition to non-mechanical treatment would be enforced.

Thematic Response

A specific design of non-mechanical treatment is not included in the Project Description and the NorthMet Project Proposed Action would rely on mechanical treatment for as long as necessary. During operations and closure, the use of non-mechanical treatment may be considered as an adaptive management measure if pilot and other feasibility studies indicate that this method has potential utility in accordance with permit conditions, and is cost-effective. In the FEIS, the possible future use of non-mechanical treatment is stated as a long-term goal, but the details of how such systems would operate would be determined once operations begin and site specific data could be used for pilot/feasibility studies, and if eventually proposed would be addressed in future permitting. . Reference to a seasonal application of the wild rice standard has been removed from the description of these potential future non-mechanical treatment systems for the FEIS

Theme WR 138

Theme Statement

The SDEIS does not describe the frequency of cover and liner replacement or acknowledge that leaks are most often due to accidental flaws in installation.

Thematic Response

Some water is predicted to leak through the Category 2/3 and 4 geomembrane liners as a result of tears or defects and this effect is included in the GoldSim model. The Hydrologic Evaluation of Landfill Performance model was used to estimate liner leakage, including the use of uncertainty analysis. Leakage rates are summarized in FEIS Table 5.2.2-26 and Section 5.2.2.3.2, and are included in the documents Mine Site and Plant Site Water Modeling Data Packages (PolyMet 2015m and 2015j, respectively, as cited in the FEIS). Mitigation measures are summarized in FEIS Section 5.2.2.3.5. It should be noted that the liners used for the Category 2/3 and 4 Stockpiles would be temporary and would only be used for a maximum of 20 years. It is unlikely liner replacement would be required in this timeframe if the liner is installed properly.

For the Category 1 Stockpile geomembrane cover, which would be overlain by a vegetative soil cover, maintenance would be required to ensure its effectiveness. The Adaptive Water Management Plan (AWMP) (PolyMet 2015d, as cited in the FEIS) describes modification to the cover system in FEIS Section 3.4.3.2 that could also be made before and after installation. This is also summarized in FEIS Section 5.2.2.3.5. Despite maintenance and modifications, if deterioration of the liner were indicated, either visually or by systematic increases in flows to the containment system, then mitigative actions would be undertaken that may include liner repair/replacement and replacing soil that may have been eroded. If full depletion of constituents from the stockpile required more than 1,000 years, the geomembrane could need to be replaced.

The Hydrometallurgical Residue Facility would be double-lined at the bottom to facilitate collection of water that contacted the hydrometallurgical residue. More specifically, the double liner would consist of a composite liner system utilizing a geomembrane liner above a geosynthetic clay liner with a second liner placed above the first, separated by a leakage collection system, substantially removing all hydraulic head from the lower liner. This design would virtually eliminate leakage from the Hydrometallurgical Residue Facility to groundwater resources. The collection system capture rate was calculated and included in Section 5.2.2.5.4 of PolyMet 2015j (as cited in the FEIS). The Hydrometallurgical Residue Management Plan includes a description of the operating plans, monitoring procedures, and adaptive management approaches for the Hydrometallurgical Residue Facility. Information on the design of the Hydrometallurgical Residue Facility is in FEIS Section 3.2.2.3.10.

Theme WR 139

Theme Statement

The FEIS should describe the groundwater and surface water monitoring plans and systems rather than stating that monitoring plans would be determined during the permitting phase. Furthermore, the FEIS should state who would be responsible for water monitoring. It seems inadvisable to depend on PolyMet to perform such a critical function, especially when it is potentially hurtful to their bottom line. Where monitoring shows effluent limit exceedances, enforcement and corrective actions needs to be taken. An understanding of baseline groundwater flow direction is necessary before implementing a monitoring system.

Thematic Response

FEIS Section 5.2.2.3.6 provides a description of the monitoring plans proposed by PolyMet. Monitoring would be used on a continual basis to document compliance with permit conditions, annually validate and update water models, and provide input to optimize operations of adaptive engineering controls. The FEIS provides information on objectives, monitoring summary, and general location for monitoring of process water streams, storm water, surface discharges, groundwater, wetlands, and surface water in the Partridge River and Embarrass River watersheds (as applicable). For groundwater monitoring, the general number of sampling locations and frequency are identified. For surface water, general sampling locations and timeline are identified. As mentioned in the FEIS, the water monitoring plans would be finalized in detail (including specific locations, frequencies, and parameters) during the NPDES/SDS water permitting and water appropriations processes and updated as required during the life of the NorthMet Project Proposed Action.

PolyMet, as the assigned Permittee for the NorthMet Project Proposed Action, would be responsible of carrying out the proposed monitoring activities as described in the legally enforceable permits. The permits, supported by state and federal laws, include provisions that address failure to comply with the terms and conditions of the permit, including those related to conducting required monitoring.

Theme WR 140

Theme Statement

The FEIS should discuss contingencies in the event that Colby Lake and Whitewater Reservoir cannot be used for drinking water due to mine withdrawals and contributions of polluted water.

Thematic Response

Colby Lake is classified listed as a Class 1B waterbody (protected for domestic consumption) and is currently used as a potable water source for the City of Hoyt Lakes. As stated in FEIS Sections 4.2.2.2.2 and 5.2.2.3.2, recent monitoring data show elevated concentrations of aluminum, iron, mercury, and manganese, which at times exceed secondary drinking water standards. The City of Hoyt Lakes currently treats the water drawn from Colby Lake to remove these constituents prior to distribution. Additionally, Colby Lake is classified as "impaired waters" as it is on the Minnesota 303(d) TMDL List due to mercury concentrations in fish tissue.

With the proposed designs and engineering controls, the water quality model predicts that the NorthMet Project Proposed Action would not cause or increase the magnitude of a current exceedance of Colby Lake surface water evaluation criteria at the P90 level. Furthermore, the model predicts a slight decrease in P90 concentrations of aluminum, iron, and manganese over time.

Based on current conditions and uses and the predicted conditions, no issues with continued use Colby Lake as a potable water source have been identified.

Theme WR 141

Theme Statement

The FEIS should discuss the monitoring necessary to ensure wildlife protection, human health, and water quality related to open water in the East Pit wetland, West Pit Lake, and Tailings Basin pond.

Thematic Response

Based on the results of water quality modeling, the water quality of the West Pit Lake, East Pit wetland, and Tailings Basin pond is predicted to be at concentrations not injurious to wildlife or incidental human contact. On-site monitoring of waterbodies within facility boundaries would likely be a part of a monitoring program. Monitoring details would be finalized in the permitting process. FEIS Section 5.2.5.2.3 discusses potential effects on wildlife from incidental contact with the Tailings Basin pond and pit lakes. FEIS Section 7.3.4 discusses potential human health impacts. FEIS Section 5.2.2.3.6 discusses on-site water monitoring.

Theme WR 142

Theme Statement

The FEIS should discuss monitoring and mitigation associated with potential effects on drinking water wells.

Thematic Response

With regard to water wells, the FEIS groundwater impacts analysis indicates that drinking water standard-based evaluation criteria would be met at the Mine Site and Plant Site property boundaries, which are upgradient of current and possibly future residential or domestic water wells. Evaluation criteria can be found in Section 5.2.2. If evaluation criteria are met at the properties boundaries, it is highly unlikely that the NorthMet Project Proposed Action could cause exceedances of groundwater standards outside the property boundary. Note that at the Plant Site, groundwater standards for some parameters may currently be exceeded beyond the property boundary as a result of legacy issues with the Tailings Basin; however, engineering controls included as part of the NorthMet Project Proposed Action are expected to address these exceedances over time.

Theme WR 143

Theme Statement

SDEIS does not adequately describe the dual proposed reverse osmosis systems including: the design, discharge locations, and timing of implementation; treatment processes; the results of pilot testing; reliability; cost, effectiveness; operations; and management, including that of potential overflows.

Thematic Response

The Project Description in the FEIS indicates that an RO system would be constructed at the WWTP at the Plant Site at the beginning of the NorthMet Project Proposed Action and that an RO unit would be added to the WWTF at closure if water monitoring of sulfate concentrations during operations indicated the need to do so. Pilot-testing of an RO system was conducted by the Proponent and is reported in the document ‘Final Pilot Testing Report, June 2013’ referenced in FEIS Section 5.2.2.3. The final detailed design, treatment process, operation, and maintenance of the RO systems to be installed would be included as part of the permitting process.

Theme WR 144

Theme Statement

The SDEIS does not adequately describe measures that would be taken in the event of short-term or long-term reverse osmosis system failure.

Thematic Response

RO is a standard water treatment technology and industrial-scale systems have been operated around the world for decades. The FEIS describes the proposed RO system as being modular with redundant treatment streams. If one or more of the membranes were to fail, the flow could be quickly diverted to standby cells and no flow would pass through the RO system untreated. Further, membrane failure tends to be gradual and provide advanced warning so corrective actions could be taken before there was a loss of treatment. The system would be designed to have storage capacity for the incoming influent so the system could be shut down for brief periods for equipment repair/replacement, with the stored influent treated after the system were back online.

PolyMet would contract with specialty service companies providing self-contained truck-mounted RO systems that could transported to the site on short notice for temporary treatment while modifications were made to the resident RO system (if ever necessary).

Theme WR 145

Theme Statement

The FEIS should provide additional detail on the characterization, and the risks of temporary storage, transportation and disposal of treatment residuals (brines and solids), including uranium.

Thematic Response

Sludge produced by the chemical precipitation system would be managed at the Hydrometallurgical Residue Facility during operations or disposed off-site at an appropriately licensed solid waste disposal facility. During reclamation sludge would be hauled to an approved off-site landfill. During operations, the reject concentrate from the WWTP would be transported to the WWTF via railcar, fed to the precipitation system via a transfer pump, and directed to the applicable precipitation train. During closure and long-term maintenance, the WWTP residual solids generated from thermal treatment would be transported off site for disposal. The description of treatment residual disposal in the FEIS is at a sufficient level of detail for the FEIS to assess their potential for impact on the environment. There is no uranium risk or exposure associated with the NorthMet Project. FEIS Section 5.2.13 addresses risk and management of hazardous materials associated with the NorthMet Project Proposed Action.

Theme WR 146

Theme Statement

The SDEIS does not adequately describe the precipitation process to be used at the WWTF.

Thematic Response

FEIS Section 5.2.2.3.1 describes the chemical precipitation and membrane filtration treatment methodologies to be used at the WWTF based on the predicted water loads and constituents modeling.

Theme WR 147

Theme Statement

The FEIS should describe the influent and effluent assumptions and targets for the WWTF and WWTP. Influent concentrations for some parameters are underestimated or not considered which effects effluent concentrations.

Thematic Response

The influent concentrations of all chemical constituents to the WWTF and WWTP, based on information from GoldSim modeling, are presented in the Mine Site Data Package and Plant Site Data Package (PolyMet 2015m and PolyMet 2015j, respectively, as cited in the FEIS).

Because the water treatment facilities would be designed systems, they could be engineered to achieve target effluent concentrations. The assumed effluent treatment concentrations in the FEIS are based on extensive laboratory-scale and pilot-scale testing conducted by PolyMet and on case histories of currently operating systems at mine sites.

Theme WR 148

Theme Statement

The FEIS should describe contingencies if water treatment flow rates are higher than expected.

Thematic Response

The WWTF to be used at the Mine Site for mine years zero to 40 would be designed to have a larger treatment capacity than expected. The excess treatment capacity would be sufficient to handle all reasonable flow rates that could occur during mine operations and reclamation. In the unlikely event that influent flow rates were greater than the WWTF capacity, the excess flow could be diverted to the Plant Site RO system, which would also be designed to have excess treatment capacity. The preliminary design of the WWTP would be based on estimates for the volumetric flow and chemical composition of Plant Site water from the seepage capture pond-level management systems, but the WWTP treatment system would be part of the adaptive management system, so that its capacity could be "adapted, as necessary, in response to the actual conditions encountered during the Project, the monitoring results, and the conditions estimated by continued model updating" (Section 4.2.4 of PolyMet 2015d, as cited in the FEIS).

RO systems would be used at the Plant Site for the entire life cycle of the NorthMet Project Proposed Action and at the Mine Site during closure. These systems would be designed with excess flow capacity and redundant treatment streams. The modular design of the RO systems would allow the ability to add capacity in the unlikely event that influent flow rates exceeded both the primary and redundant design flow rates. PolyMet would contract with specialty service companies providing self-contained truck-mounted RO systems that could transported to the site on short notice for temporary treatment while modifications were made to the resident RO system (if ever necessary).

Theme WR 149

Theme Statement

The SDEIS generally underestimates sulfate concentrations at points of compliance. There is insufficient information to determine whether this mine would contribute to significant degradation of the waters of the United States due to sulfate discharges. Permits must be denied on this basis.

Thematic Response

NorthMet Project Proposed Action-related sulfate concentrations at groundwater and surface water evaluation locations would mostly be dependent on chemical release rates from chemical source areas including mine pits, stockpiles, and the Tailings Basin. In addition, sulfate concentrations would be strongly influenced by the capture efficiency of containment systems along the outside perimeter of the Tailings Basin and surrounding the Category 1 Stockpile.

GoldSim inputs pertaining to chemical release rates were scrutinized by the Co-lead Agencies and extensively reviewed and modified through a cooperative process with the Project Proponent and Cooperating Agencies. These inputs are considered realistic median values based on NorthMet geochemical characterization and information obtained from similar mine sites. The capture efficiencies used for containment systems at the Mine Site and Plant Site are considered reasonable or conservatively low based on subsidiary MODFLOW modeling specifically meant to address this issue. The Co-lead Agencies believe that GoldSim inputs for these processes are reasonable and do not have any systematic tendencies leading to underestimates in sulfate concentrations at the evaluation locations.

The GoldSim modeling is probabilistic so that most chemical release inputs are put into the model as probability distributions (rather than single deterministic values). The mean (or central-tendency) values in these distributions are considered by the Co-lead Agencies to reasonably conform to median values based on geochemical characterization. In addition, the range of probable values above and below the mean do not bias the overall probability distributions to higher or lower release rates from what is indicated by the data. Note further that evaluation of NorthMet Project Proposed Action-related impacts is based on P90 sulfate concentrations, which are always higher than the P50 (median) concentrations.

Given the above discussion, the Co-lead Agencies believe that GoldSim-computed sulfate concentrations are not systematically underestimated at evaluation locations at the Plant Site and Mine Site. It is further believed that the P90 concentrations computed by GoldSim and used to assess NorthMet Project Proposed Action impacts are likely higher than what would actually occur under the NorthMet Project Proposed Action.

The evaluation and decision of whether or not the NorthMet Project Proposed Action may or may not discharge into surface waters where water quality standards are exceeded is a permit decision.

Theme WR 150

Theme Statement

The SDEIS does not account for accumulation of sulfate in tailings or other waste.

Thematic Response

The GoldSim water- and solute-transport models track the mass of all sulfate released from the oxidation of sulfide minerals. If sulfate concentrations in pore water were below the concentration cap, all of the sulfate released in a time step could migrate out with the flowing water. But if enough sulfate were released over a time step that the sulfate concentrations in pore water exceeded the concentration cap, then the pore water would be set equal to the concentration cap, and the mass of excess sulfate would be stored in the model as a “labile” phases (i.e., a solid phases that remains in place, but is assumed to be able to dissolve in each new model time step). The result of this method is that when solute release produces sulfate concentrations above the concentration cap, the effluent remains at the concentration cap, and the eventual release of the stored “labile” sulfate causes the sulfate concentrations in effluent to remain at the cap for a longer duration. This method is applied to waste rock and tailings. Waste rock and wall rock contains “non-contacted” rock an additional reservoir for “labile” sulfate. This is the portion of the rock that is not flushed by percolating water, and sulfate is released from this zone when (and if) the rock is submerged in water. This same approach is applied to all solutes as part of the model design to preserve mass balance.

Theme WR 151

Theme Statement

The SDEIS does not adequately consider the amount or effects of dust and depositional impacts, and ore spillage from rail cars on groundwater, surface water, and wetlands.

Thematic Response

The Project Description in the FEIS includes routine inspections of the Transportation and Utility Corridor to identify accumulations of dust or ore spillage.

Regarding dust, given the majority of the dust that could leave the NorthMet Project area could be characterized as low sulfide/low metal, potential impacts would be controlled by: 1) the commitment to treat all runoff from disturbed areas as process wastewater, and 2) the facilities would be subject to an air quality Fugitive Emissions Plan. Significant impact on water resources or historic properties is not expected.

All active areas at the Mine Site and Plant Site would be subject to a Fugitive Dust Control Plan approved by the MPCA, which describes management of fugitive dust generated from unpaved roads across the NorthMet Project area, rock dumping and loading locations on the Mine Site, and areas potentially subject to wind erosion on the Plant Site (see Section 4.1.6 and Section 4.3.9 in PolyMet 2015a, as cited in the FEIS).

Regarding potential spillage, any significant accumulations would be removed by a combination of machines and hand work. Ore transport would be by special railcars that minimize dust and spillage, where, since the SDEIS, the Proposer has committed to retrofit the railcars to better control spillage. It is unlikely that there would be sufficient spillage to affect the quality of surface water or groundwater, as discussed in FEIS Section 5.2.2.3.2. See FEIS Section 3.2.2.4 for more information on the railcars, and Sections 5.2.3 and 5.2.7 for impacts of railcar spillage and dust on wetlands and air quality, respectively. The effect of dust falling on the disturbed portions of the Mine Site would be controlled by the perimeter dike and ditch system, which would route runoff to the WWTF (see Section 4.1.5.3 and Large Figures 19 through 21 of PolyMet 2015a, as cited in the FEIS).

Theme WR 152

Theme Statement

The SDEIS does not adequately incorporate the findings of recent research on the influence of sulfates and sulfides on the growth of wild rice. Research into and evaluation of the Minnesota sulfate wild rice water standard are ongoing, and application of the standard (where it applies, what time of year, and what the numeric standard should be) may change. The FEIS should incorporate the most recent MPCA research and needs to consider the findings of "Effects of Sulfate on the Biomass and Seed Production of Wild Rice." Given regulatory uncertainty and the lack of wild rice locational data, the FEIS should assume all waters surrounding the NorthMet Project Proposed Action site are wild rice waters.

Thematic Response

The FEIS recognizes the MPCA is overseeing a variety of studies on wild rice. At applicable surface water locations, the FEIS evaluated impacts using an impact criteria based on the current

MPCA 10 mg/L standard for sulfate concentration in waters used for the production of wild rice. This impact assessment metric is keyed to the current regulation.

It is recognized that the MPCA is currently evaluating the current wild rice sulfate water quality standard and, as part of that process, new information on potential contributing factors on the growth of wild rice has been generated. However, that information has not yet been holistically reviewed in the context of its possible influence on the wild rice standard. Future change to the wild rice sulfate standard, if any, is speculative and outside the scope; applying research findings outside the basis of the current rule is not appropriate.

The FEIS includes descriptions of the Plant Site WWTP and Mine Site WWTF, both of which would be capable of discharging treated wastewater at concentrations at or below 10 mg/L as demonstrated by pilot-testing already conducted. More detailed information on these treatment systems would be available as part of the permitting process. However, should a more stringent standard be developed in the future, operation of the RO treatment systems could be adjusted to meet a more stringent effluent limit.

See FEIS Sections 5.2.2.1.2, 5.2.2.3.2, and 5.2.2.3.3 for more information.

Theme WR 153

Theme Statement

Seasonal application of the Minnesota sulfate standard is not technically justified; the standard needs to be applied year round. If seep collection and non-mechanical water treatment after closure do not work as planned, the seasonal discharge would have a greater effect than predicted in the SDEIS.

Thematic Response

Neither seasonal application of the wild rice standard nor non-mechanical treatment systems would be part of the NorthMet Project Proposed Action, which would rely solely on mechanical treatment and year-round application of the sulfate standard. Non-mechanical treatment may be considered during operations and closure if pilot studies demonstrated their utility and cost-effectiveness for water treatment and water disposal.

Theme WR 154

Theme Statement

Regulatory standards need to consider historical and current wild rice areas. Historical wild rice harvesting occurred upstream of MPCA-designated waters. The wild rice standard therefore needs to be applied to entire Embarrass River Watershed and additional portions of the Partridge River Watershed.

Thematic Response

For purposes, the MPCA has provided guidance as to what waters in the Embarrass and Partridge rivers are waters used for production of wild rice, to which the current 10 mg/L wild rice sulfate standard applies. The MPCA reviewed all available relevant information in making their recommendation; however, that recommendation in itself is a policy decision of the MPCA that is not part of the EIS process.

Theme WR 155

Theme Statement

The Land Exchange Proposed Action would not compensate for current and future loss of wild rice areas. The SDEIS must be rejected until it contains an analysis of the effects of groundwater pollution on Land Exchange Alternative B.

Thematic Response

The Land Exchange Proposed Action would result in the public ownership of additional wild rice beds by the acquisition of Tract 1. Tract 1 contains Little Rice Lake, which supports a continuous population of wild rice. Wild rice also grows along the Pike River south of Little Rice Lake and in isolated populations on Hay Lake. FEIS Section 4.3.4.2.5 provides further discussion of wild rice on Tract 1. Wild rice does not currently grow within the proposed federal land boundaries. As a result, the public would have better opportunities for wild rice harvesting on Tract 1, where there is currently no opportunity to harvest wild rice directly on the federal lands (i.e., no known wild rice populations) despite the public water access onto the federal lands. A carry-down boat launching access is located on Tract 1, which may provide private access for wild rice harvesting on the Tract 1 lands. Access to wild rice beds on the federal lands would not be lost as a result of the Land Exchange Proposed Action, but access to wild rice beds on Tract 1 would be gained.

The Land Exchange Proposed Action and Lane Exchange Alternative B would not directly result in groundwater pollution. Any impacts from the NorthMet Project Proposed Action on groundwater within the federal lands included under Land Exchange Alternative B are considered in FEIS Section 5.2.2.3.2.

Theme WR 156

Theme Statement

Sulfates and toxic metals from the NorthMet Project Proposed Action that are not captured for treatment would affect water quality and wild rice production. This would harm and could even prevent the traditional, treaty-protected harvesting of wild rice by the Bands. Water quality is a legal right for Native Americans.

Thematic Response

It is acknowledged that the NorthMet Project Proposed Action would increase concentrations of some metals at some evaluation locations. However, the NorthMet Project Proposed Action would not cause predicted concentrations to be above applicable water quality standard-based evaluation criteria. Evaluation criteria can be found in Section 5.2.2. Water quality and quantity modeling predictions for SW-005 and PM-13 indicate that the NorthMet Project Proposed Action would not result in adverse impacts on wild rice. These locations are the nearest downstream locations in the Partridge and Embarrass rivers, respectively, and are recommended by the MPCA to be considered as waters used for the production of wild rice. Impacts on wild rice further downstream in these waters, or on wild rice resources regionally throughout the treaty areas, would not be expected.

Theme WR 157

Theme Statement

The NorthMet Project Proposed Action may affect wild rice and other aquatic plants that are making a recovery in these waters. Effects on wild rice in the vicinity of the NorthMet Project Proposed Action must be more rigorously analyzed and reported, including the extent to which wild rice beds would decrease as a result of the NorthMet Project Proposed Action and how this could impact the quality and quantity of wild rice available for consumption by people or wildlife. The FEIS should assess the effects of winter water releases from the NorthMet Project Proposed Action on spring sulfite levels in the seedlings of downstream wild rice beds. The FEIS should also provide additional details about mitigation of wild rice effects.

Thematic Response

Water quality and quantity modeling predictions for SW-005 and PM-13 indicate that the NorthMet Project Proposed Action would not result in adverse impacts on wild rice. These locations are the nearest downstream locations in the Partridge and Embarrass rivers, respectively, and are recommended by the MPCA to be considered as waters used for the production of wild rice. Impacts on wild rice further downstream in these waters, or on wild rice resources regionally throughout the treaty areas, would not be expected.

Theme WR 158

Theme Statement

The NorthMet Project Proposed Action would increase mercury and sulfate pollution in the St. Louis River Watershed, including the Partridge River and Embarrass River, which is already impaired for these pollutants. This has serious implications for human health and wild rice. Iron mines have already created water quality problems like wild rice dead zones and concerning mercury levels.

Thematic Response

The FEIS indicates that the NorthMet Project Proposed Action would result in a reduction in sulfate-loading to the Embarrass River at the monitoring site (PM13), and a small increase in sulfate-loading to the Partridge River resulting in an overall decrease in loading to the St. Louis River. The FEIS also indicates a net decrease of mercury-loadings of approximately 0.6 grams per year (i.e., a net decrease of 1.2 grams per year in the Partridge River and a net increase of 0.6 grams per year in the Embarrass River) and therefore would not contribute to cumulative effects on mercury-loading to the St. Louis River. Based on FEIS modeling predictions, the NorthMet Project Proposed Action is not anticipated to have adverse effects on downstream wild rice. Consequently, the NorthMet Project Proposed Action does not include, or need to include, mitigation for the cultivation of new wild rice beds in unaffected waters.

Theme WR 159

Theme Statement

The St. Louis River downstream from the PolyMet site is already heavily impacted by sulfate, and wild rice production in the watershed is a fraction of what it once was. The state should reduce or eliminate problem pollution sites before permitting. The FEIS should analyze cumulative effects of the NorthMet Project Proposed Action on sulfates and wild rice in the NorthMet Project area and the St. Louis River Watershed as a whole. Cumulative effects on wild rice in the 1854 Ceded Territory also need to be addressed.

Thematic Response

Sulfate-loading is predicted to decrease overall as a result of the NorthMet Project Proposed Action. Although sulfate-loadings are predicted to increase slightly in the Partridge River Watershed (0.1%) as a result of the NorthMet Project Proposed Action, this is offset by a large decrease in the Embarrass River Watershed (21% at PM-13), resulting in a significant net decrease in overall sulfate-loadings to the St. Louis River as a result of the NorthMet Project Proposed Action. The NorthMet Project Proposed Action is also predicted to have negligible impact on the hydrology of either the Partridge or Embarrass rivers. Therefore, the NorthMet Project Proposed Action is not considered to have the potential to contribute to cumulative effects on hydrology and water quality in the St. Louis River. As a result, the CEAA for surface water is defined by the Partridge River and Embarrass River watersheds as shown on Figure 6.2.3-1.

Theme WR 160

Theme Statement

Given the mounting evidence demonstrating negative effects on wild rice from relatively low levels of sulfides, the positive correlation between levels of sulfate in water column and sulfides in sediment combined with the remaining uncertainties about long-term effects and the relationship between sulfate and methyl mercury, add to the weight of evidence against weakening the 10 mg/L sulfate standard.

Thematic Response

The water quality evaluation criterion for sulfate for the SDEIS and the FEIS for waters recommended by the MPCA to be waters used for production of wild rice (represented by evaluation locations SW-005 in the Partridge River and PM-13 in the Embarrass River) is the current Class 4A wild rice sulfate water quality standard of 10 mg/L.

Theme WR 161

Theme Statement

The NorthMet Project Proposed Action would meet the strict Minnesota standard for wild rice waters. The SDEIS makes it very clear that there would be a net decrease in both sulfate and mercury loadings as a result of this NorthMet Project Proposed Action. The NorthMet Project Proposed Action is not expected to damage downstream wild rice beds. Overall concerns about wild rice beds are unfounded, since wild rice beds are found in many nearby lakes that historically had no wild rice. Wild rice harmed by sulfides associated with the NorthMet Project Proposed Action could be mitigated through the cultivation of new wild rice beds in unaffected waters. The USFS and the State of Minnesota have planted wild rice in the area with very good success.

Thematic Response

The FEIS indicates that the NorthMet Project Proposed Action would result in a reduction in sulfate-loading to the Embarrass River at the monitoring site (PM13), and a small increase in sulfate-loading to the Partridge River resulting in an overall decrease in loading to the St. Louis River. The FEIS also indicates a net decrease of mercury-loadings of approximately 0.6 grams per year (i.e., a net decrease of 1.2 grams per year in the Partridge River and a net increase of 0.6 grams per year in the Embarrass River) and therefore would not contribute to cumulative effects on mercury-loading to the St. Louis River. Based on FEIS modeling predictions, the NorthMet Project Proposed Action is not anticipated to have adverse effects on downstream wild rice. Consequently, the NorthMet Project Proposed Action does not include, or need to include, mitigation for the cultivation of new wild rice beds in unaffected waters.

Theme WR 162

Theme Statement

Sulfate and wastewater from the NorthMet Project Proposed Action would exceed the state 10 mg/L standard for wild rice and would likely eliminate wild rice in the St. Louis River and its tributaries. Since sulfate levels in wild rice beds downstream of the Proposed Mine already exceed the standard, the FEIS should demonstrate that the NorthMet Project Proposed Action "would have an acceptably high probability of not increasing sulfate concentrations in these areas." The SDEIS does not currently meet this test. The Partridge River would exceed the standard during low-flow conditions.

Thematic Response

The discharge from WWTFs using RO technology is expected to meet the wild rice sulfate standard of 10mg/L during operations and closure. The FEIS closely evaluated the potential changes to sulfate concentrations as a result of the NorthMet Project Proposed Action in the Embarrass and Partridge rivers at evaluation locations representing the location of wild rice production waters subject to the wild rice sulfate water quality standard of 10 mg/L. The analysis showed that the NorthMet Project Proposed Action would result in a reduction of sulfate-loading to the Embarrass River and only a very slight potential increase in loading to the Partridge River. Consequently, the NorthMet Project Proposed Action is not anticipated to have adverse effects on downstream wild rice. As part of the permitting process, the MPCA would continue to evaluate the NorthMet Project Proposed Action's potential sulfate contributions to the Embarrass and Partridge rivers based upon all available relevant information to ensure compliance with applicable standards.

Theme WR 163

Theme Statement

Although the MPCA has specified that only certain wild rice producing waters are protected under the wild rice sulfate water quality standard, the rights of Ojibwe people to gather wild rice on off-reservation land was affirmed by the U.S. Supreme Court in 1999. Therefore, all wild rice beds in the Ceded Territory are protected under 1864 Treaty. The SDEIS fails to explain how the NorthMet Project Proposed Action would meet the statutory requirements regarding wild rice water quality standards and the Clean Water Act.

Thematic Response

Water quality and quantity modeling predictions for SW005 and PM13 indicate that the NorthMet Project Proposed Action would not result in adverse impacts on wild rice. These locations are the nearest downstream locations in the Partridge and Embarrass rivers, respectively, and are recommended by the MPCA to be considered as waters used for the production of wild rice. Impacts on wild rice further downstream in these waters, or on wild rice resources regionally throughout the treaty areas, would not be expected.

Theme WR 164

Theme Statement

The MPCA has postponed their decision on sulfate levels in waters that support wild rice beds. When standards are still undecided, decisions pertaining to those standards ought not to be concluded. If the rule-making process is not complete, the FEIS should not rely on a preliminary draft recommendation from MPCA based on incomplete knowledge.

Thematic Response

The evaluation in the FEIS is based on the current Class 4A wild rice sulfate standard of 10 mg/L applicable to waters used for production of wild rice and current MPCA draft staff recommendation identifying the location of waters used for the production of wild rice. It is not appropriate for the EIS to speculate as to if or how the standard, or application of the standard, may evolve.

Theme WR 165

Theme Statement

Underestimated Partridge River baseflows in the Mine Site GoldSim model lead to underestimated recharge, incorrect surficial deposit hydraulic conductivities, and underestimated chemical loading to groundwater and the Partridge River in the Mine Site GoldSim model. As a result, the SDEIS version of the Mine Site GoldSim model is invalid, and the model should be revised to include inputs that are consistent with the correct baseflows.

Thematic Response

As discussed in the response to theme WR 003, Partridge River groundwater baseflows used in the SDEIS and transferred to the FEIS are reliable best estimates and are not erroneously low. This is because the SDEIS (and FEIS) groundwater baseflow values were based on winter 1986-77 and winter 1987-88 stream gaging in the Partridge River that occurred when there were no discharges from the Northshore Mine. When expressed as a groundwater baseflow yield per unit area, the similar results for both the Partridge and Embarrass River watersheds (approximately 0.05 cfs per square mile) lends credibility to the approach used.

As discussed in the response to theme WR 004, the low-flow measurements at gaging station SW003 are not reliable indicators of groundwater baseflow due to the complicating effects of Northshore Mine pumped discharges to the Partridge River.

The Mine Site MODFLOW model was recalibrated based on new groundwater level data collected through the end of 2013; however, calibrations performed for the FEIS used the same Partridge River baseflows as were used in SDEIS. Revised hydraulic conductivities and recharge values that come from MODFLOW recalibration informed the FEIS Mine Site GoldSim model.

Groundwater baseflow discharge varies with time and is a reflection of longer-term weather and climatic conditions. The variability of groundwater baseflow discharge is demonstrated by the examination of estimated values for several years using different methods. Evaluation of these values affirms that groundwater baseflows used in the Mine Site GoldSim model are reliable and appropriate for FEIS impact evaluation.

Theme WR 166

Theme Statement

The Mine Site GoldSim model does not adequately consider hydraulic connectivity between wetlands and groundwater in the surficial deposits.

Thematic Response

Using an observational approach based on data from similar nearby mine sites (i.e., analog method), the Co-lead Agencies concluded that drawdowns in the surficial aquifer would not be expected to extend very far from the mine pits. This is explained by the following factors: 1) the surficial aquifer is thin and moderately permeable, 2) the surficial aquifer is subject to aerial recharge, and 3) the surficial aquifer is underlain by low-permeability bedrock that limits downward leakage from the surficial unit. These factors support the conclusion that wetland drawdown did not need to be included in the Mine Site GoldSim model. See FEIS Section 5.2.2.3.2 for more information on the analog method.

It is acknowledged that there is some degree of hydraulic interaction between wetlands and the surficial aquifer at the Mine Site. However, attempts to quantitatively model the effects of these interactions on drawdown and water quality would be highly uncertain and potentially misleading. The FEIS approach was to not model hydraulic connections between wetlands and the surficial aquifer in the Mine Site GoldSim model, but instead to rely on future monitoring and adaptive mitigation measures in the unlikely event that wetlands were affected by the NorthMet Project Proposed Action. See FEIS Sections 5.2.2.3.5 and 5.2.2.3.6 for more information on adaptive mitigation and monitoring at closure.

Theme WR 167

Theme Statement

There are numerous discrepancies and concerns regarding surficial groundwater flowpaths in the Mine Site GoldSim model. Three critical issues are that the model does not account for northward flowpaths (e.g., to Yelp Creek and One Hundred Mile Swamp), inappropriately assumes constant saturated thickness for the surficial flowpaths, and uses the wrong distance to the Partridge River for the East Pit—Category 2/3 flowpath. In addition, the hydraulic conductivity distributions for the surficial aquifer are not technically justified, are based on means rather than the full range of measured values, and do not consider the likely presence of higher permeability features such as buried stream channels. It is unclear if different hydraulic conductivity values are chosen for each flowpath during each simulation. The GoldSim flowpaths are not accurate, compared to flow trajectories in the Mine Site MODFLOW model. With regard to transport, the effective porosity value is not justified and sorption parameters are speculative and not sufficiently conservative and do not account for the saturation of adsorbed solutes within flowpaths. Pollutant travel times are underestimated. The model does not consider lateral dispersion in the surficial flowpaths or vertical dispersion of chemicals into bedrock. The SDEIS provides no rationale for the assumption that groundwater can migrate long distances without any discharge to wetlands and streams. The FEIS should disclose where the model predicts upwelling of groundwater into wetlands and other surface water features.

Thematic Response

FEIS Mine Site MODFLOW modeling and hydrogeologic relationships for operations and closure conditions indicate that northward flow from the mine pits and Category 1 Stockpile would be non-existent or minimal. Northward flows (if any) would not be sufficient to cause impacts to groundwater or surface water. As a consequence, there are no northward groundwater flowpaths in the FEIS Mine Site GoldSim model.

The groundwater flowpaths in the Mine Site GoldSim model are simple streamtubes with uniform linear groundwater flow. While the linear flowpath streamtubes do not exactly line up with flow trajectories predicted by the Mine Site MODFLOW Model, the streamtubes have hydraulic gradients, recharge, flow directions, and flowpath distances that are similar to those generated by the MODFLOW model. The difference between the GoldSim flowpaths and results of the MODFLOW model are of secondary importance and do not diminish the reliability of the GoldSim predictions of groundwater transport from mine facilities to the Evaluation Locations and the Partridge River.

The assumption of constant saturated thickness for the GoldSim groundwater surficial flowpaths is reasonable given site data and the purpose of the flowpath analyses in the GoldSim model (that is, average groundwater flow and chemical transport).

The distance from the East Pit to the Partridge River is based on the average distance to the river shown on FEIS Figure 5.2.2-4 (2,120 meters or 6,955 feet).

The surficial aquifer hydraulic conductivity distribution used in the FEIS Mine Site GoldSim model represents the probabilistic distribution of the mean hydraulic conductivity and should not represent the full range of measured values. The range of the probability distribution is expected to capture natural heterogeneity in the flowpaths including the effects of buried channels (if any).

In the Mine Site GoldSim model, a different hydraulic conductivity distribution is used for each groundwater flowpath. A new hydraulic conductivity value for each flowpath is statistically selected at the beginning of each realization of the Monte Carlo simulation.

The effective porosity of 30% is reasonable for an unconsolidated granular material.

It can be justified that not considering lateral and vertical dispersion tends to overestimate chemical concentrations in the surficial flowpath, which is conservative for impacts analysis.

The sorption values used for selected constituents are based on USEPA guidance documents. Due to the low absolute concentrations of constituents modeled with adsorption, it was reasonable (and standard practice) to assume that adsorption sites would not become "saturated." This was also a reasonable assumption for fractured bedrock, because diffusion can transport chemicals from fractures into the rock matrix, which greatly increases the available adsorption sites. For constituents not modeled with adsorption, the approach was conservative because the transport analysis would tend to overestimate groundwater concentrations and underestimate travel times.

It is acknowledged that there could be groundwater discharge to wetlands along a flowpath and this process is not incorporated into the GoldSim model. This process was not modeled because it is considered speculative and quantitatively uncertain. The Co-lead Agency approach is to monitor water levels and water quality in the wetlands during operations, reclamation, and closure to identify mining effects on wetlands (if any). If monitoring were to identify the potential for violation of regulatory criteria, adaptive mitigation measures would be initiated to mediate the impact. See FEIS Section 5.2.3.3 for more information on wetland monitoring and possible future mitigations.

Theme WR 168

Theme Statement

There are numerous discrepancies and concerns regarding bedrock flowpaths used in the Mine Site GoldSim model. One critical issue is that the bedrock hydraulic conductivity is far too low compared to field testing and information from other sites. In addition:

- The model does not consider the effects of fractures, and uses inputs that are intentionally chosen to eliminate significant bedrock flow and transport;

- The model is biased in that it uses the Duluth Complex as the basis for very low bedrock hydraulic conductivity;

- The model inappropriately treats bedrock as being hydraulically isolated from the overlying surficial deposits; and

- The effective porosity and sorption values used for bedrock are unrealistic.

The SDEIS needs to be reviewed to account for these discrepancies.

Thematic Response

In the FEIS Mine Site GoldSim model, bedrock flowpaths have been reconfigured with a bulk hydraulic conductivity that is approximately one order of magnitude higher than what was used in the SDEIS. In addition, the flowpaths are remodeled to be 15 meters thick, consistent with the concept of an upper more-permeable bedrock zone interpreted from RQD data (in the SDEIS model, the bedrock flowpath was 100 meters thick). Fracture flow in bedrock is considered by using an appropriate bulk hydraulic conductivity and low effective porosity (0.05) as a reasonable surrogate for fracture porosity and chemical diffusion into the matrix between fractures.

The bedrock flowpaths in the Mine Site GoldSim model are physically situated in Duluth Complex rocks, so it is appropriate to use the Duluth Complex as the basis for bedrock hydraulic conductivity.

In the FEIS Mine Site GoldSim model, the bulk hydraulic conductivity of the bedrock flowpaths is two to three orders of magnitude lower than the hydraulic conductivity of the surficial flowpaths, so it is reasonable to neglect flow between bedrock and surficial deposits.

The sorption values used in the model are based on USEPA guidance documents.

Theme WR 169

Theme Statement

The Mine Site GoldSim model does not consider the presence of higher permeability bedrock structures (faults and fracture zones), despite the fact that these types of features are known to exist in bedrock. The model incorrectly assumes that pit water would not enter the bedrock groundwater system.

Thematic Response

The FEIS indicates that structural faults may exist between mine facilities and perennial streams that receive groundwater discharge. Because the landscape is covered with surficial deposits and there are limited bedrock outcrops, the existence of faults is conjectural and locations, at best, can only be inferred. It is unknown if faults (if and where they exist) behave as conduits or barriers to groundwater flow. Given these uncertainties, it is unlikely that a new, practical field program, with a goal to identify faults, would provide data to reasonably inform the impact assessments. The management approach is to set up a robust monitoring program during operations and closure to provide direct or indirect evidence on the existence of hydrologically significant faults. If significant faults were identified (i.e., faults which could lead to violation of water quality standards), then adaptive measures would be employed to mitigate the fault-related effects. See FEIS Sections 5.2.2.3.5 and 5.2.2.3.6 for further information.

Theme WR 170

Theme Statement

The Mine Site GoldSim model does consider the fact that uppermost bedrock tends to have higher hydraulic conductivity than deeper bedrock. This characteristic has been documented in evaluations at other nearby mine sites and in studies conducted by the Minnesota Geological Survey.

Thematic Response

In the FEIS Mine Site GoldSim model, bedrock flowpaths have been reconfigured with a bulk hydraulic conductivity that is approximately one order of magnitude higher than what was used in the SDEIS. In addition, the flowpaths are remodeled to be 15 meters thick, consistent with the concept of an upper more-permeable bedrock zone interpreted from RQD data (in the SDEIS model, the bedrock flowpath was 100 meters thick). Fracture flow in bedrock is considered by using an appropriate bulk hydraulic conductivity and low effective porosity (0.05) as a reasonable surrogate for fracture porosity and chemical diffusion into the matrix between fractures.

Theme WR 171

Theme Statement

An independent flow/transport model of the Mine Site and Plant Site developed and reported by Myers differs substantially from the SDEIS models. In particular, compared to the SDEIS models, the Myers model predicts: higher groundwater flow rates, higher pit dewatering rates, greater effects on the Partridge River, higher flow rates to the WWTF, higher sulfate concentrations in groundwater, higher stockpile seepage rates and concentrations, higher areal recharge, higher hydraulic conductivity of surficial deposits, and higher bedrock hydraulic conductivities. In addition, the Myers model predicts that copper concentrations would exceed water quality standards at the Partridge River, that pump-and-treat of East Pit backfill is not hydraulically feasible, and that extensive drawdown would occur between the dewatered pits and the Partridge River. Some commenters have noted that the Myers model computed negative concentrations near chemical sources/sinks, which is impossible, and that some chemical sources have concentrations that are orders-of-magnitude higher than reasonable maximum field values.

Thematic Response

The differences between the Myers model and the FEIS models can be compared/contrasted as follows:

- The Myers model considers higher groundwater baseflows in perennial streams and this leads to higher recharge and higher hydraulic conductivities for surficial deposits. Reliable gaging data for the Partridge and Embarrass rivers indicate lower baseflows and associated lower recharge and hydraulic conductivities used in the FEIS models.
- The Myers model generally assigns higher hydraulic conductivities to bedrock units. These values are higher than what can be justified by field-testing at the NorthMet Project area or indicated in Barr 2014b, as cited in the FEIS).
- The Myers model does not include all groundwater capture systems presented in the FEIS Project Description.
- The Myers model does not use concentration caps, so that computed chemical concentrations in some mine-related chemical sources are much higher than what is reasonable or observed at other similar mine sites.
- The Myers model uses lateral and vertical dispersion, while the FEIS models do not. These uncertain processes tend to reduce chemical concentrations in the surficial aquifer, which is the dominating hydrogeologic unit that transports chemicals from mine facilities to the perennial rivers. With regard to dispersion, the Myers model would tend to compute lower chemical concentrations in the surficial aquifer compared to the FEIS models. By not considering lateral and vertical dispersion, the FEIS models tend to be conservative (i.e., more likely to overestimate impacts) compared to the Myers model.

These issues are discussed in more detail in the memorandum titled: "Comparison of the Myers Groundwater Flow/Transport model with the FEIS Impacts Analysis Models" (ERM, February 2015). Given the above deficiencies of the Myers model, it is not considered a reliable basis for evaluating future impacts associated with the NorthMet Project Proposed Action.

Theme WR 172

Theme Statement

The Mine Site GoldSim model should be revised to show groundwater concentration distributions along flowpaths at different points in time, as well as concentration distributions 200 years after closure. The FEIS should justify the use of cobalt as an indicator of nonreactive transport. For constituents assumed to be nonsorbed, the FEIS should state that actual migration velocities would be less than or equal to modeled seepage velocity. The FEIS should also acknowledge that groundwater concentrations are generally underestimated by the GoldSim model.

Thematic Response

Potential groundwater impacts are assessed at specific evaluation locations defined for each flowpath. This methodology satisfies both federal and state environmental review requirements to inform regulators, the project proponent, and public of the type, extent, and reversibility of impacts. Monitoring would typically occur at the source origins to document whether flowpath water quality predictions were being satisfied. If not, then contingency and/or adaptive measures would be applied to address potential concerns. See FEIS Section 5.2.2.1.1 for information on evaluation locations.

Cobalt was used to illustrate groundwater transport at the Mine Site because it is released by oxidation of the major source materials (waste rock and pit walls), is assumed in the GoldSim model to migrate unattenuated (i.e., travels in groundwater at an average velocity equal to the rate at which groundwater travels), and enter the surficial flowpaths at concentrations higher than baseline groundwater. Groundwater cobalt concentrations thus illustrate the time required for solutes released from sulfide-bearing mine waste to reach their peak concentration at the evaluation locations, as illustrated in concentration-versus-time plots (FEIS Figure 5.2.2-19) and described in FEIS Section 5.2.2.3.2.

The FEIS has been modified to indicate that "Some the constituents modeled as unattenuated in the GoldSim model may in fact exhibit some attenuation due to adsorption onto surfaces in the surficial and bedrock aquifer. The peak concentrations of these solutes would arrive at the evaluation locations later than estimated in the GoldSim model, though the peak concentrations of such late-arriving solutes would be lower than the concentrations estimated under the assumption in the FEIS of unattenuated transport" (FEIS Section 5.2.2.3.2, subheading "Contaminant Transport in Groundwater from Waste Rock").

The GoldSim modeling was designed so as to bracket evenly the uncertainty in model parameters, though ranges for a few parameters were skewed so as to tend towards producing higher concentrations at model evaluation points. Thus, model results are not generally underestimated, but are instead an attempt to accurately represent a balanced assessment of uncertainty that may in some cases generally overestimate predicted concentrations.

Theme WR 173

Theme Statement

There are numerous issues associated with chemical sources used in the Mine Site GoldSim model. Critical issues are that the model:

- Does not consider internal storage with the Category 1 and other stockpiles;

- Consistently underestimates chemical loadings (flow and concentration);

- Incorrectly assumes that chemical loading from submerged backfill and pit walls is near zero; and

- Provides no technical justification that East Pit backfill can be maintained saturated during pump-and-treat.

The FEIS should show flows and concentrations of water leaving chemical sources over time, flows and concentrations of water transferred between the Mine Site and Plant Site, residual concentrations at chemical sources after closure, and P90 concentrations over time. The use of concentration caps is not adequately explained or justified. In addition, the model does not consider: chemical leaching from unsubmerged pit walls, pit lake stratification, leaching from submerged pit walls due to dissolved oxygen in pit water, seasonal flushing of waste rock and pit walls, and that Category 1 stockpile drainage (and chemical loading) may vary over time or occur as slugs. The probabilistic inputs associated with chemical sources do not capture the full range of possible chemical loadings. The FEIS should acknowledge that the East Pit rinsing plan is untested and may fail, and that the north pit wall of the East Pit would contribute a substantial load of sulfate and metals to pit water. No groundwater capture systems are proposed downgradient of the pits, seepage through the Category 1 Stockpile may be underestimated, and pits and stockpiles remaining after closure would leach contaminated water for hundreds of years. With regard to the West Pit, the FEIS should acknowledge that the pit would not be a hydraulic/chemical sink when full, and that the plan for accelerated refill would cause contaminants to reach the Partridge River sooner, and the FEIS does not provide contaminant levels from the West Pit flowpath at the Partridge River where groundwater discharges to surface water. For the East Pit and West Pit, the FEIS should show predicted outflows (and concentrations) into surficial deposits and bedrock over time after closure. The Reclamation Plan should ensure that specific goals for pit pools are established and achieved.

Thematic Response

The GoldSim Mine Site model assumes that the waste rock and ore stockpiles start with water at an approximate "field capacity" (i.e., no water drains from the facility unless water enters the top, but if water does enter the top of the facility in a time step, then same amount would flow out the bottom). Although excess water is not stored in the rock, GoldSim maintains a mass balanced on all chemical constituents, so any solutes released from the rock than can't dissolve and leach out in a time step are stored and released in later time.

The specific ranges for GoldSim parameters were selected to bracket evenly the uncertainty in model parameters and avoid underestimating estimates of chemical loading (MDNR et. al. 2011, as cited in the FEIS). In a few instances, model parameters are selected to produce larger ranges than indicated by simple statistical application of test data (e.g., solute release rates from waste rock are based on the range in individual humidity-cell tests, not the range in the average; see

Section 8.1.2.1 of PolyMet 2015q, as cited in the FEIS). But the Co-lead Agencies do not believe that there is a systematic bias toward underestimating flow or chemical load.

The rate of oxidation and associated release of acidity and metals from waste rock and wall rock after it is submerged under water was considered directly as part of the Impact Assessment Planning process (MDNR et. al. 2011, as cited in the FEIS). Supporting analysis found that after the rock was submerged by a layer of oxygenated water, the rate of oxidation in the rock would decrease by at least a factor of ~800 relative to the oxidation rate when it was exposed directly to atmospheric oxygen (Day 2008). Based on this analysis, which is consistent with general results of studies on subaqueous disposal of sulfide-bearing mine waste, the GoldSim model assumed that oxidation in submerged wall rock and waste rock was negligible.

FEIS Section 5.2.2.3.1 accurately describes how East Pit backfill would be flooded as it is emplaced during operations to maintain water within 5-ft of the backfill surface using effluent from the WWTF and storm water runoff. The Co-lead Agency's review of the model found that the footprints and depths of East/Central Pit are correctly incorporated into the three-dimensional model mesh, and that appropriate boundary conditions are used to simulate pit inflows. Treating solutes in backfill is not contingent on rapid pumping, but instead allows for treating at rate that would not dewater the for backfill water. During reclamation (year 21 – 40), "water from the East Pit would also be pumped to the WWTF and treated. . .", after which treatment of water in East Pit Backfilled may continue into closure and long-term maintenance (Section 2.1.1 of PolyMet 2015d, as cited in the FEIS).

Estimates for mass loading and effluent concentrations from Mine Site facilities are presented in Attachment I and J of PolyMet 2015m, as cited in the FEIS; for Plant Site tailings facility, values for these model results are presented in Attachments D through I of PolyMet 2015j (as cited in the FEIS). Estimated flows between facilities vary in response to stochastic parameters such as monthly precipitation, but characteristics describing water flow into groundwater flowpaths and average flows to treatment facilities are in Attachment B of PolyMet 2015j, as cited in the FEIS, and Attachment B (Input Variables for the Mine Site Model) of PolyMet 2015m, as cited in the FEIS.

The description of concentration caps providing in FEIS, "empirical upper-concentration values…estimated in part using measured behavior of laboratory tests on waste rock from the NorthMet Deposit [and] measured in effluent from field-scale facilities of similar waste rock Section," is accurate (FEIS Section 5.2.2.2.3). Concentration caps are illustrated in measured composition of effluent from the Amax Stockpiles, in this case showing their dependence on pH (Large Figure 23 through 27 in the Waste Characterization Data Package—PolyMet 2015q, as cited in the FEIS).

Regarding the release of chemical loads as "slugs" from pit wall or waste rock, this can occur in the GoldSim model if solutes that exceed concentration caps are stored as labile phases. These stored loads would be released as a "slug" over a single time step if higher precipitation increases. Submerging backfill and wall rock produce a second type of slug, as any solutes stored in "non-contacted" rock are assumed to be released immediately upon inundated by water.

The ranges for probabilistic solute-release parameters were developed during the Impact Assessment Planning effort (MDNR et. al. 2011, as cited in the FEIS), and are adequate for representing uncertainty in estimates of water quality for the FEIS.

Regarding the absence of groundwater capture systems down gradient from the East Pit and West Pit, the analysis of effects presented in the FEIS are based on a model that does not have pit capture systems in place, and no additional capture trenches are proposed.

Seepage through the Category 1 stockpile is based on liner leakage rates for the cover, which are derived from combination of literature values, experience at mine sites, experience at other types of industrial facilities, manufacturer documentation, and information provided in standard engineering guidance documents (Section 5.2.2.3 in PolyMet 2015m, as cited in the FEIS). Liner leakage rates were estimated using the HELP model, where simulations combined NorthMet Project design values for slopes and subgrade design with the published values for average liner defects per acre.

It is acknowledged that there have been historical instances where poor-quality liner installations have failed or leaked at relatively high rates. However, for the high-quality liner installations to be used for the Proposed Action, the assumed liner leakage rates are reasonable and consistent with industry standards. While solid waste landfills may typically be smaller than the NorthMet facilities, the liner leakage rates are expressed on a unit area basis, so the results can be scaled to larger facilities.

It is acknowledged that the NorthMet Project Mine Site pits and waste rock would be long-term loads of some solutes to groundwater relative to the continuation of existing conditions. Estimates for these loads are presented in Attachment I of PolyMet 2015m, as cited in the FEIS.

The FEIS does not assume that the West Pit would be a sink, but instead acknowledges that outflow to the surficial and bedrock aquifers would be related to lake level. Concentrations in the West Pit Lake surficial and bedrock flowpaths are presented in Attachment J (Concentration Statistics at the Groundwater Evaluation Locations) of PolyMet 2015m, as cited in the FEIS.

The FEIS recognizes that active site management would be tied to attaining specific water-quality goals: “The objective of closure is to provide mechanical or non-mechanical treatment for as long as necessary to meet regulatory standards at applicable groundwater and surface water compliance points” (FEIS Section 5.2.2).

Finally, State rules for mineland reclamation and water appropriations require impacted watershed to be returned as close as possible to pre-mining characteristics.

Subtheme WR 173-1

Theme Statement

Provide values for volumetric flow rates and solute concentration estimates for the water released from each source and in each waste water stream, with concentrations before and after application of concentration caps and adsorption and reported in units comparable to water quality standards. Include specific values for solute concentrations and routing of runoff from waste rock.

Thematic Response

Estimates for mass loading and concentrations from the Mine Site facilities, including effluent from waste rock and ore stockpiles, are presented in Attachment H of the Mine Site Water Modeling Data Package (PolyMet 2015m, as cited in the FEIS). The assessment of environmental effects are not based on concentrations in specific mine features, so the source concentrations are not presented with regulatory criteria; groundwater evaluation criteria are listed in Large Table 1 Groundwater Quality Standards Applicable to the NorthMet Project Modeling in the Mine Site Water Modeling Data Package (PolyMet 2015m, as cited in the FEIS). They also can be found in Section 5.2.2 of the FEIS.

The NorthMet GoldSim water quality model has not been run without concentration caps in source materials or adsorption-related attenuation in groundwater because these are widely observed effects in mine environments. Thus, eliminating these effects from the GoldSim model would not be realistic, and such a model would not improve the assessment of environmental effects.

Adsorption is widely observed in studies of metal transport in groundwater, and is an important-enough effect that the USEPA provides guidance documents with screening level values for adsorption (as “Kd”) to support estimates of exposure to solutes migrating in groundwater (USEPA 2005, as cited in the FEIS). This literature review by the USEPA indicates that Kd for the four metals assumed to be affected by adsorption in the NorthMet surficial aquifer (arsenic, antimony, copper, and nickel) vary widely across different sites. In response, the GoldSim modeling at NorthMet selected values from the low end of this range (i.e., values that produce rapid transport in groundwater, and thus earlier arrival at groundwater evaluation points [PolyMet 2015j, as cited in the FEIS]). But eliminating entirely the effect of adsorption from the GoldSim model would not improve the assessment of environmental effects. The Co-lead Agencies thus do not believe that the GoldSim water quality model needs to be been run without adsorption-related attenuation in groundwater.

The effect of concentration caps can be seen in measured composition of effluent from the Amax Stockpiles, in this case showing their dependence on pH (Large Figures 23 through 27, PolyMet 2015q, as cited in the FEIS). The selection of specific values for concentration caps was considered by the Co-lead Agencies (see Table 1, MDNR et al. 2011, as cited in the FEIS), and specific ranges for concentration caps in waste rock are presented in Tables 1-30 through 1-33 in the NorthMet Mine Site Water Modeling Work Plan (Barr 2012c, as cited in the FEIS).

Subtheme WR 173-2

Theme Statement

Provide estimates for pH, sulfate, and alkalinity predicted in the PolyMet pit lakes and tailings effluent, and compare these to the values observed in natural and mine-produced lakes in the region.

Thematic Response

Estimates for the concentration of all modeled solutes in the West Pit Lake are presented in the Attachment H of the Mine Site Water Modeling Data Package (PolyMet 2015m, as cited in the FEIS). For the tailings basin effluent, estimated concentrations are presented in Attachment G of the Plant Site Water Modeling Data Package (PolyMet 2015j, as cited in the FEIS).

The pH of water is a dynamic parameter that reflects chemical equilibrium condition, and is not predicted explicitly by the GoldSim model for any of the NorthMet Project area waters, including the West Pit Lake. However, the West Pit Lake is a component of the active water management and treatment system during and after the 20-year operating life of the mine, and its water quality would be monitored as part of the NorthMet Project Proposed Action (PolyMet 2015d, as cited in the FEIS; Large Figure 1, Water Treatment Overall Flow Sheet-Operations, and Large Figure 3, Water Treatment Overall Flow Sheet- Long-Term Closure.)

Water quality in the West Pit Lake would thus be controlled by pumping and, where necessary, treatment. Most of the effluent from the Tailings Basin would be captured and treated, and the GoldSim model results and associated effects presented in the FEIS account for some bypass of the capture system. Because the environmental effect of the West Pit Lake and Tailings Basin are not dependent on water quality of other lakes, the Co-lead Agencies do not plan to compare model results for the West Pit Lake to a compilation of water quality in other lakes in the region.

Subtheme WR 173-3

Theme Statement

Provide estimates of water balance on the Mine Site to illustrate whether the West Pit will eventually overflow.

Thematic Response

Plans for managing water in the West Pit during operations and into closure include actively maintaining the West Pit Lake water level so that it remains below the spillway to the Partridge River until the lake meets discharge standards. Specifically: "No discharges are planned from the Mine Site during operations and reclamation. During long-term closure, West Pit water would be pumped to the Mine Site Waste Water Treatment Facility (WWTF) as needed to prevent the West Pit from overflowing. An NPDES/SDS permit would be required to discharge WWTF effluent to the Partridge River" (PolyMet 2015m, as cited in the FEIS). The logic for maintaining the West Pit Lake level below the discharge point is incorporated in the GoldSim modeling.

The FEIS Section 5.2.2.3.2 indicates that West Pit Lake water would not be allowed to overflow direct to the Partridge River until it meets discharge standards.

Subtheme WR 173-4

Theme Statement

PolyMet should "bolt, wire, and shotcrete" the pit walls to inhibit the migration of water and pollutants in and out of the pit (as done by Kennicot at its Flambeau Mine).

Thematic Response

The current Mine Site GoldSim water quality model of the proposed West, Central, and East pits does not include any plans to add bolts or surficial coatings to the pit wall rock. Instead, the assessment of effects in the FEIS considers oxidation reactions and the associated solute release assuming that the wall rock is exposed to the atmosphere, and that oxidation ceases only when the wall rock is covered by backfill (in the East and Central pits), submerged by the pit lake (in the West Pit), or the available sulfide minerals are fully oxidized. The parameters used to estimate oxidation rates in pit walls (thickness of reactive veneer, decay in reaction rate, oxidation after wall rock is submerged in the lake, metal releases for different wall rock types, etc.) were considered in detail by the Co-lead Agencies, and are described in the Waste Characterization Data Package (PolyMet 2015q, as cited in the FEIS), Section 9 Geochemical Parameters – Pit Lake. The estimates for wall rock oxidation rates used in GoldSim were consistent with observed rates in field studies at other mines. The Co-lead Agencies thus believe that that the current analysis of environmental effects is adequate, and that the NorthMet Project Proposed Action does not need to alter the pit wall surfaces with bots, wire, shotcrete, or other surface treatments.

Subtheme WR 173-5

Theme Statement

Provide estimate for the effects of outflow from the West-Pit and backfilled East and Central Pits on the quality of receiving groundwater, including an analysis where the sulfate concentration is much higher than currently predicted.

Thematic Response

Estimates for mass loading from the Mine Site facilities are presented in Attachment H of the Mine Site Water Modeling Data Package (PolyMet 2015m, as cited in the FEIS). The effect of effluent from these Mine Site facilities on the quality of receiving groundwater is presented in Attachment J.

The specific ranges for GoldSim parameters were selected by the Co-lead Agencies to evenly bracket the uncertainty in model parameters and avoid underestimating estimates of chemical loading. Comparison tests of the GoldSim model found that the model may underestimate solute release in some cases (e.g., a comparison of GoldSim estimates to measured effluent from the existing Amax piles found that the model tended to overestimate sulfate concentrations [PolyMet 2015q, as cited in the FEIS, Section 8.2.7 Scale-Up Model Verification]). But the Co-lead Agencies do not believe that there is a systematic bias toward underestimating chemical loading or concentration of sulfate or other constituent.

Subtheme WR 173-6

Theme Statement

Demonstrate that the reactive backfilled East Pit would remain saturated during mining and perpetually beyond this in closure.

Thematic Response

Water quality in the East Pit backfill would be managed by actions taken before, during, and after flooding of the pit. At the time of initial backfilling, the waste rock and overburden material that is backfilled into the East Pit would be treated with limestone to reduce acidity and maintain basic pH (PolyMet 2015q, as cited in the FEIS). During operations, the East Pit backfill would be flooded as it is emplaced to maintain water within 5 ft of the backfill surface using effluent from the WWTF and storm water runoff, as described in Section 5.2.2.3.1 of the FEIS. The Co-lead Agencies' review of the GoldSim model found that the footprints and depths of the combined East Central Pit are correctly incorporated into the three-dimensional model mesh, and that appropriate boundary conditions are used to simulate pit inflows. The plan for treating water in the East-Pit backfill is not contingent on rapid flushing, but instead allows pumping at a rate that would not dewater the backfill.

During reclamation (years 21 to 40), "water from the East Pit would also be pumped to the WWTF and treated ...," after which treatment of water in East Pit Backfilled may continue into long-term closure (PolyMet 2015d, as cited in the FEIS). The Co-lead Agencies believe that the existing plans, as described in the FEIS, are sufficient to ensure that the East Pit backfill would remain saturated perpetually beyond closure.

Subtheme WR 173-7

Theme Statement

Provide an estimate for pH in the West Pit Lake, along flow paths, and in the Partridge River.

Thematic Response

Solution pH is a dynamic parameter that reflects chemical equilibrium condition, and is not predicted explicitly by the GoldSim model for any of the NorthMet Project area waters, including groundwater, the Partridge River, and the West Pit Lake. However, sulfide minerals oxidation in the NorthMet mine rock can cause pH to decrease, and where pH becomes acidic, this chemical shift causes an increase in oxidation rates, concentration caps, and associated solute concentrations in leachate. These effects from pH are incorporated explicitly into the GoldSim model in the calculations of solute loads from both the non-acid-generating and acid-generating wall rock in the West Pit (PolyMet 2015q, as cited in the FEIS).

The lake water quality would be affected by pH (e.g., if the lake water became acidic, then concentration caps would be higher, and the concentrations of some metals could be higher). However, the West Pit Lake is not a passive basin, but is instead a component of the NorthMet Project Proposed Action's active water management system, so that during and after the 20-year operating phase, its water quality would be monitored and treated as part of the NorthMet Project Proposed Action (Large Figure 1 and Large Figure 3 of PolyMet 2015d, as cited in the FEIS).

Regarding predicting water quality along flowpaths, please see the response to theme WR 177.

Subtheme WR 173-8

Theme Statement

Expand model analysis to determine whether a slug of water and solutes could be released periodically from Waste Rock stockpiles.

Thematic Response

The GoldSim model of waste rock stockpiles is configured so that it can release slugs of accumulated solutes under three conditions. As observed in weathering of waste rock under field conditions, solutes are released from waste rock in proportion to the time over which it is exposed to air. During a dry period, GoldSim stores constituents released by oxidation as a soluble but immobile phase. These stored constituents are then available to dissolve and flush out as a slug in the first occurrence of percolating water, as would occur in a rainy month following one or more dry months. A second type of concentration slug occurs at the onset of acidic conditions, where the constituent-release rates and concentration caps applied in the GoldSim model both increase (PolyMet 2015q, as cited in the FEIS). Third, waste rock submerged under water (i.e., as occurs in the East Pit backfill) produces a slug release when the solutes stored in non-contacted portion during the air-oxidation period are allowed to dissolve (up to the concentration caps) when the rock is submerged. The Co-lead Agencies believe that the GoldSim model configuration described in the FEIS adequately addresses slug releases of constituents from waste rock.

Subtheme WR 173-9

Theme Statement

Expand model analysis to consider solute transport in groundwater with no retardation effect.

Thematic Response

Adsorption is widely observed in studies of metal transport in groundwater, and is an important enough effect that the USEPA provides guidance documents with screening level values for adsorption (as "Kd") to support estimates of exposure to solutes migrating in groundwater (USEPA 2005, as cited in the FEIS). This literature review by the USEPA indicates that Kd for the four metals assumed to be affected by adsorption in the NorthMet surficial aquifer (arsenic, antimony, copper, and nickel) vary widely across different sites. Adsorption parameters were also used from laboratory studies for antimony. In response, the GoldSim modeling selected values from the low end of this range (i.e., values that produce rapid transport in groundwater, and thus earlier arrival at groundwater evaluation points [PolyMet 2015m, as cited in the FEIS]).

But eliminating entirely the effect of adsorption from the GoldSim model would not improve the assessment of environmental effects. The Co-lead Agencies thus do not believe that the NorthMet GoldSim water quality model needs to be rerun without adsorption-related attenuation in groundwater.

Subtheme WR 173-10

Theme Statement

Modify the model of the West Pit Lake to include the effect of sulfide oxidation caused by air pulled into the pit walls to fill the voids that are desaturated by groundwater drawdown.

Thematic Response

PolyMet provided the Co-lead Agencies with calculations used to determine the mass of sulfate released by the additional oxidation in pit wall rock caused by air pulled in to replace the voids emptied as groundwater in bedrock drains into the pit (PolyMet 2014a). This approach assumes that the volume of water extracted from bedrock is replaced by an equal volume of air, and all of the oxygen in this entering air reacts with sulfide minerals in the wall rock.

The volume of water extracted from bedrock was estimated to be equal to the total inflow to the pits from bedrock in the time between the beginning of mining and the time when pit flooding begins (i.e., the point of maximum drawdown in the bedrock). At the concentration of oxygen in air (8.89 mole O2/m^3), the reaction ratio for pyrrhotite oxidation (0.44 mole SO4/mole O2), and the molecular weight of sulfate (96 g/mole), each cubic meter of air pulled into the bedrock wall rock would release 375 g SO4.

In the West Pit, the estimated volume of water extracted from bedrock is 2.79x10^5 m^3, which when converted to airflow into pit wall rock, would release 1.13x10^5 kg SO4.

When this mass is mixed into the full West Pit (1.05x10^8 m^3), this would add 1.1 mg/L to the concentration of the West Pit, or ~1.5% increase relative to the P50 concentration of 77 mg/L SO4 estimated by GoldSim without this air-advection effect, and also ~1% of the range in uncertainty in West Pit sulfate concentration at year 20 (i.e., P10 to P90 range is ~ 50 to 100 mg/L [PolyMet 2015m, as cited in the FEIS; Figure H-11-24.2 SO4 in the West Pit]).

For the East Pit, the MODFLOW model result indicates that 2.55x10^6 m^3 of bedrock groundwater would be removed, and the air to replace it would produce 9.7x10^5 kg SO4. At the full volume of the East Pit (1.44x10^7 m^3), this would add 67 mg/L to the sulfate concentration, or an increase of 2.6% relative to the GoldSim model P50 prediction of 2,578 mg/L sulfate in the current model without the air-advection effect.

The effects of advection-induced air oxidation are small for the Mine Site pits in part because the bedrock porosity is small (0.05; Barr 2012c, as cited in the FEIS, Table 1-1), so that drawdown around the pits would produce a relatively small amount of water from bedrock.

The Co-lead Agencies believe that constituent release from this advective air flow into bedrock by dewatering is small enough relative to both absolute concentrations and current uncertainty in the GoldSim model that this effect can be ignored in the FEIS.

Theme WR 174

Theme Statement

The Mine Site GoldSim model underestimates chemical concentrations in non-contact runoff from the mine facilities (particularly sulfate).

Thematic Response

Non-contact runoff from the NorthMet Project Proposed Action-related mine facilities represents overland flow that would not contact ore, tailings, waste rock, or processing residues. This flow would generally contact natural ground, soil/vegetated covers, and synthetic plastic materials. This water would not be chemically impacted to any significant extent and its chemical concentrations would be similar to natural runoff. See the response to theme WR 151 for additional information.

Theme WR 175

Theme Statement

The FEIS should include a sensitivity analysis for numerous parameters used in the Mine Site GoldSim model, including Partridge River baseflow. In the model, evapotranspiration from stockpiles should use a sample standard deviation rather than population standard deviation. The FEIS should indicate what all pumped flows are used for, and should acknowledge that accelerated refill of the West Pit would increase chemical loading to groundwater. The FEIS should also acknowledge that chemical loading from the Mine Site is very small compared to natural loading in the Partridge River, and that the One Hundred Mile Swamp flows into the BWCAW.

Thematic Response

To better understand the relationship of groundwater baseflow to the GoldSim model's water quality impact projections, a sensitivity analysis for the Mine Site was conducted to evaluate if predicted Project impacts are sensitive to groundwater baseflow values. The sensitivity analysis considered the relationship of various model inputs to groundwater baseflow including hydraulic conductivity, recharge, and surface runoff chemical concentrations. It also reflected consideration of the flow data collected at SW003 in requiring groundwater baseflows at all locations on the Partridge River be increased by a factor of 4 (e.g., 0.5 to 2 cfs at SW-003). The results indicate that modeled groundwater and surface water concentrations are sensitive to changes in groundwater baseflow. However, the NorthMet Project Proposed Action's ability to meet groundwater quality and surface water quality evaluation criteria is not sensitive to changes in baseflow. Evaluation criteria can be found in Section 5.2.2.

The probabilistic inputs for evapotranspiration are based on an evaluation performed at the Amax test pile (Eger and Lap Akko 1985, as cited in the FEIS). Measurements and back-calculations performed in that study were used to develop a best-estimate mean and standard deviation of the stockpile evapotranspiration.

The FEIS has revised text to indicate where pumped flows are transported at both the Mine Site and Plant Site and between the sites. It is acknowledged in the FEIS that accelerated refill of the West Pit would result in seepage of impacted pit water into the West Pit surficial flowpath sooner than if the pit were to refill naturally. The FEIS acknowledges that chemical loading from the Mine Site would be small compared to natural chemical loading in the Partridge River and that there are t portions of One Hundred Mile Swamp that flow into the BWCAW.

Theme WR 176

Theme Statement

With regard to water treatment and discharge, the Mine Site GoldSim model underestimates pit inflows and, therefore, underestimates water treatment flow rates. If treatment rates are higher, sludge production would be higher and costs would be higher. The FEIS should provide flow rates and influent concentrations over time, treated water discharge locations, flows, and timing, and contingencies to handle extreme weather events.

Thematic Response

Pit inflows predicted by the FEIS Mine Site MODFLOW model and used to inform the FEIS Mine Site GoldSim model are sensitive to the hydraulic conductivities of surficial deposits and bedrock units. The MODFLOW model's prediction of pit inflows is reasonable because the hydraulic conductivities used in the model are best estimates, based on site characterization.

The FEIS contains new text and tables indicating water treatment flow rates, influent concentrations, and effluent concentrations over time. The FEIS also indicates where treated water would be transported to at different stages of the NorthMet Project Proposed Action. Because the GoldSim model uses monthly time steps, the analysis does not explicitly consider extreme storm events that may last for a day or two. However, the design of engineered facilities would entail Factors of Safety that ensure the ability to handle a 100-year storm event.

Theme WR 177

Theme Statement

Evaluation locations in the Mine Site GoldSim model do not adequately assess effects on groundwater and Partridge River surface water, and specifically do not address effects on the Partridge River upstream of evaluation location SW-004, which would be affected by chemicals from the Category 2/3 Stockpile and East Pit. In general, evaluation locations need to consider the nearest locations where impacted groundwater could affect wetlands and other surface waterbodies. The Mine Site GoldSim model does not provide a quantitative analysis of wetland effects, and incorrectly assumes that groundwater does not upwell into wetlands or other surface waterbodies along the surficial flowpaths. The FEIS should disclose that the groundwater quality criteria for cobalt, aluminum, and possibly copper are exceeded in the Category 2/3-East Pit surficial flowpath. The FEIS should provide a more detailed discussion of sulfate in the Partridge River, and should acknowledge that the model likely underestimates sulfate concentration in the River. The FEIS should show the distribution of chemical concentrations in the groundwater flowpaths at 200 years after closure. The model does not simulate appropriate (seasonal) timing of natural processes such as recharge. The model should evaluate specific conductance, which is a regulated water quality criterion. The assessment of effects should be based on both Health Risk Limits and Clean Water Act compliance points. Implementation of the Land Exchange alternative would also require different evaluation locations (property boundaries).

Thematic Response

Potential groundwater impacts are assessed at specific evaluation locations defined for each flowpath. This methodology satisfies both federal and state environmental review requirements to inform regulators, the project proponent, and public of the type, extent, and reversibility of impacts. Monitoring would typically occur at the source origins to document whether flowpath water quality predictions were being satisfied. If not, then contingency and/or adaptive measures would be applied to address potential concerns. See FEIS Section 5.2.2.1.1 for information on evaluation locations.

Surface water monitoring station SW004 is used to estimate the effects of Mine Site facilities on surface water because it has baseline values for water quality and flow (Mine Site Water Modeling Data Package, Large Table 10 Surface Water Data Summary Partridge River Watershed and Wyman Creek) and incorporates the cumulative effects of solutes released from the Category 2/3 Stockpile and East Pit, Ore Surge Pile, WWTF ponds, and Overburden Storage and Laydown Area (Mine Site Water Modeling Data Package, Large Figure 28 Mine Site Groundwater Flow Paths – Surficial Aquifer). Thus, if the NorthMet Project Proposed Action did not cause a water quality violation at SW-004, then it would not produce a violation farther upstream, where cumulative mine site loads would be proportionately smaller than the lower flows that would be observed upstream.

FEIS Table 5.2.2-11, Table 5.2.2-21 and Figure 5.2.2-20 provide additional information. Figures showing sulfate groundwater concentration distributions through time for the West Pit and the Category 2/3 flowpaths are in Section 6.3.2 of PolyMet 2015m (as cited in the FEIS).

It is acknowledged that there could be groundwater discharge to wetlands along a flowpath and the Mine Site GoldSim model does not explicitly incorporate wetlands or potential hydraulic connectivity between wetlands and the surficial aquifer. This process was not modeled because it is considered speculative and quantitatively uncertain. The Co-lead Agency approach is to monitor water levels and water quality in the wetlands during operations, reclamation, and closure to identify mining effects on wetlands (if any). If regulatory criteria were violated, adaptive water mitigation measures would be initiated to mediate the impact. The monitoring and mitigation for potential indirect effects would be determined during permitting. FEIS Section 5.2.3.3 has been revised to include more information on the monitoring and mitigation plan for the potential indirect wetland effects.

Regarding exceedances in groundwater quality criteria in the Category 2/3-East Pit Surficial flowpath, predicted concentrations were compared to applicable criteria (Large Table 1 in PolyMet 2015m, as cited in the FEIS). Aluminum is a secondary standard (range 50–200 μg/L), established by the USEPA to assist with managing drinking water for aesthetic considerations; it is not based on risk to human health. Aluminum concentrations were estimated by GoldSim (Figure J-01-02.2 of PolyMet 2015m, as cited in the FEIS), but because local groundwater already exceeds the aluminum sMCL, estimated concentrations above the sMCLs are not be considered exceedances of the groundwater evaluation criteria (Section 2.1 of PolyMet 2015m, as cited in the FEIS). Cobalt is reported in the Category 2/3-East Pit Surficial flowpath (Figure J-01-02.2 of PolyMet 2015m, as cited in the FEIS), but cobalt does not have a groundwater quality criterion. The maximum copper concentration at the property boundary in this flowpath is far lower than 1,000 μg/L, the groundwater standard for copper of (Figure J-01-13.2 and Large Table 1, respectively, in PolyMet 2015m, as cited in the FEIS).

The GoldSim modeling was designed so as to bracket evenly the uncertainty in model parameters. The Co-lead Agencies do not believe that the Mine Site GoldSim model produces a systematic underestimate of sulfate concentrations in the Partridge River.

Recharge is simulated as a fraction of precipitation, and precipitation varies monthly (Attachment, B Input Variables for the Mine Site Model, Table 1-11 Seasonal Distribution of Annual Open Water Evaporation and Annual Precipitation, in PolyMet 2015m, as cited in the FEIS).

Electrical conductance provides an estimate for TDS. There are TDS standards for surface water (700 mg/L) and groundwater (500 mg/L), and, at the request of the MPCA, GoldSim results include estimates for TDS at each time step, calculated by summing major solutes (Section 6.2.6.2 of PolyMet 2015m, as cited in the FEIS).

The FEIS and associated estimates of solute concentrations in groundwater are for the evaluation locations as identified under the Land Exchange Proposed Action. There is no change in applicable evaluation locations across the land exchange alternatives.

The surface water quality standards used in the FEIS are from *Minnesota Rules* 7050, which derive from the Clean Water Act; where Lake Superior Basin rules apply (Chapter 7052, which do consider human health), they are used as evaluation criteria (Section 2.2 of PolyMet 2015m, as cited in the FEIS). The groundwater criteria are generally federal or state drinking water standards, which are mostly health-based. Evaluation criteria can be found in Section 5.2.2.

Theme WR 178

Theme Statement

The Mine Site GoldSim model should be rerun. It does not incorporate known hydrology and geochemistry, and is not sufficiently accurate for effects evaluation. The Myers model produces results that are different from the SDEIS modeled effects.

Thematic Response

The Mine Site GoldSim model has been modified and rerun in the FEIS based on new monitoring data, recalibrations, and issues raised in comments to the SDEIS. The FEIS model is considered to be sufficiently accurate for impacts analysis.

The Co-lead Agencies have reviewed and acknowledge the existence of the Myers model, but given the reliability issues discussed in WR171, the Co-lead Agencies do not believe the results are valid for assessing NorthMet Project Proposed Action-related impacts in the FEIS.

Theme WR 179

Theme Statement

Due to the low bedrock hydraulic conductivities assumed at the Mine Site, the pit inflow rates used on the Mine Site GoldSim model are underestimated. The Myers model predicts pit inflow rates approximately two times higher than the rates used in the GoldSim model and also predicts extensive drawdown between the pits and the Partridge River. The GoldSim model should consider ranges of pit inflow rates, and should treat these as probability inputs in the model. West Pit inflows are also underestimated because Partridge River water would enter bedrock fractures and flow to the pit.

The GoldSim model does not evaluate the effects of large-scale drawdown associated with pit dewatering. The SDEIS should provide both the modeled drawdown at SW-003 and an explanation of the area used for groundwater inputs to the Partridge River and how those inputs correlate with the groundwater elevation contour map.

Thematic Response

Pit inflows predicted by the FEIS Mine Site MODFLOW model and used to inform the FEIS Mine Site GoldSim model are sensitive to the hydraulic conductivities of surficial deposits and bedrock units. These hydraulic conductivities are reasonable best-estimates, so the inflow predictions are reasonable best-estimates, as well. The Co-lead Agencies do not agree that the predicted pit inflows are underestimated.

The Co-lead Agencies have reviewed and acknowledge the existence of the Myers model, but given the reliability issues discussed in WR062 and WR171, the Co-lead Agencies do not believe the results are valid for assessing NorthMet Project Proposed Action impacts in the FEIS. These issues are discussed in more detail in ERM 2015.

Best estimate pit inflows over time are determined from the calibrated FEIS Mine Site MODFLOW model and these results are used to inform the FEIS Mine Site GoldSim model. The uncertainty in the groundwater inflow rate is represented with a probability distribution that scales the model-estimated inflow values. This log-normal distribution is defined such that the mean is the MODFLOW-estimated value (scaling factor of 1.0) and the 95% confidence interval extends from approximately 0.75 to 2.0.

There is no evidence of pervasive fractures or faults that behave as groundwater conduits connecting the Partridge River mine pits. Pit inflows are related to the bulk hydraulic conductivity of bedrock units, which are inputs to the FEIS Mine Site MODFLOW model. Best-estimate pit inflows predicted by the MODFLOW model are used to inform the FEIS Mine Site GoldSim model.

Large-scale drawdown affects in bedrock associated with pit dewatering is assessed in the FEIS Mine Site MODFLOW model, not the Mine Site GoldSim model. See the Water Model Data Package for more information (PolyMet 2015m, as cited in the FEIS).

In the Mine Site MODFLOW model, the Partridge River is modeled with river cells having high conductance values. As a consequence, there is no appreciable groundwater drawdown at the River, including the SW-003 location. The model predicts that the Partridge River at SW-003 is a gaining stream for both the NorthMet Project Proposed Action and for Continuation of Existing Conditions. The areas used to compute river cell conductance values are explained in PolyMet 2015m (as cited in the FEIS). Conductance values were calibrated so that hydraulic heads in the vicinity of the river cells were similar to estimated groundwater levels in the surficial aquifer adjacent to the Partridge River.

Theme WR 180

Theme Statement

The SDEIS does not adequately consider future climate change impacts, including its effects on: weather patterns, rainfall, storm events, droughts, sea level rise, vegetation types, vegetation distributions or mitigation.

Thematic Response

Estimates of monthly and annual rainfall amounts were based on best available data obtained from weather stations near the Proposed Action site. In the GoldSim models, these parameters were treated as uncertain inputs and assigned probability distributions to capture the range of possible future conditions. While climate change may occur in the future, it cannot be stated at this time if in the long-term there would be more or less rainfall. Thus, the probabilistic approach to rainfall used in GoldSim represents a technically defensible method for dealing with this issue.

Individual storm events and frequency are not incorporated into the GoldSim models. Rainfall inputs are monthly and annual. The effects of individual storms are considered by designing facilities to handle a 100 year - 24 hour storm event based on current data. If over time, climate change causes a gradual increase in annual rainfall, the 100 year storm event would be redefined to a larger value and mine facilities would be upgraded to handle a larger design storm.

Theme WR 181

Theme Statement

The FEIS should describe the water balance and mechanisms of consumptive use at the Mine Site, including diversion of Colby Lake water for mine process, reduction of flows in the Partridge River, evaporation from ponds and pit lakes, increased evapotranspiration from wetlands, and evaporation and disposal of reverse osmosis reject water. The use of Colby Lake water for augmentation or consumptive use should be discouraged since it is a small lake and fresh water is scarce and valuable. Appropriating water from Colby Lake would lower its water quality. Regional impacts from water use should be considered.

Thematic Response

In the FEIS Project Description, there is no direct diversion of Colby Lake water to the Mine Site.

During operations, some of the mine pit inflow water would be sent to the Tailings Basin pond and used for process makeup water. This represents a water diversion from the Partridge River watershed to the Embarrass River watershed. Some of this water would percolate into the tailings, be collected at the tailings toes, treated, and discharged to Embarrass River tributaries for augmentation. The consumptive use this component of Colby Lake water would be evaporation from the Tailings Basin pond, water loss during ore processing, and disposal/evaporation of RO reject water when this water is eventually treated at the WWTP.

There is no expectation of increasing the overall area of wetlands at the Mine Site, so evapotranspiration from wetlands would not increase under the NorthMet Project Proposed Action compared to current (natural) conditions.

The Mine Site GoldSim model tracks all water diversions and the main consumptive uses at the Mine Site including evaporation from ponds, evaporation from pit lakes, and disposal/evaporation of RO reject water. Most other water flows are returned to the natural system with or without treatment.

The annual average water withdrawal rate from Colby Lake (sent to Plant Site) would be 1.68 cfs during operations. The annual maximum withdrawal rate during operations would be 3.89 cfs. During reclamation and closure and long-term maintenance, water would not be withdrawn from Colby Lake. There are no plans to use Colby Lake water to directly augment flows in perennial streams at the Plant Site.

During operations (mine years 0 to 20), water would be pumped from Colby Lake to the Plant Site and used for makeup water at the processing plant and the Hydrometallurgical Residue Facility. GoldSim tracks these flows and computes the water balance for Colby Lake on a time-step by time-step basis. The average Colby Lake drawdown was modeled at 0.3 feet, with an average annual water level fluctuation of about 3.6 feet, compared to 3.9 feet for zero withdrawal. During operations, the average inflow reduction to Colby Lake is estimated to be 0.6 cfs and the maximum inflow reduction (year 12) is estimated to be about 1 cfs. During closure and long-term maintenance, inflow to Colby Lake would be increased by an annual average of about 0.6 cfs. In the FEIS, the GoldSim model has been modified to provide more accurate estimates of the Lake water quality. While there are some project-related effects on the lake water chemistry, the Co-lead Agencies have concluded that the effects do not constitute an unacceptable impact to Colby Lake. Because flow and water quality impacts to Colby Lake are minimal, it is further concluded that impacts downstream of Colby Lake would also be minimal and not constitute an unacceptable NorthMet Project Proposed Action-related impact.

Theme WR 182

Theme Statement

The FEIS should describe the water balance and mechanisms of consumptive use at the Plant Site, including reduction of flows in the Embarrass River, evaporation from the Tailings Basin pond, water use in ore processing, transfer of water to the Mine Site, and evaporation and disposal of reverse osmosis reject water. Dewatering water should be reused on site if possible. The FEIS should also describe the volume of water required, the water's origin, and the timeframes for use at the Tailings Basin.

Thematic Response

See the response to theme WR 181 for information on water diversions from Colby Lake, and between the Partridge River watershed and the Embarrass River watershed.

The Plant Site GoldSim model tracks all water diversions and the main consumptive uses at the Plant Site including evaporation from the Tailings Basin pond, water loss to ore processing, and disposal/evaporation of RO reject water. Most other water flows are returned to the natural system with or without treatment. The FEIS has a new table summarizing the quantities of consumptive water use at the Mine Site and Plant Site, including but not limited to items listed in the theme. See Mine Site Data Package and Plant Site Data Packages (PolyMet 2015m and PolyMet 2015j, respectively, as cited in the FEIS) for a summary of NorthMet Project Proposed Action-related consumptive uses.

The GoldSim models track water balances for the Mine and Plant Site facilities, and many of these flows are reported in the FEIS. More comprehensive reporting of water balances is provided in the NorthMet Project Water Modeling Data Package Volume 1 - Mine Site" and "NorthMet Project Water Modeling Data Package Volume 2 - Plant Site" (PolyMet 2015m and 2015l, respectively, as cited in the FEIS).

Theme WR 183

Theme Statement

The SDEIS does not demonstrate that mine water use and augmentation would maintain wetlands, headwater streams, and the St. Louis River Watershed hydrology.

Thematic Response

FEIS Section 5.2.2.3.2 summarizes that the NorthMet Project Proposed Action would not affect groundwater levels along the Transportation and Utility Corridor (other than as a result of the West Pit dewatering, which is discussed as part of the Mine Site) or at the former LTVSMC processing plant. The NorthMet Project Proposed Action would affect groundwater levels at the Mine Site during operations by dewatering the active mine pits and pumping water to the Plant Site (years 0 to 11) or to the East Pit and Tailings Basin (years 11 to 20). During years 20 to 40, water from the Plant Site would be pumped to the West Pit to accelerate flooding and help return groundwater levels to near pre-mining conditions. However, potential impacts on wetland or stream hydrology are not expected beyond areas immediately adjacent to the West Pit (as estimated from the analog method of estimating indirect wetland impacts from mine pit dewatering). The monitoring and mitigation for potential indirect effects would be determined during permitting. FEIS Section 5.2.3.3 has been revised to include more information on the monitoring and mitigation plan for the potential indirect wetland effects.

The cumulative effects analysis in FEIS Section 6.2.3.3.1 of the SDEIS concludes that the NorthMet Project Proposed Action would not have a significant effect on the St. Louis River hydrology.

Theme WR 184

Theme Statement

Use of Colby Lake water (which has mercury concentrations of approximately 5 ng/L) to augment upstream flow would violate Great Lakes mercury standard of 1.3 ng/L.

Thematic Response

The NorthMet Project Proposed Action described in the FEIS would include treatment of all water that would be discharged at the Plant Site, including water used for flow augmentation. The amount of water from Colby Lake used for flow augmentation would be low; however, any water used for augmentation would be treated prior to discharge. PolyMet proposes that tributaries be monitored that extend from the Tailings Basin. Additional information has been included in FEIS Section 5.2.2.3.6.

Theme WR 185

Theme Statement

The SDEIS does not provide a technical justification for the requirement to augment flows to within 20% of current conditions, nor does it address minerals and nutrients to maintain aquatic ecology, wetland ecology, or the need of riverine systems to be flushed to maintain ecosystem health.

Thematic Response

The NorthMet Project Proposed Action described in the FEIS includes treatment of all water that would be discharged at the Plant Site including water used for flow augmentation. The amount of water from Colby Lake used for flow augmentation would be low; however, any water used for augmentation would be treated prior to discharge. PolyMet proposes that tributaries be tributaries that extend from the Tailings Basin be monitored. Additional information has been included in FEIS Section 5.2.2.3.6. Potential impacts on aquatic species are addressed in FEIS Section 5.2.6.

Theme WR 186

Theme Statement

The FEIS discussion of stream augmentation needs to consider flows in Yelp Creek and other tributaries of the Partridge River and Embarrass River.

Thematic Response

The FEIS evaluated the need for stream augmentation as a result of the NorthMet Project Proposed Action. The flow of Yelp Creek would not change. Flow to the tributaries of the Embarrass River and Second Creek would be augmented under the NorthMet Project Proposed Action. Partridge River flows would not require augmentation. The FEIS recommends surface water flow monitoring in creeks and rivers surrounding the NorthMet Project area. If data were to indicate that the NorthMet Project Proposed Action had resulted in unacceptable flow reductions, augmentation would be considered.

Theme WR 187

Theme Statement

The FEIS discussion of stream augmentation needs to consider flows in the Partridge River at SW-004a, SW-004, SW-003 and SW-002.

Thematic Response

Partridge River flows would not require augmentation because the MDNR does not require augmentation unless the median annual flow changes by more than 20%. This threshold is not predicted to be exceeded at SW-004, which is an appropriate location to assess potential drawdown. The FEIS recommends surface water flow monitoring in creeks and rivers surrounding the NorthMet Project area. If data were to indicate that the NorthMet Project Proposed Action had resulted in unacceptable flow reductions, augmentation would be considered.

Theme WR 188

Theme Statement

The FEIS discussion of consumptive use and augmentation must consider the effects of prolonged droughts.

Thematic Response

This issue would be relevant to the NorthMet Project Proposed Action if augmentation water were not available to maintain surface water flows to within 20% of what they would be under drought conditions without the NorthMet Project Proposed Action. Typically the two go hand-in-hand. During a drought, there could be less water available for augmentation, but the amount of augmentation water needed to maintain lower surface water flows under drought conditions would also be less. The sources of augmentation water for the NorthMet Project Proposed Action (mainly water treatment effluents) are expected to be sufficient to handle normal and drought conditions. The Co-lead Agency approach is to monitor the amount of augmentation water required and available for years with variable rainfall and evaluate if a shortfall could occur during a prolong drought. If it were apparent that a shortfall could occur, adaptive measures would be proposed to ensure that the 20% requirement could be met during a prolonged drought.

Theme WR 189

Theme Statement

There are numerous general concerns with and deficiencies in the GoldSim model used for the SDEIS. These concerns relate to model assumptions, inputs, and methodology, as well as inadequate QA/QC and the appropriateness of using GoldSim for a mining project. In addition, the model should include a scenario with probable maximum precipitation. Modeling is not reliable out hundreds of years. The water models should be re-run.

In addition, the SDEIS itself has numerous general deficiencies. The FEIS should have a better discussion and explanation of GoldSim setup, inputs, accuracy, and assumptions, which inputs are treated as probabilistic, and should acknowledge that GoldSim has not been widely used for NEPA effects analysis. The FEIS should better explain the reasons for using 200- and 500-year simulations. In addition, the FEIS should report flows and concentrations at all facilities and discharge locations; should acknowledge that chemically impacted mine water would enter groundwater and surface water outside the property boundary; and should acknowledge that under closure, streamflows would not return to pre-mining conditions. Presentation of exceedances is inconsistent between supporting documentation and the SDEIS.

Thematic Response

The GoldSim model was selected because it includes the computational tools required to conduct probabilistic simulation of the NorthMet Project Proposed Action water balance, solute release, and solute transport. Specific QA/QC procedures that were applied to the data collection and modeling are in Section 4.3.4.3 and Attachment L of PolyMet 2015m (as cited in the FEIS) and Section 4.3.4.3 and Attachment N of PolyMet 2015j (as cited in the FEIS). The level of QA/QC conducted for the FEIS is adequate, and the GoldSim Model is an appropriate tool for simulating water balance and water quality.

The FEIS provides adequate detail on the GoldSim model's setup. FEIS Section 5.2.2.2.3 (Water Quality Modeling [GoldSim]) describes GoldSim as a computer platform designed to conduct dynamic simulations and that includes the ability to conduct probabilistic analysis. Subsections of FEIS Section 5.2.2.2.3 provide details on the assumptions used to estimate water flow and the release and transport of solutes at both the Mine Site (Partridge River Watershed) and Tailings Basin (Embarrass River Watershed). In particular, details of the GoldSim model design and its simulation of proposed features are presented in FEIS Figures 5.2.2-7 (Mine Site GoldSim Flow Chart) and 5.2.2-10 (Plant Site GoldSim Flow Chart).

It is acknowledged that the NorthMet Project Proposed Action-related facilities would release solutes and cause an increase in loading of some solutes to surface water and groundwater relative to the continuation of existing conditions. Estimates for mass-loading from Mine Site facilities are presented in Attachment I of the Mine Site Water Modeling Data Package. Estimates for mass-loading from the Plant Site Tailings Basin are presented in Attachment G of the Plant Site Water Modeling Data Package.

It is also acknowledged that the NorthMet Project Proposed Action would alter stream flows relative to existing conditions. However, the flows would be similar to existing conditions. Where and when necessary, surface streams would receive treated augmentation water to maintain stream flow to within +/- 20% of existing natural flows. The augmentation water would generally consist of water obtained from the capture systems or mine pits, and treated at the WWTF or WWTP prior to discharge.

The Co-lead Agencies have made an attempt to communicate modeling results clearly in the FEIS. Deviations from the presentations in technical documents were at times necessary. Mine Site GoldSim inputs—be they deterministic or uncertain—are contained in Attachment C of PolyMet 2015m (as cited in the FEIS) and Attachment B of PolyMet 2015j (as cited in the FEIS). It is acknowledged that modeling results for hundreds of years in the future should be viewed with appropriate caution.

Theme WR 190

Theme Statement

The NorthMet Project Proposed Action minimizes water resource impacts. Similar mines have experienced success. Water model runs sufficiently disclose impacts by presenting results out to 200 or 500 years to address slow moving water. Effects on water resources in the NorthMet Project area and in the Lake Superior Basin have been thoroughly addressed in the SDEIS and reviewed by Co-Lead agencies and deemed satisfactory. Water treatment and capture systems designs, engineering controls, and monitoring and mitigation measures would protect water resources. The water model demonstrates that the NorthMet Project Proposed Action would meet the standards set in Minnesota state law and federal initiatives. Acid rock drainage would not be created.

Thematic Response

These comments generally supported the findings in the SDEIS that the NorthMet Mining Proposed Action would minimize impacts to water quality. Because no specific information was provided, no changes were made to the EIS.

Theme WR 191

Theme Statement

The FEIS should address the quantities or volumes of sediment from erosion that could contaminate surface water.

Thematic Response

PolyMet proposes to collect non-contact storm water runoff from undisturbed and reclaimed vegetated areas within the Mine Site and route it to the Partridge River via existing drainage patterns to the extent possible. There would be the potential for increased suspended solids. PolyMet would provide sedimentation ponds at the outlet locations to manage suspended solids prior to discharge to surface waterbodies (see Figures 3.2-5, 3.2-6, 3.2-7, and 3.2-8). These sedimentation ponds should be adequate to manage suspended solids, but monitoring of the discharge is recommended as part of any water quality permit. Due to the containment systems at the Plant Site, no erosion is expected to impact surface waters downgradient from the tailings basin.

Theme WR 192

Theme Statement

The P90 impact threshold can be interpreted differently. One in ten projects might result in unacceptable contamination. Ten percent of the time concentrations of solutes would be higher. Descriptions of how P90 values are determined from GoldSim runs (described in the SDEIS page 5-77) appears incorrect. P90 level presents the worst-case analysis of water quality (SDEIS page 5-77) are simply untrue as the P90 level presents a worst-case scenario only if everything goes exactly as intended: if no mistakes were made in designs, calculations, or modeling inputs, if no mistakes are made in operations, if no larger-than-expected storms occur, etc.

Thematic Response

The GoldSim model was developed primarily to estimate the effects on surface and groundwater quality from the NorthMet Project Proposed Action. NEPA does not require probabilistic analysis for disclosing effects, but a probabilistic model yields a more realistic estimate for predictions by addressing the uncertainty of some input assumptions than simpler modeling methods. A second benefit of using a probabilistic model is the ability to accommodate divergent opinions. In this case, competing perspectives among technical experts could often be addressed by widening the range of values for specific model parameters.

A disadvantage of using a probabilistic model is that it increases the burden on the EIS preparer by producing results that are more complicated to interpret and explain. For the NorthMet Mining Project and Land Exchange FEIS, the major simplification is to use only the P90 model results when comparing simulation results to water quality regulatory criteria. If the P90 concentration of a solute equals the evaluation criteria, then there is a 10% probability that the actual concentration would exceed the criteria. The P90 concentration is not a "worst-case" value, but rather a model threshold selected so that plans are based on solute concentrations than are probably higher than would actually occur. In the NorthMet GoldSim results, nearly all of the P90 solute concentrations were below the regulatory criteria at evaluation points, so the chance that any of these would exceed the criteria is less than 10%. Further, when comparing model results to regulatory criteria, the comparison used the maximum P90 model value obtained from over the entire simulation period (200 or 500 years for Mine Site and Plant Site, respectively). In these cases, if the P90 equaled the evaluation criterion, it would mean that there is a 10% chance that the concentration of the solute would ever exceed the criteria, and that over most of the simulation period, the chance of exceedance would be less than 10%. Importantly, the water quality model is designed to provide a reasonable estimate for water-quality effects and to help plan for water treatment, but it is not a guarantee of outcomes. Actual protection of quality in receiving waters would rely on the monitoring and contingency plans put in place during the permitting and financial assurance process.

The discussion in the FEIS under the "Application of Evaluation Criteria to Probabilistic Modeling Results" heading in Section 5.2.2.2.3 has been revised to more clearly describe the interpretation of probabilistic water quality model results.

Theme WR 193

Theme Statement

The XP -SWMM and GoldSim models are not accurate predictors of potential pollutant inputs into these riverine systems. The potential for overflow during large storm events were not part of these model calculations. The Co-Lead Agencies did not require PolyMet to consider the stochastic modeling capabilities of MODFLOW and MT3DMS (the transport module available for use with MODFLOW). Nor does PolyMet provide any support for its statement that GoldSim is "widely used in the industry." The Co-Lead Agencies have not demonstrated why a publicly available model, such as MODFLOW, which was used in the initial DEIS in 2009, is not adequate and more accepted to characterize the water quality and quantity at the PolyMet site. Use of a publicly available model, such as MODFLOW, rather than a proprietary one, would have made review and analysis of the PolyMet model far easier for the public.

Thematic Response

The NorthMet Project Proposed Action facilities would be designed with excess storage to handle large storm events by routing water to mine pits or the Tailings Basin pond instead of discharging untreated contact water. In the event of an extreme event (e.g., 100-year storm), excess water would remain in the mine pits, which would essentially have unlimited storage capacity with mine operations in the pits temporarily shut down. Even during an extreme event, no untreated water would be discharged to a natural waterbody. More information on storm water would be acquired during permitting.

Regarding use of a publicly available model, selecting GoldSim was in part a response to public comments on the DEIS to improve the transparency and comprehensibility of the modeling, as well as disclose probabilities of outcomes to help the public and Co-lead Agencies assess environmental risks. See FEIS Section 5.2.2 and FEIS definitions for more information.

By downloading the free GoldSim Player, one can view, navigate, and run GoldSim models. This allows a modeler to distribute a model to others without requiring them to license GoldSim. Manuals are also available free for download.

Theme WR 194

Theme Statement

The use of the Duluth Complex as a hydrogeologic analogue is difficult to support. The Giants Range Batholith is Archean in age, more than 1.5 billion years older than the Duluth Complex, and therefore the assumption that the two units have similar stress, weathering, and erosional histories is deficient when applied to numerical modelling of smaller-scale sites, especially for predicting solute transport. Instead, the development of conceptual models that employ techniques whereby discrete fractures or fracture zones are more fully considered, results in improved prediction of solute transport, including better estimates of travel times, and recognition of variation in flow directions and discrete pathways in three dimensions.

Thematic Response

It is presumed that this comment refers to using the Duluth Complex as a hydrologic analog for the Giants Range Granite at the Plant Site. In fact, the only conceptual connection made between the Duluth Complex and Giants Range Granite is the idea of the upper 10 to 15 meters of bedrock being more fractured and more permeable than deeper bedrock. Due to the large number of exploration coreholes at the Mine Site, there are abundant RQD data to support this concept. The limited RQD data at the Plant Site do not conflict with this concept, but do not provide sufficient independent data for a firm interpretation. There are studies conducted at other sites to indicate that an upper more-permeable zone in bedrock is typical of the Iron Range, regardless of the bedrock rock type. So the RQD observations in Duluth Complex rocks at the Mine Site are taken as credible evidence that upper Giants Ridge Granite at the Plant Site also has an upper zone 10 to 15 meters thick with increased fracturing and hydraulic conductivity compared to deeper bedrock. Note that the hydraulic conductivity of the upper zone of Giants Range Granite is determined from 2014 packer tests conducted in five boreholes along the perimeter of Tailings Basin that were advanced 4.0 to 6.2 meters below the top of rock (not Duluth Complex testing conducted at the Mine Site).

Methods have been developed evaluating chemical transport through discrete fracture systems in hard rock. However, it is acknowledged within the industry that these theoretically based methods are simply not practical and reliable for large field sites. Discrete fracture transport models require intensive characterization of fracture apertures, orientations, and pervasiveness that can never be accomplished for a large field area. These models have only been applied successfully to small rock masses at pilot test sites, but never to a large-scale field problem. For field-scale evaluations, the standard of the industry is to treat fractured rock as an equivalent porous medium and use surrogate parameters (e.g., low effective porosity) to model chemical transport within the large rock mass. This is the approach taken in the FEIS and it is the only practical method that can be employed for impact evaluation.

Theme WR 195

Theme Statement

The NorthMet Project Proposed Action is a source of great concern and should not proceed due to potential impacts to water resources or the duration of water treatment necessary. There is a lack of experiential and other evidence to support the claim that sulfide, open pit copper nickel, or copper cobalt mining can be done without causing watershed pollution; it cannot be demonstrated that contaminated groundwater or surface water won't leave the site; it is contrary to DNR's mission, the NorthMet Project Proposed Action would violate water quality standards for generations to come; the costs would not be worth the benefits, water is a natural resource with inherent economic value, it is more valuable than ore, it is essential to Minnesotans' quality of life and water quality in lakes and rivers should be protected.

Thematic Response

The hydrologic and water quality modeling do indicate that impacted water would leave the NorthMet Project area under closure conditions. At the Mine Site, this would include seepage of West Pit and East Pit water into groundwater that slowly migrates to the Partridge River. At the Plant Site, it would include capture system bypass that allows subsurface tailings water to continue slow migration towards the Embarrass River. A key feature of the NorthMet Project Proposed Action is to evoke management strategies and engineered facilities that would minimize the flow of impacted water leaving the NorthMet Project area to a rate that is small compared to diluting recharge and diluting flows in the rivers (hundreds to thousands of gpm). The GoldSim water quality models acknowledge and quantify the flow rates and chemical concentrations of these excursions from the Mine Site and Plant Site, but show that the associated chemical-loading would be sufficiently small that groundwater quality criteria would not be violated at the evaluation locations. Further, the modeling shows that water quality criteria either would not be violated in surface water or would not increase the frequency of violations that would occur under non-NorthMet Project Proposed Action conditions.

It is acknowledged that operation, maintenance, and periodic replacement of environmental controls would be required during closure. Regardless of the precise duration of effects or water treatment at either the Mine Site or Plant Site, there would be measures available to address impacts to natural resources. *Minnesota Rules* 6132.3200 specifies that it is a goal for a mining area to be maintenance-free. Passive water treatment is described as a long-term goal if future pilot studies were to demonstrate that it could be successful. The decision to go to passive treatment at some time in the future would be based on monitoring of actual NorthMet Project area conditions and pilot-testing, rather than predictive modeling and would be subject to applicable permitting requirements at that time. Regardless of treatment mechanism, financial assurance would be required under *Minnesota Rules* 6132.1100 before the State of Minnesota's Permit to Mine can be issued. Permit conditions and financial assurance would be required to perform reclamation and closure activities for as long as these activities are needed. FEIS Section 3.2.2.4 describes financial assurance process and requirements.

Theme WR 196

Theme Statement

The effects to water resources cannot be modeled satisfactorily due to climate change and the uncertainty about future hydrology, which prevents a comprehensive analysis of water flow. Climate change is progressing so rapidly that it is not possible to predict with accuracy the extent of pollutant migration into the hydrological system. Mitigation must be planned from the basis that passive water treatment is not applicable due to the inability to accurately project rainfall and to accurately project future rainfall and climate change.

Thematic Response

Passive water treatment is not part of the Project Description and is only described as a long-term goal if future pilot studies were to demonstrate that it could be successful. The decision to go to passive treatment at some time in the future would be based on monitoring of actual NorthMet Project area conditions and pilot-testing, rather than predictive modeling and would be subject to applicable permitting requirements at that time.

Climate change is a legitimate concern, but its effects are not rapid as indicated by climate modeling done by research institutions and government agencies. It is the Co-lead position that long-term monitoring of climate and NorthMet Project area conditions would provide adequate advanced warning that climate change issues needed to be addressed and adequate time to implement adaptive mitigation measures if they are needed.

Theme WR 197

Theme Statement

The FEIS should address potential environmental impacts to water resources from the NorthMet Project Proposed Action, not only state if the water quality standards would be met. Potential environmental analyses or discussions that should be added to the FEIS include: how water quality is determined; if the environmental impacts are greater as water is being released into two watersheds; how evaporation in backwaters, marshes and ephemeral flooded ponds affects constituent loading; if filling of wetlands would increase flooding; whether or not there is any point along the Embarrass, Partridge, or St. Louis Rivers where sulfate or metals would tend to precipitate (due to local chemistry) and accumulate mass of additional sulfate and other metals build up in Colby Lake (Partridge River) or Sabine or Wynne Lakes (Embarrass River); whether or not the mass of sulfate would lead to an increase in the methyl mercury concentrations in Colby, Sabine, or Wynne Lakes; and whether the high volume carries those pollutants down to Lake Superior and the St. Louis River delta.

Thematic Response

Water resources are considered not to be significantly impacted if water quality evaluation criteria are met at evaluation locations and there are no substantial changes to surface water flows. If water quality criteria are not met under the Continuation of Existing Conditions modeling scenario, the FEIS evaluates whether the NorthMet Project Proposed Action causes or increases concentrations to an unacceptable degree. Using these definitions, GoldSim water quality modeling predicts that the NorthMet Project Proposed Action would not lead to impacts to groundwater and surface water.

The modeling indicates no impacts at downstream station SW-005 on the Partridge River and PM-13 on the Embarrass River. Although modeling was generally not performed downstream of these surface water locations (except Colby Lake), it is concluded that there would be no impacts downstream of the locations since natural processes tend to not increase surface water concentrations.

Surface water features mentioned in the theme text are generally not on flowpaths with water potentially affected by the NorthMet Project Proposed Action.

Predicted chemical concentrations in off-site, potentially NorthMet Project Proposed Action-affected waters are not high enough to cause precipitation or solids accumulation in surface waterbodies.

Theme WR 198

Theme Statement

The Mine Site and Plant Site are in a water rich part of the country that is subjected to freeze and thaw conditions. This would cause extreme challenges to pollution prevention.

Thematic Response

Given the mitigation proposed for the NorthMet Project Proposed Action and the experience of the mining industry in cold climates, freeze and thaw are not expected to compromise the Proposer's ability to operate at the FEIS's predicted impact levels.

Theme WR 199

Theme Statement

Studies should be done of the water quality in areas proposed to substitute for the exchanged lands in the Partridge River watershed.

Thematic Response

FEIS Sections 4.3.2, 5.3.2, and 6.3.2 discuss water resources in area of the Land Exchange Proposed Action.

Theme WR 200

Theme Statement

Mining does not appear in the list of six water allocation priorities allocation determined by the commissioner (SDEIS page 4-23), and would appear to be a low priority for allocation of water. It is not explained who the commissioner is or what organization the commissioner is with.

Thematic Response

The MDNR Commissioner (currently Commissioner Landwehr) has responsibility for adopting rules allocating waters for consumptive use based upon priorities contained in Minnesota Statute 103G.261.

Theme WR 201

Theme Statement

Much of the information in Chapter 5 of the SDEIS depends upon the use of water models with which a layperson has no familiarity. Chapter 5 also uses technical terms and technical documents which are difficult to understand. Supporting information for technical documents sometimes cannot be found. Therefore, the ability to judge whether the models being used for decision making are competent has to fall to the experts; however, there is no discussion of the water models by experts in the SDEIS. Despite the use of many water models, a lot of this work appears to be "educated guesswork" that would have to be field monitored and checked for accuracy at the time the mine is operating and that is pretty late to make changes.

Thematic Response

The Co-lead Agencies have attempted to clarify and simplify FEIS text. Summaries are provided in the Executive Summary, and in the first part of each section within FEIS Chapter 5, including Section 5.2.2 for water impacts from the NorthMet Project Proposed Action. FEIS supporting information can be acquired by contacting the MDNR Environmental Review Unit. The text in the FEIS reflects the opinions of Co-lead Agency water resources experts and that of other experts who have provided input to the FEIS through comments or direct dialogue with the Co-lead Agencies. It is acknowledge that monitoring of the NorthMet Project Proposed Action is a critical element to understanding and controlling environmental impacts and enforcing regulatory requirements.

Theme WR 202

Theme Statement

The SDEIS does not describe water resources impacts from probable or worst-case NorthMet Project Proposed Action failure scenarios or weather events.

Thematic Response

Neither NEPA nor MEPA implemented through Environmental Quality Board Rules requires the evaluation of worst-case or failure event scenarios. By not explicitly considering these scenarios, the Co-lead Agencies are adhering to these regulations.

Theme WR 203

Theme Statement

Mineral exploration leads to environmental harm. This impacts baseline conditions and was not considered. How can the USFS ignore the lack of funding to monitor the extent of exploratory drilling and the necessary future monitoring of the sites for acid mine drainage?

Thematic Response

Natural background (unimpacted) conditions have been disclosed in the FEIS as a baseline for the evaluation of environmental effects.

Theme WR 204

Theme Statement

The discussion of beryllium, thallium and manganese groundwater concentrations at the NorthMet Project Proposed Action site is misleading. Water samples have been impacted by mining. Concentrations of manganese in surface waters at the former LTVSMC tailing basin already exceed Minnesota's Health Risk Limit.

Thematic Response

Natural background concentrations were used to establish groundwater evaluation criteria for impact evaluation in FEIS Section 5.2.2.1. The same dataset that was used to define natural background water quality for use in the water quality impact modeling was used to develop site-specific evaluation criteria for the FEIS. At the Plant Site, 49 background thallium samples were collected from the bedrock and 50 background manganese groundwater samples were collected from the surficial aquifer. At the Mine Site, 320 background beryllium groundwater samples were collected from the surficial aquifer and 49 samples were collected from the bedrock. Three hundred and eleven background manganese groundwater samples were collected from the surficial aquifer and 49 background manganese samples were collected from the bedrock. Forty-nine background thallium samples were collected from the bedrock. For information on how evaluation criteria were determined, see Section 4.3.4.2 of PolyMet 2015j (as cited in the FEIS) and Section 4.3.4.2 of PolyMet 2015m (as cited in the FEIS).

A.5.25 References Cited in Thematic Responses

The following references cited in the Thematic Responses in Section A.4, have not been cited elsewhere in the FEIS. References used in the FEIS are listed in that document.

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A.6 RESPONSES TO EDITORIAL COMMENTS

Table A-4 lists each editorial comment, the name of the sender, and the corresponding response.

Table A-4 Editorial Comments and Responses

Sender	Comment	Response
1854 Treaty Authority	This section also contains language about "1854 Treaty Authority-regulated species". We suggest removing or altering this language. The Fond du Lac Band also exercises treaty rights in the 1854 Ceded Territory, and has their own regulations. Further, the 1854 Treaty Authority maintains seasons and limits on some species, but these are not the only species of importance.	Text has been added to clarify the definition of "1854 Treaty Authority-regulated species" in Section 5.2.9.2.2. As discussed in this section, Fond du Lac has its own regulations applicable to the 1854 Ceded Territory. The discussion of "1854 Treaty Authority-regulated" species or resources is not inclusive of all species important to the Bands. Instead, the lists serve as the most updated and best available data for the most common game species or tribally harvested resources on the 1854 Ceded Territory.
Becky Milanese	GLOSSARY Page lx- geosynthetic membrane cover- what is this made of and would we expect decomposition over time from natural forces or the sulphuric wastes?	Chapter 3 includes information on the proposed geomembrane covers.
Becky Milanese	IMPLAN- How accurate is this model? Who or which agency uses this modeling?	IMPLAN is described in Section 5.2.10.
Becky Milanese	MODFLOW- How accurate is this and who uses it?	MODFLOW is a water model used for impact analysis as described in FEIS Section 5.2.2.
Becky Milanese	National Pollutant Discharge Elimination System (NPDES) Permits- No agency is listed as responsible for issuance of these permits and setting their limits and requirements.	FEIS Section 2.6 discusses permits and describes that the MPCA would be responsible for NPDES permits
Becky Milanese	Page lx-GoldSim- what is a engineered systems model? Which analysis gets used in which place and who uses these models?	GoldSim is a water model used for impact analysis as described in FEIS Section 5.2.2.
Becky Milanese	Page lxi- Humidity cell- Who or which agency uses this test? Hydrometallurgical residue- what is an amorphous form?	Humidity cell tests are described in FEIS Section 5.2.2.2.3. The term "amorphous form" has been removed from the glossary.
Becky Milanese	Page lxiii- Monte Carlo Simulation- Who or what agency uses this simulation and determines its use and outcome?	Monte Carlo is defined in the glossary as, "A computerized mathematical technique that allows people to account for risk in quantitative analysis and decision-making. The simulation furnishes the decision-maker with a range of possible outcomes and the probabilities they will occur for any choice of action." It generates model permutations for probabilistic results and ranges as described FEIS in Section 5.2.2.2.3.
Becky	Page lxiv- Paste or thickened tailings- what is a homogeneous nonsegregated	Homogeneous nonsegregated mass is material that is uniformly mixed so there are not defined layers of different

Sender	Comment	Response
Milanese	mass?	materials.
Becky Milanese	Page lxix- Wastewater treatment facility (WWTF) & Wastewater Treatment Plant (WWTP) - What is the difference between these two and who permits and oversees their discharges?	The WWTP (Plant Site) and WWTF (Mine Site) are described in FEIS Sections 3.2.2.3.10 and 3.2.2.1.8, respectively, and discharges would be managed under the permits described in Section 2.6.
Becky Milanese	Page lxv- Permeable reactive barrier- Huh? Who installs and maintains this barrier? Is it a separate facility?	A permeable reactive barrier is an option for non-mechanical water treatment and is discussed in FEIS Chapter 3 and Section 5.2.2.
Becky Milanese	Page lxvi- Reject concentrate- What happens to this water or brine?	Reject concentrate from the WWTP would be treated at the WWTF, and the reject concentrate from the WWTF RO would be evaporated and the residual solids disposed of off-site.
Becky Milanese	Page lxvi-lxvii- Spill Prevention Control and Countermeasure (SPCC) Plan- Who produces, writes, revises and oversees this plan.	The project proponent would be responsible for the SPCC plan and would be overseen by regulators under permit.
Becky Milanese	Pumping Test- Who uses these tests and determines the results and effects that need to be considered?	Pumping tests are used and interpreted by the project proponent and their consultants. Results are analyzed in the FEIS to characterize groundwater flow and contaminant transport.
Becky Milanese	Reclamation- Who oversees this and decides that it is done in a proper manner?	Reclamation would be undertaken by the project proponent and overseen by the MDNR under the Permit to Mine per FEIS Section 3.1.1.6.
Becky Milanese	XP-SWMM- Which agency uses this modeling software and what is it used to determine.	XP-SWMM is a surface water model used for impact analysis as described in FEIS Section 5.2.2.
Bert Hyde	Pg 4-45 and 46, 47 – The content of these pages is so well hidden that I could not understand what the author was trying to communicate.	The FEIS has been revised to improve writing clarity.
Bert Hyde	Pg 3-114, 3.2.2.3.7. High purity gypsum is a useful product – it should not be managed as waste – waste is ultimately very expensive.	No change made.
Bob Tammen	It has been my experience in the industry that acid draining from a mine is referred to as Acid Mine Drainage. Industry efforts to euphemize the term to Acid Rock Drainage is sadly unprofessional and should be corrected in the glossary and in the SDEIS. 4-165 "The Plant Site is located north of the Laurention Divide... Misprint? The plant is South of the divide. See map. 4-376 Last paragraph. Heal should be heel. 5-5 "located in...Mesabi Iron Range" The mine is located in the Duluth Complex in the Superior National	Regarding the use of the term, "Acid Mine Drainage" or "Acid Rock Drainage," no change has been made. Regarding the location of the Plant Site in relation to the Laurentian Divide, change has been made as requested. Regarding the use of "heal" or "heel," change has been made as requested.

Sender	Comment	Response
	Forest. Once again, the SDEIS deserves an EU-3. 6-9 6.2.2.1.6 Essar...begin operation in 2014. Essar will not begin operation in 2014. Update SDEIS. 6-7 Table 6.2-1 Mesaba Energy Project. The IRRRB has granted Mesaba Energy an option to purchase land near Hibbing for a gas power plant. Update table. 6-1 reasonably forseeable. The impacts of developing a 10 billion ton ore body as described by geologists in Minnesota should be evaluated as reasonably forseeable.	
Bob Wagner	II. Contradicting statements on streamflow, Executive Summary p. 39, table 51 and (appendix C sub sec 1) “reduce water flows to range of annual natural variability	The text of the Executive Summary has been updated to improve clarity.
Center for Biological Diversity	the discussion of mine pit inflow does not provide a citation at all, see SDEIS 5-90.	Change has been made, as requested.
Grand Portage Band	The SDEIS also speculates that the tribes will benefit economically from the Project through additional visitation to Band-operated Casinos, but provides no data to back up the statement: “Increased employment and income associated with the NorthMet Project Proposed Action could increase visitation and revenues at [area tribal gaming] facilities.” This statement is entirely unsupported by any market analysis and must be deleted from the socioeconomic assessment of the Project.	No change made.
Joel Roberts	There are discrepancies among the various descriptions of this construction in the SDEIDS and the relevant references. These should have been resolved before the SDEIS was released.	No change made.
klhanson@frontiernet.net	[Text from SDEIS] “Based on the results...would not exceed applicable environmental evaluation criteria except for two water constituents as a side effect of the project.” - [should read] Would exceed applicable environmental evaluation criteria for two water constituents.	FEIS text has been revised to read, “Based on the results….would exceed applicable environmental evaluation criteria for two water constituents as a side effects of the project.”
Michele Ross	In most cases, either the federal MCL or the Minnesota Health Risk Limit (HRL) is selected, but higher SDEIS evaluation criteria were chosen for beryllium, manganese and thallium“…based on background water quality”. Although manganese exceeded the federal MCL of 50 µg/L in most samples, Table 4.2.2-6 in the SDEIS indicates most of the groundwater samples collected near the proposed Mine Site were near or below the state Risk	There are no drinking water wells at the Mine Site. The FEIS bases water quality evaluation criteria off of regulatory requirements. Using regulatory requirements to assess risk best informs the permitting process--a major objective of EISs. RAA guidance is not likely to be promulgated, either because of a high level of uncertainty

Sender	Comment	Response
	Assessment Advice (RAA) levels of 100 µg/L for infants and 300 µg/L for children and adults. MDH recommends the RAA values be used as the groundwater evaluation criterion for manganese… Use 100 µg/L for infants and 300 µg/L for children and adults as the groundwater evaluation criterion for manganese.	about the numeric guidance, because the methods used to develop the guidance are different than the methods in rule, or because the resulting guidance is qualitative rather than a water value. The RAA values were added as a footnote to FEIS Table 5.2.2-1.
Michele Ross	[T]he detections of beryllium near the proposed Mine Site indicate background concentrations in the aquifers are generally below the federal MCL of 0.4 µg/L and only slightly above the MDH HRL of 0.08 µg/L. MDH recommends the HRL be used as the groundwater evaluation criterion, as beryllium concentrations in the Plant Site flow paths are also predicted to exceed the HRL in areas where domestic wells are present…Use 0.08 µg/L as the groundwater evaluation criterion for beryllium.	Groundwater standards include primary and secondary drinking water standards and the HRL. *Minnesota Rules* 7060.0600, subpart 8, states that "where the background level of natural origin is reasonably definable and is higher than the accepted standard for potable water and the hydrology and extent of the aquifer are known, the natural level may be used as the standard." The groundwater evaluation criterion for beryllium at the Mine Site is 0.39 µg/L. At the Plant Site, it is 0.54 µg/L. The basis for the evaluation criteria is Minnesota Rules. The MDH HRL of 0.08 µg/L is disclosed in FEIS Table 5.2.2-1.
Northeastern Minnesotans for Wilderness	[The SDEIS] states that the proposition that "taconite tailings appear to be a sink for mercury in full-scale actual tailings basins in northern Minnesota, at least similar to other media like soils . . . is supported by surface and groundwater monitoring around the existing LTVSMC Tailings Basin, which found mercury concentrations consistent with baseline levels (see Table 4.1-31), generally averaging less than 2.0 ng/L." SDEIS 5-202. This statement in regards to groundwater appears to be blatantly false. And an attempt to learn more from Table 4.1-31 was thwarted by the fact that there is no Table 4.1-31.	Change has been made, as requested. The reference to Table 4.1-31 has been removed from the text, and replaced with an appropriate table reference.
Northeastern Minnesotans for Wilderness	Regarding scenic integrity objectives (SIOs), the SDEIS states that it used SIO definitions in the Forest Plan for evaluating the Federal lands but used a 1995 Forest Service publication to evaluate the non-Federal lands. SDEIS 4-349. The discrepancy is not explained. The SDEIS needs to provide sufficient information to determine whether this difference could lead to inaccurate comparisons.	No change made.
Patty Lange	It has been brought to my attention that the maps outlining the drainage area around the proposed mine in the environmental study for the Polymet mine are incorrect.	The referenced figures have been revised for the FEIS, and now include additional features that add clarity to the hydrology.
Patty Lange	The fact that the incorrect maps outline the swamp with a dashed teal line on satellite maps with green backgrounds makes it extremely difficult to see. This discrepancy between the environmental impact statement maps and US	The outline of the One Hundred Mile Swamp on figures has been revised to make it more visible. No other changes made.

Sender	Comment	Response
	government maps makes this environmental impact study inadequate.	
Paul Stolen	Sulfate loadings, reference to MPCA {2006), p. 5-208. This MPCA document is quoted in Reference #42 in Appendix A of these comments. This MPCA document refers primarily to sulfate permitting issues rather than impact assessment, and is also outdated in enough respects to question its utility for this EIS.	Citation has been revised to "MPCA 2006a," to refer to the MPCA Strategy to Address Indirect Effects of Elevated Sulfate on Methylmercury Production and Phosphorus Availability, published by the MPCA in October 2006, which is the approach source in this context.
Phil Larson	Glossary The glossary contains a number terms whose definition is inconsistent with standard usage. These include: Drift: Material such as sand, clay, gravel, and rocks transported and deposited by a glacier or glacial process. Glacial deposit: A collection of various-sized rocks and debris that is deposited by a glacier as it advances or recedes across a landscape. There are many types of deposits, including till, drift, erratics, and moraines. (Note: sediment deposits of glacial origin are termed 'drift', less commonly 'glacial drift'. Erratics refers to individual clasts, while 'moraines' refer to a landform, not a sediment type.) Glacial till: Direct glacial deposits of rocks, gravel, or boulders that are unsorted and unstratified. (Note: all till is by definition glacial in origin; there is no need to include the modifier 'glacial'.) Surficial glacial deposit: A collection of various sized rocks and debris deposited by glacial activity that is left on the earth's surface after the glacier recedes. (Note: 'surficial glacial deposit' is not used in the text of the SDEIS.) Till: see Glacial till These definitions should be revised to conform to accepted usage. The following definitions are taken from the Glossary of Geology (5th Edition): Drift A general term applied to all rock material (clay, silt, sand, gravel, boulders) transported by a glacier and deposited directly by or from the ice, or by running water emanating from a glacier. Drift includes unstratified material (till) that forms moraines, and stratified deposits that form outwash plains, eskers, kames, varves, fluvioglacial sediments, etc. Outwash Stratified detritus (chiefly sand and gravel) removed or "washed out" from a glacier by meltwater streams and deposited in front of or beyond the end moraine or the margin of an active glacier. The coarser material usually is deposited nearer to the ice. Till Dominantly unsorted and unstratified drift, generally unconsolidated,	The glossary is deemed adequate for the FEIS.

Sender	Comment	Response
	deposited directly by and underneath a glacier without subsequent reworking by meltwater, and consisting of a heterogeneous mixture of clay, silt, sand, gravel, and boulders ranging widely in size and shape. In addition to adapting these definitions, I recommend that the definition of 'surficial aquifer' be modified to indicate that the aquifer is hosted by unconsolidated sediment, including drift.	
Phil Larson	Notes on Nomenclature The text of the SDEIS contains a number of inconsistent usages of terminology: • The text mentions 'glacial till' 33 times, and 'till' alone 29 times. 'Till' should be used in all cases. • The text mentions 'glacial drift' 6 times, and 'drift' alone 7 times. 'Drift' should be used in all these cases. • The glossary does not define 'outwash'. The text mentions 'glacial outwash' 5 times, and 'outwash alone 3 times. 'Outwash' should be used in all these cases. • The text uses the term 'surficial deposits' 25 times, although the term is not defined in the glossary. The usage suggests that this refers to all unconsolidated sediments lying above bedrock, including drift (till and outwash), peat, and other sediment. • In a number of cases, usage of the term 'till' is confused or inconsistent: • Page 4-95 – "several soil borings into the surficial till identified the composition as layers of clay and sand, plus cobbles and boulders". In this case 'till' is the sediment type, and by definition contains particle sizes ranging from clay to boulders. • Page 4-151 – "The depth of soil and till overlying the bedrock". • Page 4-367 – "areas of glacial till (typically silty sand)". Either the sediment is till, or silty sand. By definition it cannot be both. • Page 4-376 - "native till material that ranges from clay to gravel". In this case 'till' is the sediment type and by definition contains particle sizes ranging from clay to gravel. In several instances, the term 'till soil' is used. Till is a sediment type. A soil may develop at the surface of a till deposit, however the entire thickness of the till is not soil. 'Till' alone suffices in these instances. In a number of other cases, convoluted sediment descriptions are given, when	Text within the FEIS has been updated since the SDEIS - not all suggested edits have been applied.

Sender	Comment	Response
	it is likely the sediment is simply till. In these cases, the non-specific and complex description gives the impression of extreme heterogeneity in sediment deposits, rather than a relatively homogeneous till deposit. For example: • Page 4-45 – "The overlying surficial sediments at the Mine Site are poorly sorted and range from very dense clay to well-sorted sand with boulders and cobbles". This sediment is highly likely to be simply till. • The term 'overburden' as defined in the glossary appears to be inconsistently applied. Although it is defined as all unconsolidated sediment and waste rock overlying the mineral deposit, in most places it appears to refer to only the unconsolidated material overlying bedrock. For example: • Page 3-15 – "overburden and waste rock" • Page 3-17 – "overburden and waste rock" • Page 3-37 – "use of waste rock, overburden, and peat" • In other cases, 'overburden' clearly refers to only the unconsolidated sediment overlying bedrock. For example: • Page 3-44 – "Three types of overburden are present at the site: unsaturated overburden, saturated overburden, and peat." The term 'soil' is not defined in the glossary. In most cases, the term is used in a manner referring to unconsolidated materials at the surface, containing organic matter, and capable of supporting life. In other cases, it appears to be used in a geotechnical sense, referring to unconsolidated sediment overlying bedrock, equivalent to usage of the term 'overburden'. In these cases, the term appears to be applied to the entire thickness of drift or till overlying bedrock, similar to usage of 'surficial deposits' noted above. For example, • Page 4-149 – "lateral flow that is either on the surface or within the subsurface soil." Soil used in this sense refers to either drift or the surficial aquifer. • Page 5-201 – "mercury stored in rock, soil, peat, and vegetation." Soil used in this sense refers to drift. • Page 5-227 – "The Mine Site contains localized heterogeneous vertical and horizontal hydraulic conductivities within each soil unit." Soil used in this sense refers to drift. A clear distinction need to be made between soil referring to the shallow	

Sender	Comment	Response
	surface layer containing or	
Phil Larson	Note on usage of Unified Soils Classification System (ASTM D 2487-83) The USCS was used to describe unconsolidated sediments recovered from boreholes drilled in support of the NorthMet Project. It is important to note that this system is designed to best describe and name relatively well-sorted unconsolidated sediments with a unimodal particle size distribution. As such, poorly sorted sediments with potentially multimodal particle size distributions (e.g. till) are not well-described using this classification. Relatively minor changes in the relative proportions of clay-silt-sand-pebble-boulder may lead to application of multiple group symbols and the perception of significant heterogeneity within what is in actuality a relatively homogeneous till sequence. In cases where USGS group symbols and nomenclature are utilized in the SDEIS and supporting documents, it is advisable that sediment identified as till be explicitly name as such, e.g. GC (till).	Not all instances changed. The FEIS is for public use - technical description can be found in the reference materials.
Phil Larson	Geology of the Mine Site: The observation is made that "the surficial till is a heterogeneous and laterally discontinuous zone with a composition ranging from very dense clay to well-sorted sand." This statement seems to use the term 'heterogeneous' to refer to the poor sorting and wide particle size range of what is likely a relatively homogeneous till. The lateral discontinuity in the till referred to in this case is likely its thickness, not its sedimentological heterogeneity. Here, and elsewhere in the document, well-defined, consistent, and judicious application of the terms 'heterogeneous' and 'homogeneous' when describing tills is advised.	No change made.
Robert Tammen	Several documents refer to PolyMet and Poly Met (Two words). There must be a reason for having two different legal entities. The SDEIS should explain the difference and perhaps declare which will get dividends and which will have environmental clean up liability.	FEIS text has been revised to ensure consistent use of "PolyMet."
Robert Tammen	4-165 "The Plant Site is located north of the Laurentian Divide ...Misprint? The plant is South of the divide. See map.	Text has been revised to indicate the Plant Site is south of the Laurentian Divide.
Robert Tammen	4-376 Last paragraph. Heal should be heel.	FEIS text has been revised to refer to the "base of the dam."
Robert Tammen	5-5 "located in ... Mesabi Iron Range" The mine is located in the Duluth Complex in the Superior National Forest. Once again, the SDEIS deserves an EU-3.	Text has been revised to state, "The NorthMet Project Proposed Action would be located near an historic mining area, known as the Mesabi Iron Range …"
Robert Tammen	Table 6.2-1 Mesaba Energy Project. The IRRRB has granted Mesaba Energy an option to purchase land near Hibbing for a gas power plant. Update table.	The list of Projects has been updated.

Sender	Comment	Response
	At the same meeting the IRRRB granted the City of Hibbing an option to purchase land for a possible Racino. This was probably an effort to pressure tribal interests by threatening to compete with Fortune Bay and Black Bear casinos. The actions were connected and should be analyzed.	
Robert Tammen	6-9 6.2.2.1.6 Essar ... begin operation in 2014. Essar will not begin operation in 2014. Update SDEIS.	The FEIS has been revised to address this comment.
Robert Tammen	A-5 Thematic Response. AQ-1. Oar should be ore.	Change has been made, as requested.
Roger A Powell	Figure 6.2.3-1 does not show the corridor that the text on page 5-374 states that it shows. The figure must be revised to show the corridor.	The SDEIS cited an incorrect figure number. The FEIS has updated the figure number to be 6.2.5-1.
Roger A Powell	Figures 5.2.2-18, 19 and 41a of the SDEIS show PSO, contradicting the text.	No change has been made to FEIS Figures 5.2.2-18 and 5.2.2-19. The text associated with FEIS Figure 5.2.2-41a has been changed, as requested.
PolyMet	PolyMet suggests revising the first sentence in the second full paragraph on page 5-6 to read: "…PolyMet proposes a containment system that would capture about 99 percent of seepage from the Tailings Basin…"	No change made.
PolyMet	The first sentence on page 5-54 states that for Category 1 rock, "…instead of using lab tests, the rate of oxidation and constituent release was estimated from studies of seepage release measured in Dunka Mine rock…..". PolyMet suggests revising the first sentence to read "… instead of using lab tests, the rate of oxidation and constituent release in the field was estimated from lab release rates that were scaled using the results of studies of seepage release measured in Dunka Mine rock…."	Change has been made, as requested.
PolyMet	It is important to note that the Central Pit will not exist until after the Category 4 Stockpile has been decommissioned and the Category 4 waste rock has been relocated to the East Pit for subaqueous disposal. The most apparent benefit of relocating the Category 4 Stockpile as part of the Proposed Action Design Changes is that by locating the stockpile over an area that will be subsequently engulfed by the Central Pit, the overall area of surface disturbance (including vegetation, wetlands, etc) of the NorthMet project will be reduced.	No change made.
PolyMet	The second to last sentence should read: "Compensation proposed at the Aitkin Site would be expected to meet in-kind compensation, resulting in a compensation ratio for effects to wetlands with rare or exceptional functions or difficult-to-replace bogs of 1.75:1, and if in advance, the ratio would be reduced to 1.5:1."	No change made.

Sender	Comment	Response
PolyMet	The second to last sentence in the second paragraph should read: “Compensation proposed at the Hinckley Site would be expected to meet the in-kind incentive, resulting in a compensation ratio for effects to wetlands with rare or exceptional functions or difficult-to-replace bogs of 1.75:1, and if in-advance, the ratio would be reduced to 1.5:1.”	No change made.
PolyMet	The last full sentence on the page should read: “Compensation proposed for the Zim Site would be expected to meet both in-kind and in-place incentives, thereby reducing the compensation ratio for effects on wetlands with rare or exceptional functions or difficult-to-replace bogs from 2:1 to 1.5:1.”	No change made.
PolyMet	The third paragraph states that the United States Army Corps of Engineers (“USACE”) and the Minnesota Department of Natural Resources (“MDNR”) studied “the original NorthMet Project Proposed Action” between 2005 and 2009. Use of the defined term “NorthMet Project Proposed Action” in this context is confusing because the proposed action studied in the Draft EIS was substantially different than the proposed action being studied in the SDEIS. To avoid confusion over the nature of the alternatives studied in the two documents, PolyMet recommends changing the language to state that “Between 2005 and 2009, the USACE and MDNR evaluated PolyMet’s original mining proposal.”	Change has been made, as requested.
PolyMet	The terms “NorthMet Mining Project” and “Land Exchange,” rather than the defined terms “NorthMet Project Proposed Action” and “Land Exchange Proposed Action,” are used on these pages. To avoid confusion, PolyMet recommends consistent use of the defined terms.	FEIS text has been reviewed to ensure consistent use of these terms.
PolyMet	Under the heading “Cooperating Agencies,” the SDEIS describes USEPA’s responsibilities to review and comment on an EIS under Section 309 of the Clean Air Act. USEPA does this for all Environmental Impact Statements, even when it is not acting as a cooperating agency. USEPA has formally participated in the preparation of the current SDEIS as a cooperating agency, which is not the same thing as fulfilling its responsibilities under CAA Section 309. PolyMet recommends clarifying this point by adding a sentence to this paragraph that explicitly notes EPA’s status as a cooperating agency.	Section 1.2.1 has been revised to provide improved clarity on the USEPA’s role.
PolyMet	PolyMet recommends explicitly referencing and incorporating into the SDEIS those portions of the FSDD and the 2009 DEIS that address alternatives. This should increase understanding of the iterative process of alternatives review that the SDEIS already references in several places… these changes should also be reflected in the Executive Summary, which tends to focus on the SDEIS alternatives review process, without fully acknowledging the role	FEIS Section 3.2.3 has been revised to address this comment.

Sender	Comment	Response
	played by alternatives review in the FSDD and the 2009 DEIS.	
PolyMet	PolyMet recommends including an updated version of Table 3.2-4 from the 2009 DEIS somewhere in the Final EIS, either directly in the discussion of alternatives or as an appendix. This would provide context for the discussion of alternatives review and the elimination of alternatives that are not discussed as part of the SDEIS process… [these changes should also be reflected in the Executive Summary, which tends to focus on the SDEIS alternatives review process, without fully acknowledging the role played by alternatives review in the FSDD and the 2009 DEIS.]	No change made.
PolyMet	The Final EIS accordingly should clarify that the alternative of proceeding with the Land Exchange Proposed Action in the absence of the NorthMet Project Proposed Action was considered but eliminated from detailed analysis in the SDEIS because it is represented by the combination of "no action" on the NorthMet Project Proposed Action and Land Exchange Proposed Action Alternative A. This could be accomplished by adding a brief description of the Land Exchange Proposed Action as a "stand alone" action in Section 3.3.3.3. The alternative would not be eliminated as unreasonable, but rather it would not require further analysis because its impacts were already revealed and evaluated in the SDEIS detailed evaluation of other alternatives.	The FEIS presented the range of alternatives that were developed for the Land Exchange Proposed Action as well as those that were considered but eliminated from detailed analysis. The Land Exchange Proposed Action would not have been entertained if not for the NorthMet Project Proposed Action. While benefits of the Land Exchange Proposed Action could accrue without associated mining, this could be true for lands throughout the Superior National Forest. The catalyst for the Land Exchange Proposed Action is the proposed mining activities, current permit applications, and the need to address the conflict associated with split ownership of mineral and surface rights.
PolyMet	PolyMet recommends that the USFS ensure that the Executive Summary is updated to conform to any changes made in the Final EIS. The independent grounds for undertaking the Land Exchange Proposed Action should be particularly clear in the revised Executive Summary, because many readers likely will rely on the Executive Summary to understand the contents of the EIS.	The Executive Summary has been revised to reflect updated information since publication of the SDEIS.
PolyMet	the SDEIS concludes that there will be no cumulative impact on recreational and visual resources. It bases this conclusion on the fact that there are no significant cumulative impacts on individual specific resources that factor in to the assessment of recreational and visual resources (such as air quality, wetlands, etc.). The phrasing used implies that the co-leads have analyzed the effects on recreational and visual resources from impacts to these specific resources individually, rather than collectively. PolyMet suggests clarifying that the agencies have analyzed whether the impacts on these resources, although insignificant when considered individually, would have any impact on recreational and visual resources when combined and has concluded that	No change made.

Sender	Comment	Response
	there would be no significant impact.	
PolyMet	The SDEIS should also use consistent language regarding the scope of the cumulative effects assessment areas throughout Chapter 6. On page 6-2, the SDEIS states: "For all resources, future temporal boundaries are the expected service life of the mining activities, including closure (years 20 to 40) and post-closure restoration (year 40 and beyond)." PolyMet recommends removing this sentence, which is not an accurate description of the temporal boundaries for all resources. Indeed, the very next sentence on page 6-2 rightly states that "temporal boundaries for each resource are defined within the respective resources' sections of this analysis." That sentence should remain as the sole, accurate explanation of temporal boundaries.	FEIS language will be updated as appropriately
PolyMet	The first sentence on this page indicates that completion of mining in the East Pit will occur in "approximately year 11" after the start of mining. By contrast, the first sentence in the paragraph following the three bullet points states that mining in the East Pit will end "by year 11" after the start of mining. The second statement is inaccurate. Mining in the East Pit will end approximately 11 years after mining, but not necessarily by year 11.	No change made. The SDEIS stated that "after year 11," mining would be completed in the East Pit.
PolyMet	In the last paragraph of the Mining Operations Section on page ES-23, the SDEIS defines "process water" in connection with the Mine Site. On page ES-24, the SDEIS refers to "Plant Site process water." To clarify and define terms, page ES-23 should be changed to refer to "Mine Site process water," and "Plant Site process water" should be defined by adding a sentence (see bold text below) to the last paragraph of the Processing Operations Section on page ES-23: "Water seepage from the Tailings Basin would be collected by the groundwater containment system and sent to either the Tailings Basin pond or the Plant Site WWTP. All other water that is collected at the Plant Site, such as water used during processing, and water that contacts the plant site facilities (collectively referred to as Plant Site process water) will also be treated at the Plant Site WWTP. Treated water would be used to augment flows in the streams that would otherwise receive reduced flows because of the Tailings Basin groundwater containment system."	Terminology has been revised for clarity.
PolyMet	PolyMet recommends that the Executive Summary explicitly state that aluminum concentrations in the water, or the lowering of the hardness caused by stormwater, represent natural or background concentrations and/or are the result of natural processes, not process water from the NorthMet Project.	The Executive Summary text has been updated to improve clarity.

Sender	Comment	Response
PolyMet	The SDEIS indicates that the NorthMet Project could potentially "affect water quality by increasing solute concentrations above Class 2B (aquatic life) standards." This appears to refer to the aluminum and lead exceedances discussed earlier in the Executive Summary. As explained in Comment 6 above, PolyMet recommends that the Executive Summary explicitly state that any such exceedances would be the result of background and/or naturally occurring concentrations or processes, not process water from the NorthMet project.	The Executive Summary text has been updated to improve clarity.
PolyMet	The second full paragraph beginning with the phrase "natural resources" does not accurately summarize the discussion of cultural resources in the SDEIS. PolyMet recommends that the paragraph be replaced with the following: "Cultural resources under NEPA can also include natural resources of cultural importance to the Bands. The Co-lead agencies have considered the effects of the Proposed Action on such resources, including 1854 Treaty resources, under NEPA. The Co-lead agencies have concluded that, while the Proposed Action has the potential to have effects on 1854 Treaty resources, construction and operation of the Proposed Action is not likely to significantly reduce overall availability of 1854 Treaty resources that are typically part of subsistence activities in the 1854 Ceded Territory."	No change made.
PolyMet	In Table 1, the Land Use effects of the Proposed Connected Actions are described in the first bullet point as "[n]o effects on land use that would require changes in ordinances or comprehensive forest plans." This language is confusing, given that the NorthMet Project Proposed Action would involve the construction of an open pit mine. PolyMet proposes changing this language to say: "Changes in land use would occur after the Land Exchange Proposed Action and would not require changes in ordinances or comprehensive forest plans."	No change made.
PolyMet	Although the co-lead agencies have concluded that a segment of the Beaver Bay to Lake Vermilion Trail is an eligible historic property, the SDEIS alternates between referring to the "BBLV Trail" and the "BBLV Trail Segment." To ensure consistency with the co-leads' eligibility determination, PolyMet recommends that the agencies consistently refer to the property as the "BBLV Trail Segment." This comment applies throughout all Cultural Resources sections in the SDEIS.	FEIS text has been revised to ensure consistent use of "BBLV Trail Segment."
PolyMet	PolyMet recommends that the section of the chart dealing with "Cultural Resources & Historic Properties" be referred to simply as "Cultural	Change has been made, as requested.

Sender	Comment	Response
	Resources" since that term is inclusive of historic properties.	
PolyMet	The first sentence in Section 2.3.2.2, "Revised Proposed Action and Alternatives," states that the NorthMet Project Proposed Action has "changed greatly since the release of the DEIS." The use of the phrase "changed greatly" is ambiguous. The modifications to the proposal studied in the DEIS are described in detail elsewhere in the SDEIS. PolyMet accordingly recommends revising the first sentence in Section 2.3.2.2 to read: "As a result of input from the public, Cooperating Agencies, and the Colead Agencies via the workgroups, and additional modeling and impact analyses, PolyMet's mining proposal has been modified since the release of the DEIS."	Section 2.3.2.2 has been revised based on this comment and other project modifications since publication of the SDEIS.
PolyMet	The second bullet point in Section 2.4.2, "Adequacy Determination/Records of Decision," states that the USACE will issue a ROD "[f]ollowing a 30-day comment period." Under NEPA, the 30-day period following issuance of a Final EIS is not a "comment period." Rather, under 40 C.F.R. § 1506.10(b), agencies are simply prohibited from making a decision on the proposed action until 90 days after publication of a notice of availability for a draft EIS, or 30 days after publication of a notice of availability for a final EIS. The Council on Environmental Quality regulations do not require agencies to solicit comments on the FEIS during this 30-day waiting period.	Section 2.4.2 of the FEIS, which addresses the Adequacy Determination and Record of Decision process, has been revised since the SDEIS.
PolyMet	The first bullet on this page does not specify which permits would be transferred to PolyMet. The Minnesota Pollution Control Agency has stated that the NPDES permit for the Tailings Basin would not be transferred. Instead, a new permit would be issued.	Section 2.6 of the FEIS, which identifies the key permits that would be required for the NorthMet Mining Project and any further changes would be beyond the scope of this EIS.
PolyMet	The fourth bullet on this page refers to a "bentonite layer on top of the Tailings Basin to restrict oxygen and water infiltration with pond." PolyMet recommends clarifying that there is a bentonite layer on the outer dam slopes during construction and that, during closure, a bentonite layer will be added to the top of the Tailings Basin. As currently written, the reader may incorrectly assume that a bentonite layer will be added at construction, below the new tailings.	Change has been made, as requested.
PolyMet	Reclamation of the Category 1 Stockpile is scheduled to begin in Year 14. As currently written, reclamation of the Category 1 Stockpile is included only in Years 16-20. It should also be included in Years 11-16.	Change has been made, as requested.
PolyMet	The movement of waste rock from the Category 2/3 stockpile to the pit will be completed by the end of operations (Year 20). As currently written, the SDEIS incorrectly indicates that this activity will occur after year 20.	Change has been made, as requested.

Sender	Comment	Response
PolyMet	The transmission lines are not shown correctly on these figures [Figures 3.2-5 through 3.2-9]. The figures should show a connection between the transmission line south of the Central Pit and the line south of the Category 1 stockpile.	Change has been made, as requested, based on updated GIS mapping provided by PolyMet.
PolyMet	The second paragraph on this page states that unsaturated overburden use would require MDNR approval. This is not accurate. Unsaturated overburden should not require approval from the MDNR.	Change has been made, as requested.
PolyMet	The fourth sentence of the third paragraph on this page should state: "Applications for saturated overburden would include those where water contacting the construction material would be collected or drained to the mine pits, where it would be placed back below the water table or above a membrane liner system." There should be an 'or' in this sentence.	Change has been made, as requested.
PolyMet	For clarity, PolyMet suggests editing the second paragraph and the beginning of the third paragraph in this section as follows: "Figure 3.2-11 shows the containment system that would consist of a cutoff wall (a low permeability hydraulic barrier extending down to bedrock) combined with a drainage collection system surrounding the perimeter of the stockpile near its toe. The cutoff wall would have a hydraulic conductivity specification of no more than 1x10-5 centimeters per second (cm/sec)."	Change has been made, as requested.
PolyMet	The last sentence in the paragraph under the heading "Reclamation Planning" correctly states that PolyMet will submit an annual Contingency Reclamation Plan pursuant to *Minnesota Rules* 6132.1300. In the interest of completeness, the paragraph should also note that the rules require PolyMet to provide financial assurance sufficient to carry out that reclamation plan.	Change has been made, as requested.
PolyMet	The second paragraph inaccurately refers to disposal of material (remaining ore and sediment from ditches and process water ponds) in the West Pit. This material would be disposed in the East Pit, as described in Section 2.1.2 of the Reclamation Plan (v3) (Rail Transfer Hopper).	Change has been made, as requested.
PolyMet	The fifth sentence of the second paragraph on this page refers to the overburden sloping as "height-to-vertical ratio of 2.5:1." Height and vertical mean the same thing (i.e., both refer to the vertical plane). PolyMet suggests changing this to read either "horizontal-to-vertical" or "length-to-height".	FEIS text has been revised to "horizontal-to-vertical ratio of 2.5:1".
PolyMet	On page 3-64, the SDEIS states: "The WWTF would be upgraded to include RO treatment to achieve an effluent with a sulfate concentration of less than 10 mg/L."	No change made.

Sender	Comment	Response
	Similarly, the SDEIS states on page 3-123: "The WWTP would be constructed south of the Tailings Basin near the coarse-crusher and would include a RO unit designed to achieve a sulfate concentration of 10 mg/L in effluent. The design of the WWTP could be adjusted to accommodate varying influent streams and discharge requirements." It is not clear when reading the two statements copied above that the water treatment goal for the effluent sulfate concentration of 10 mg/L is based on meeting the current 10 mg/L sulfate standard for waters used for the production of wild rice (Minnesota Rule 7050.0224, Class 4A water quality standard). To clarify, and because that standard is subject to adjustment, the statement "to achieve an effluent sulfate concentration that meets the sulfate standard for waters used for the production of wild rice" should be used instead of "to achieve an effluent with a sulfate concentration of less than 10 mg/L."	
PolyMet	The last sentence inaccurately states state the Category 4 Stockpile would be completely removed by year 12 to allow mining in the Central Pit. The Central Pit mining begins in Year 11, as stated earlier in the SDEIS (such as Table 3.2-4). Therefore, the Category 4 Stockpile would be completely removed by year 11.	Change has been made, as requested.
PolyMet	The second paragraph describes reclamation of the Ore Surge Pile as "…any remaining material would be relocated to the West Pit after operations cease." However, no material will be disposed of in the West Pit. As described in Section 7.2.2 of the Rock and Overburden Management Plan (v5), any material remaining in the Ore Surge Pile at the end of operations will be transported to the Process Plant for processing or disposed of in the East Pit.	Change has been made, as requested.
PolyMet	The fifth paragraph on this page, which lists all ponds that would be either filled or converted to wetlands, should include the Rail Transfer Hopper Pond.	Change has been made, as requested.
PolyMet	The fourth paragraph under the heading "Water Management" states that "[b]ased on the current GoldSim P90 model predictions, treatment activities could be required for a minimum of 200 years at the Mine Site . . . ." This statement is inaccurate and inconsistent with the discussion of the GoldSim water quality modeling elsewhere in the SDEIS.	Change has been made, as requested.
PolyMet	Section 1.3.2.2 should identify the fact that PolyMet does not agree with the USFS legal position. This could be done by cross-reference to the appropriate sections in the 2009 DEIS that discuss this issue in greater detail than the SDEIS. For example, a simple cross-cite to Section 1.3.2.2 of the 2009 DEIS	The FEIS has been revised to address this comment.

Sender	Comment	Response
	would ensure that the reader is aware that additional information on this topic is contained in the 2009 DEIS. PolyMet notes that the SDEIS repeats the USFS position (i.e., that mining cannot occur within the Federal Lands) in many places; as a result, it would be appropriate to note that PolyMet does not agree in most of the places where this issue is described.	
PolyMet	The SDEIS states: "Throughout operations, the average annual makeup water drawn from Colby Lake would vary between 20 and 810 gallons per minute (gpm), with an average annual demand of 275 gpm." These numbers are inaccurate. The sentence should be revised to show a variation between 120 and 860 gallons per minute (gpm), with an average annual demand of 320 gpm. This section should also acknowledge that additional Colby Lake water would be needed for stream augmentation.	Change has been made, as requested.
PolyMet	In the second full paragraph on this page, PolyMet recommends providing additional details on the probable maximum precipitation (PMP) to make it clear that the likelihood of the emergency overflow channel being used is extremely low. PolyMet suggests editing the text to read: "Pond elevation would be controlled by pumping any excess FTB pond water to the WWTP. An emergency overflow channel would be constructed as a backup means of controlling pond elevation, but discharge from the emergency overflow is not expected. The emergency overflow is provided for protection of the dams in the rare event that freeboard within the FTB is not sufficient to contain all stormwater. Such instances have the potential to occur in the event of a probable maximum precipitation (PMP) rainfall event or some fraction thereof. PMP rainfall events are rare and such an event has a low likelihood of being experienced during the life of the basin. The PMP does not have an assigned return period, but it is usually assumed by hydrologists to be on the order of 100 million to 10 billion years. Based on extrapolation of 72-hour rainfall depth data from US Weather Bureau-Office of Hydrology Technical Paper TP 49, and the assumed return period of the PMP of 100 million years, a 1/3 PMP event could occur roughly once in 1,000 years and a 2/3 PMP could occur once in 500,000 years. On this basis, even though there is a low likelihood of overflow, it is standard practice in dam design to accommodate even low probability overflows in a manner that protects the integrity of the dams. Given the low likelihood that there would ever be flow in the emergency overflow channel, it is not considered in the impact analysis."	Change has been made, as requested.
PolyMet	The third paragraph in Section 3.2.2.3.12, "Reclamation and Long-term	Change has been made, as requested.

Sender	Comment	Response
	Closure Management," contains a list of "reclamation objectives" and "post-reclamation activities." These terms are not used consistently with the applicable Minnesota Rules. Under the non-ferrous rules, there are two distinct periods during reclamation: closure and post-closure. "Closure" is a "process" that begins when mining ceases, and ends when the reclamation standards identified in the reclamation plan have been achieved. Thus, while it may be reasonable to describe "reclamation objectives" for the NorthMet Project Proposed Action, it would be more accurate to indicate that these objectives will be achieved during the closure process. "Post-closure maintenance" activities are defined in the applicable rules as activities necessary to "sustain reclamation." Postclosure maintenance activities begin when the closure process is complete, and end when active reclamation (e.g., water treatment plants) is no longer necessary to sustain reclamation standards. Thus, the activities described in this paragraph as "postreclamation" are more accurately described as "post-closure maintenance activities." The same comment applies to text on page 3-137.	
PolyMet	The first sentence of the third paragraph in Section 3.2.2.4, "Financial Assurance," states that the engineering design and planning needed to calculate financial assurance "is typically made available during the permitting process and was not available at the time that this SDEIS was prepared." While this statement is generally accurate, it leaves a misleading impression that something is missing from the SDEIS. The paragraph should specify that NEPA and MEPA regulations do not require a discussion of financial assurance, and that PolyMet has voluntarily provided as much information as possible at the present time.	Section 3.2.2.4 has been revised to address this comment.
PolyMet	The first sentence in the second full, non-bulleted paragraph on this page indicates that a final Reclamation Plan and Contingency Reclamation Cost Estimate will be based on studies "finalized through permitting (pursuant to the EIS process)." This reference to permitting pursuant to the EIS process is confusing and should be clarified. PolyMet is not certain what the SDEIS is trying to convey about the relationship between the permitting and EIS processes, but it should be noted that those are separate processes and that information gathered during the EIS process will be used when agencies make permitting decisions.	Change has been made, as requested.
PolyMet	Table 3.2-16 on page 3-147 provides a comparison of DEIS and SDEIS proposed actions. The table cell corresponding to the first row/first column of	Change has been made, as requested.

Sender	Comment	Response
	the table should state that "Category 1 and 2 waste rock would be stored in a permanent lined/soil covered stockpile (Category 1/2 Stockpile) north of the west pit (years 1-11)." This edit makes clear that the SDEIS proposed action (described in the second column of the table as including "a geomembrane cover system") will include a significantly improved cover system relative to the cover described in the DEIS. The third column of Table 3.2-16 should also acknowledge the other improved outcomes related to the addition of a geomembrane cover system to the Category 1 Stockpile. For example, the following additional bullet could be added to column three: "Substantial reduction of stockpile seepage volume that will need to be collected and treated at the WWTF and significant improvement in West Pit water quality in closure."	
PolyMet	General comment on all Cultural Resources Sections in Chapters 4, 5 and 6: The SDEIS often references consultation with the Bands and SHPO, but fails to include PolyMet in these references. When discussing consultation under Section 106 of the NHPA, PolyMet, as the project proponent, should be identified as a consulting party and should be included in the explanation of the Section 106 process. Examples of where PolyMet should be noted/included as a consulting party include: the third to last sentence on page 4-259 (Section 4.2.8.3); the last full sentence on page 4-262 (Section 4.2.9.2.1); the second to last sentence in Section 4.2.9.2.2 on page 4-263; the second to last sentence in the second to last paragraph on page 4-264; the second to last paragraph on page 4-302; the last full paragraph on page 4-303; the third paragraph on page 4-555; the second and third paragraphs on page 5-479; the first full paragraph on page 5-482; the second to last full paragraph on page 5-483; the last paragraph on page 5-673; and the first paragraph on page 6-89.	Change has been made, as requested.
PolyMet	This table lists the mercury TMDL target date for Sabin Lake, Esquagama Lake, and Colby Lake as 2015. The target date for those water bodies is 2025. (source: MPCA 2013. Minnesota's Final 2012 TMDL List (Section 303(d) Impaired Waters List. List approved by USEPA, July 25, 2013).	Change has been made, as requested. Table 4.2.2-2 has been revised to include 2025 as the TMDL target date for Sabin Lake, Esquagama Lake, and Colby Lake.
PolyMet	In the first sentence of the second paragraph, the order of Duluth Complex and Partridge River intrusion should be switched. The Partridge River intrusion is part of the Duluth Complex.	Change has been made, as requested.
PolyMet	In the second sentence of the second paragraph, the use of "Mesabi Iron Range" is misleading, as it could give the impression that the Duluth	Change has been made, as requested.

Sender	Comment	Response
	Complex is in direct contact with the Biwabik Iron Formation, which is not the case. PolyMet recommends listing a geologic unit (Virginia Formation) here, rather than the more vague term "Mesabi Iron Range." In addition to the cross-section shown on Figure 3.2-10, it would be helpful to include a plan view bedrock geology map to illustrate the geometric relationships between the various bedrock units.	
PolyMet	The second sentence of the second full paragraph states: "Based on limited MDNR well records within the NorthMet Project area, natural groundwater levels in the glacial till vary seasonally between 3 and 10 ft bgs." This sentence incorrectly states that the data is limited. Site-specific data on seasonal water level fluctuations is found in the Water Modeling Data Package Volume 1 – Mine Site (referenced in the SDEIS as PolyMet 2013i). PolyMet 2013i provides information on water level fluctuations observed in 24 wells completed in the glacial till at the Mine Site, some with over nine years of water level measurements. Water level fluctuation varies between wells, but the overall range observed in a single well is typically less than 4 ft.	Change has been made, as requested.
PolyMet	The range of dates cited in the bullets listed under "Baseline Groundwater Quality" is inconsistent with the groundwater data used for water quality modeling. For example, 2012 data from MW-05-02, MW-05-08, and MW-05-09 were used for the modeling. PolyMet recommends removing the dates from these bullets or revising the list so that range of dates is consistent with data used to develop Table 4.2.2-6. The range of dates for groundwater data used for the water quality modeling is as follows: • Three older wells in the surficial aquifer, sampled from March 2005 through June 2012. • 21 newer wells in the surficial aquifer, installed in November 2011 – February 2012, sampled following installation through June 2012. • Five observation wells in the upper 100 ft of the bedrock, sampled from 2006 to 2010 (current SDEIS text is correct for this bullet). • Four large-diameter bedrock wells, sampled during aquifer testing in 2005 and 2006.	Change has been made, as requested.
PolyMet	It is not clear how the baseline values that are shown in Table 4.2.2-6, and used for comparison with the site-specific data, were selected. The Northeast MN baseline data appear to be derived only from the "unconfined buried Quaternary aquifer" category. However, the MPCA study also includes data	Values in FEIS Table 4.2.2-6 were taken only from one of the three tables provided in the 1999 MPCA study. For the FEIS, minimum and maximum data was extracted from all three tables and provided. Conclusions have not changed;

Sender	Comment	Response
	for "buried Quaternary artesian aquifers" and "Quaternary water table aquifers." Either the range shown in Table 4.2.2-6 should reflect data from all Quaternary aquifers in the MPCA report or the Final EIS should provide an explanation as to why only a certain subset of data presented is provided.	however, the range of concentrations has increased.
PolyMet	The first paragraph describes USGS gage 04015475 as the flow record most representative of the Project area. However, this section also should acknowledge the presence of the recently-installed (for Teck American) flow gage at the Dunka Road crossing near the southeast corner of the proposed Mine Site (monitoring location PM-3/SW003) and note that, while closer to the Mine Site, the short period of record is insufficient for use in the SDEIS. This gage also should be shown on Figure 4.2.2-1.	Change has been made, as requested.
PolyMet	In the first paragraph, the text describing existing upper Partridge River water quality should mention mercury and aluminum concentrations exceeding water quality standards. The text also describes dissolved oxygen at SW002 as the only consistent exceedences. PolyMet reads the term "consistent" as meaning that all samples at that location exceeded the standard, but that should be made more clear the text. The term "consistent exceedences" also appears in section 4.2.6.1.2 (page 4-220), and it should be used in the same way in that section.	No change made.
PolyMet	There are multiple inaccuracies in Table 4.2.2-14 that should be addressed: 1. The average concentrations presented in Table 2.2.2-14 should include 2012 data. The 2012 data is included in Large Table 10 of the Water Modeling Data Package, Volume 1 – Mine Site v12. 2. The number of samples at SW004a and SW004b in footnote 5 is incorrect and should also include 2012 samples. The 2012 data omitted from the number of samples is included in Large Table 10 of the Water Modeling Data Package, Volume 1 – Mine Site v12. The number of samples at SW004a and SW004b should be 12 samples for each location. 3. The ranges of concentrations presented in Table 4.2.2-14 do not include the 2012 data and, therefore, may be inaccurate if maxima or minima occurred in 2012. 4. The range provided for mercury concentrations (<0.0025 ng/L to 0 ng/L) is not accurate; mercury concentrations provided in the Water Modeling Data Package – Volume 1 Mine Site v10 range from <0.5 ng/L to 18.5 ng/L.	Change has been made, as requested.
PolyMet	Section 4.2.2.2.2, p. 4-77, Table 4.2.2-14, Section 4.2.2.2.2, p. 4-80, Table 4.2.2-15, Section 4.2.2.2.2, p. 4-87, Table 4.2.2-18, Section 4.2.2.3.2, p. 4-	The referenced tables have been revised to address this

Sender	Comment	Response
	123, Table 4.2.2-29, Section 4.2.2.3.2, p. 4-132, Table 4.2.2-35: The minimum values in constituent concentration ranges shown in these tables are presented as less than half the minimum detection limit. Minimum concentrations (when not detected) should be presented consistently as either less than the minimum detection limit (e.g., "< 10 mg/L") or as a numeric value equal to half the minimum detection limit without a less than symbol (e.g., " 5 mg/L"). If the latter approach is used, the footnotes should note that minimum values represent one half the detection limits.	comment.
PolyMet	The third sentence of the fourth paragraph presents a recharge rate of 0.3 in/yr, which is inconsistent with the mean value of 0.61 in/yr used in the GoldSim model. As discussed in Sections 5.2.1.3.1 and 5.2.1.3.2 of this document, average net recharge in the Embarrass River watershed is estimated at 0.61 inches per year. A recharge rate of 0.3 in/yr represents the minimum value used in the GoldSim recharge distribution (PolyMet, 2013j; Section 5.2.1.3.2); however, it would be more appropriate to use the average value, rather than the minimum value, for the groundwater flow discussion in the SDEIS.	FEIS Table 5.2.2-11 reports the GoldSim P50 (median) aquifer recharge flux input of 0.76 in/yr for all Tailings Basin flowpaths.
PolyMet	Data for the Cell 1E pond should be included in this table. Cell 1E pond data are shown in Large Table 7 of the NorthMet Project Water Modeling Data Package, Volume 2 - Plant Site, Version 9, March 1, 2013.	No change made.
PolyMet	Regarding the first sentence, PM-13 is not "just downstream of the Heikkila Lake tributary." It is more accurate to say PM-13 is downstream of the Unnamed Creek tributary.	The FEIS has been revised to address this comment.
PolyMet	In the second sentence, it is unclear what "low flows" refers to. Based on the low flows presented in Table 4.2.2-27, PolyMet assumes the co-leads are referring to "baseflow." This should be clarified.	Change has been made, as requested.
PolyMet	In the third paragraph, the text describing the number of samples collected at PM-12.2, PM-12.3, and PM-12.4 should include data from 2012 (2012 data appears to be included in subsequent Table 4.2.2-29). The 2012 data is included in Large Table 4 of the Water Modeling Data Package, Volume 2 – Plant Site v9.	The FEIS has been revised to address this comment.
PolyMet	The row for PM-12 should reflect that data was collected in 2012 at this location.	Change has been made, as requested.
PolyMet	Data for PM-11 should not be presented in Table 4.2.2-34, which is titled "Summary of Surface Water Quality Monitoring Data for the Tailings Basin Surface Seeps." Monitoring location PM-11 is located downstream of the	Change has been made, as requested.

Sender	Comment	Response
	Tailings Basin on Unnamed Creek and is not representative of a seep. Data for PM-11 should be included in Table 4.2.2-35 (which includes tributary streams) instead.	
PolyMet	In the second to last sentence of the first full paragraph, it should be clarified that seepage and dead spruce trees are not a cause-and-effect relationship. There are many beaver dams in the area that likely play a role in the presence of dead spruce trees.	The FEIS has been updated to address this comment.
PolyMet	The last sentence under "National Hierarchical Framework of Ecological Units" reads: "Inclusion of the One Hundred Mile Swamp would likely complete representation of prominent ELTs in LTA 212Le11." Polymet suggests clarifying by revising this sentence is to say: "The One Hundred Mile Swamp and the two other sites surveyed provide a complete representation of the prominent ELTs present within LTA 212Le11."	Change has been made, as requested.
PolyMet	The third sentence of the third paragraph suggests that PolyMet will submit a revised wetland permit application. In fact, PolyMet has already submitted a revised wetland permit application, which appears as "PolyMet 2013q. NorthMet Project Revised Wetland Permit Application, Version 1. Issued August 19, 2013" in the references.	The FEIS has been updated to address this comment.
PolyMet	The first sentence of this section references three figures for the location of the Mine Site, in relation to Iron Lake and the Laurentian Divide. However, none of the figures show Iron Lake or the Laurentian Divide. The text should be revised to account for this or the figures should be edited to include Iron Lake. This issue occurs in other sections as well, such as the first sentence of Section 4.3.3.1.	The FEIS text has been edited. The Laurentian Divide boundary was added to Figure 4.2.2-1, and Section 4.2.3 refers to this figure. The reference to Iron Lake was removed.
PolyMet	The third sentence of the first paragraph should cite the USACE memo (USACE, May 2013) in addition to the baseline wetland type evaluation.	No change to EIS; USACE memo does not cite this information.
PolyMet	The first sentence of the third paragraph reads as though vegetation types are indicative of pre-settlement conditions. However, this is misleading, as there has been a significant amount of logging disturbance throughout the mine site.	The FEIS has been updated to address this comment.
PolyMet	General comment in Sections 4.2.4, 4.3.4, 5.2.4 and 5.3.4 Scientific and common names are used inconsistently throughout these sections. PolyMet recommends using consistent terms throughout the document for clarity.	Change has been made, as requested.
PolyMet	The text on page 4-192 names three ETSC species in Transportation and Utility Corridor, but Table 4.2.4-7 only lists one of these species. This	No changes made. The text preceding this Table 4.2.4-7 explains that the other species overlap the Mine Site, and

Sender	Comment	Response
	inconsistency should be resolved.	thus are not double-counted in the Transportation and Utility Corridor.
PolyMet	General Comment to Sections 4.2.5, 4.3.5, 5.2.5, 5.3.5[:] PolyMet recommends either substituting the word "bat" for the term "Myotis" or adding "(bat)" after "Myotis."	Change has been made, as requested.
PolyMet	In the fifth paragraph, the statement that lynx critical habitat "includes most of northeastern Minnesota" is imprecise. PolyMet recommends adding the clarification that the USFWS designated critical habitat does not include most of the Iron Range.	No change made.
PolyMet	The last sentence of the third paragraph references "forest and brush habitats" but parenthetically cites MIHs 1 to 14. PolyMet believes the citation was intended to be MIHs 1 and 14.	No change made.
PolyMet	Regarding the last sentence of the third paragraph [(under Bald eagle heading)], there are no standing dead trees in the existing LTVSMC Tailings Basin.	Text has been clarified to state, "Eagles may use standing dead trees near the existing LTVSMC Tailings Basin for perching."
PolyMet	The second paragraph should reference Moose zone 3, not Moose zone 30.	No change made. The moose zone is 30 according to MN DNR information and maps.
PolyMet	The fourth sentence of the second paragraph incorrectly states that the Tailings Basin is "unlikely to be heavily used by wildlife." The Tailings Basin is a local refuge for herds of deer, small mammals and wolves.	No change made.
PolyMet	The first sentence in the first paragraph references the Longnose, Wetlegs and Wyman creeks as surface water features in the Upper Partridge River Watershed. However, there is no discussion on these creeks or a reference to a previous discussion in the SDEIS. PolyMet recommends either providing a similar discussion of that provided for Mud Lake, Yelp Creek, and Second Creek on page 4-214 or explaining why such analysis is not provided.	Change has been made, as requested.
PolyMet	The second sentence uses the term "watershed" while the third sentence uses the term "larger watershed." PolyMet suggests explaining the difference between a "watershed" and a "larger watershed."	No change made.
PolyMet	The first sentence of the third paragraph should be revised to add Yelp Creek to the list of streams where "no fish or macroinvertebrate community or habitat characteristics could be documented . . . ."	No change made. Fish and macroinvertebrate sampling occurred at the confluence of Yelp and Partridge River.
PolyMet	The source of data for these stream surveys should be revised as "Source: Breneman 2005, Barr 2011b, and MPCA 2011c." Barr 2011b is the source of the information for the PM sites.	Change has been made, as requested.

Sender	Comment	Response
PolyMet	PolyMet recommends that the introductory paragraph state that the NHPA process is proceeding on a parallel path to the NEPA process, and that effects on cultural resources have also been considered and analyzed under NEPA.	No change made.
PolyMet	The last sentence of the introductory paragraph states: "Cooperating agencies have not participated in production or endorsement of any components of the EIS or the NorthMet Project." This statement is not entirely accurate, since the tribes have participated in the production of components of the EIS relative to cultural resources as well as the Major Differences of Opinion. The EIS should describe the tribes' participation in the development of the EIS.	Change has been made, as requested.
PolyMet	The second-to-last paragraph is unclear, both with respect to whether it is discussing groundwater and/or surface water, and with respect to how that discussion fits into the APE analysis. Figure 4.2.9-5, which is not referenced in this paragraph, is a groundwater quality APE, but most of the paragraph discusses surface water quality. PolyMet recommends revising this paragraph to explain how groundwater and surface water affect the APE.	Change has been made, as requested.
PolyMet	The term "Sensitive Fines" is used on the Figure, yet neither Geotechnical Data Package, Vol. 1, Version 4, nor preceding versions use the name "Sensitive Fines." April 12, 2013 Geotechnical Data Package, Vol. 1, Version 4 uses the name "Fine Tailings/Slimes." This material type is missing from the Legend on the lower left corner of Figure 4.2.14-3.	Information in the figure was sourced from the Geotechnical Data Package Volume 1. Sensitive fines have been removed from the FEIS figures.
PolyMet	Units and labels are missing from axes [of Figure 4.2.14-3] (e.g., elevation in feet amsl and distance in feet) and the dashed lines in the figures are not in the legend (layers of material).	Dashed lines removed, distance and elevation on axis.
PolyMet	In the first full sentence [of Section 4.3.3.1.1, p. 4-434], floodplains should be clearly defined, and PolyMet recommends including a figure showing mapped floodplains with wetlands.	A definition of floodplain is included in the FEIS and the floodplains are shown on Figures 4.3.3-2 and 4.3.3-5.
PolyMet	The table combines coniferous bogs and coniferous swamps. PolyMet recommends separating these two wetland types here, in the same way that they are separated for discussions of the federal lands. This is also an issue in Tables 4.3.3-6, 4.3.3-8, 4.3.3-10, 4.3.3-12.	Please refer to theme WET17 response.
PolyMet	The table contains inaccurate acreage for open bog and shallow marsh. Open bog should be 2.1 acres, and shallow marsh should be 84.1 acres. In addition, the third sentence under Table 4.3.3-6 should also be edited from: "Large bogs dominate much of the east-central portion of Tract 1" to the suggested "Shrub swamps dominate much of the east-central portion of Tract 1." The current sentence is inaccurate because there are only 2 small bogs (2.1 acres	Tables in the FEIS have been corrected. FEIS language was reviewed and no change to this sentence.

Sender	Comment	Response
	total) on the Hay Lake parcel.	
PolyMet	In footnote 2 [of Table 4.3.4-5], PolyMet suggests deleting the phrase "additional populations may be present in more marginal, secondary habitat that was not surveyed, or in wetter areas." There is no evidence (no survey) of additional populations in marginal, secondary habitat, and the SDEIS should make that clear.	Change has been made, as requested.
PolyMet	This section [(4.3.5.2.1)] discusses "species of tribal concern." This is not a legal category. PolyMet recommends deleting this phrase.	No change made.
PolyMet	The first sentence in the second paragraph should be revised to read "Some of the non-federal lands…." Not all of the non-federal lands have streams, creeks, rivers, or lakes on them.	Change has been made, as requested.
PolyMet	This paragraph incorrectly compares Coyote Creek with Stony River. These are not comparable systems. The Stony River is a higher order, more diverse aquatic system than the first order, headwaters Coyote Creek. It cannot be assumed that the conclusions drawn from the studies for Stony River are applicable to Coyote Creek.	No change made. The text is not comparing the two systems but only states that since high quality habitat is likely present in Coyote Creek some of the fish species present within the Stony River could be present in the headwater habitats of Coyote Creek.
PolyMet	The second paragraph is one sentence and cites "MIH 14." PolyMet recommends that this paragraph first provide some description of the MIH 14 before making the statement it currently contains.	Change has been made, as requested.
PolyMet	The first sentence of the second full paragraph states that the "groundwater containment system would capture at least 90 percent of seepage from the Tailings Basin." This is incorrect. The system will capture 100% of surface seepage and upwelled water, and at least 90% of seepage that remains as groundwater flow. Overall, 99% of seepage from both surface and groundwater will be captured. The sentence, as written, implies that the system will be less effective than it will be.	Change has been made, as requested.
PolyMet	The 4th paragraph states: "With the proposed design modifications and engineering controls, the water quality model predicts that the NorthMet Project Proposed Action would not cause or increase the magnitude of an exceedance of the groundwater and surface water quality evaluation criteria at the P90 level for any of 28 solutes at 29 groundwater or surface water evaluation locations within the Partridge River and Embarrass River watersheds…" PolyMet proposes the following language: "With the proposed design modifications and engineering controls, the water quality model predicts that the NorthMet Project Proposed Action would not cause or increase the	The FEIS has been revised to address this comment.

Sender	Comment	Response
	magnitude of an exceedance of the groundwater and surface water quality evaluation criteria at the P90 level for any of the 27 solutes and mercury (further addressed below) at 29 groundwater or surface water evaluation locations within the Partridge River and Embarrass River watersheds…"	
PolyMet	The 3rd paragraph states: "Within the water quality modeling, estimated concentrations for these six metals are compared to hardness-based standards at each model evaluation location and each model time step to determine compliance with the evaluation criteria." PolyMet proposes the following language: "Within the water quality modeling, modeled concentrations for these six metals are compared to hardness-based standards at each model evaluation location and each model time step to determine compliance with the evaluation criteria."	Change has been made, as requested.
PolyMet	The 4th paragraph states "Methylmercury is much more of a problem than inorganic mercury, in that it can accumulate to concentrations of concern in the aquatic food chain, it is more bioavailable than inorganic mercury, and it can bioaccumulate in fish, wildlife, and humans." The term "problem" suggests a conclusion, when this sentence is actually describing concerns. PolyMet proposes the following language: "Methylmercury is more of a concern than inorganic mercury, in that it can accumulate to concentrations of concern in the aquatic food chain, it is more bioavailable than inorganic mercury, and it can bioaccumulate in fish, wildlife, and humans."	Change has been made, as requested. The word "problem" has been replaced with the word "concern".
PolyMet	The first sentence at the top of the page reads: "Research suggests that total mercury concentrations in streams and methylmercury content in fish are roughly proportional within individual watersheds (USGS 2010), such that, for example, a 5 percent increase in total mercury in water would be expected to result in about a 5 percent increase in mercury content in fish within that watershed." This sentence should be changed to clearly state that the potential incremental change in fish mercury concentration is an evaluation criterion and that MPCA's Mercury Risk Estimation Method (MMREM) was used to assess the potential changes in fish mercury concentrations in nearby lakes. The MMREM is a method that relies on empirical fish contamination data, combined with the principle of proportionality between mercury in fish and atmospheric deposition (MPCA 2006, MMREM guidance document).	Change has been made, as requested. Additional text has been included.
PolyMet	Modeling results for location UC-1 are not presented in the SDEIS. Therefore, this location should not be shown in Figure 5.2.2-6 as a model evaluation location.	Change has been made, as requested.

Sender	Comment	Response
PolyMet	The 3rd and 4th sentences of the first paragraph should be clarified to reflect that the Plant Site MODFLOW model was not calibrated to baseflow in the Embarrass River, nor was the model used to estimate baseflow.	Change has been made, as requested.
PolyMet	Regarding the last sentence on the page, the regional MODFLOW model calibration was not updated to the revised baseflow estimates from XP-SWMM. The Mine Site Water Modeling Data Package Attachment C provides: "The regional model calibration was not updated because the original calibration did not incorporate a baseflow estimate and previous sensitivity analysis indicated that the local-scale model results were not sensitive to the lateral boundary conditions that were defined by the regional model (Barr, 2007). Therefore, the perimeter boundary conditions for the local-scale model remained unchanged."	Change has been made, as requested.
PolyMet	The footnote on the "Specific yield" column of the table [(5.2.2-9)] only applies to the surficial deposits, not the entire column in the data table.	Change has been made, as requested.
PolyMet	The 1st paragraph states: "GoldSim was programmed with a suite of complex algorithms to estimate the release of contaminants from mine facilities (i.e., "sources") and their transport to groundwater and surface water evaluation locations." PolyMet suggests the following language: "GoldSim was programmed with a suite of algorithms to estimate the release of contaminants from mine facilities (i.e., "sources") and their transport to groundwater and surface water evaluation locations."	Change has been made, as requested.
PolyMet	The 1st paragraph states: "The onset of acidic pore water is also problematic, as these conditions cause the rate of sulfide oxidation to increase and the concentration of metals to increase as precipitates dissolve." PolyMet suggests the following revision: "The onset of acidic pore water is also of concern, as these conditions cause the rate of sulfide oxidation to increase and the concentration of metals to increase as precipitates dissolve."	Change has been made, as requested.
PolyMet	The bulleted list near the middle of the page provides slightly incorrect sulfide sulfur ranges for the waste rock classification criteria, as well as an incorrect reference for this information. The sulfide sulfur classification criteria for the categories of waste rock should be revised as follows: • Category 1 – sulfur content less than or equal to 0.12%. • Category 2 – sulfur content greater than 0.12% and less than or equal to 0.31%. • Category 3 – sulfur content greater than 0.31% and less than or equal to 0.60%.	Change has been made, as requested.

Sender	Comment	Response
	• Category 4 – sulfur content greater than 0.60%. Categories 2 and 3 are combined to produce Category 2/3 with sulfur content greater than 0.12% and less than or equal to 0.60%. This information can be found in Section 4.4.1 of the Waste Characterization Data Package v10 (PolyMet 2013)	
PolyMet	The first sentence of the last paragraph on page 5-53 states that "the GoldSim model simulates constituent release from waste rock based on assumptions that either extrapolate from conditions observed under field-scale weathering of similar rock (Category 1 waste rock) or in laboratory tests (Category 2, 3, and 4 waste rock, and ore)." This should be revised to indicate that constituent release for all categories of rock is based on data from laboratory tests. Constituent release rates for all categories of rock are estimated by applying a scaling factor to lab rates to account for likely differences between field and lab conditions. The scaling approach differs between Category 1 and the other categories of rock, but release rates for all categories of rock are based on laboratory data.	Change has been made, as requested.
PolyMet	The second paragraph states: "The 80 percent rate is used because seepage from the south side of Tailings Basin is likely higher than the flow contribution to Second Creek that would occur from the Basin footprint for natural ground conditions (i.e., if the Tailings Basin were not present)". This statement is not correct. The 80% is to limit the project impact on flow to +/- 20% of existing conditions, as is recommended by MDNR on Page 5-14.	Change has been made, as requested.
PolyMet	PolyMet suggests revising the third full paragraph as follows: "WWTP effluent that would be used remaining after flow augmentation to Second Creek would be discharged to the three Embarrass River tributaries (Unnamed, Trimble, and Mud Lake creeks), as partial or complete fulfillment of required augmentation to maintain downstream hydrology and wetland function in Second Creek and the three Embarrass River tributaries (Barr 2013a). Pumping from Colby Lake would be used to meet any remaining augmentation requirement."	No change made.
PolyMet	The second paragraph states: "Tailings seepage bypassing the containment system (approximately 19.4 gpm) would continue.…" On page 5-8 (Section 5.2.2) and in Table 5.2.2-36, the flow bypassing the containment system is said to be "about 21 gpm." PolyMet recommends revising for consistency.	Change has been made, as requested.
PolyMet	The active source period for the Category 4 Stockpile is incorrect. The stockpile will be removed during the development of the Central Pit and will	Change has been made, as requested.

Sender	Comment	Response
	be entirely removed by the end of Mine Year 11.	
PolyMet	The last full paragraph should acknowledge that the pH in the East Pit backfill will be monitored and adjusted by the addition of alkaline water from the WWTF as backfilling progresses in order to maintain circum-neutral conditions in the backfill pore water.	Change has been made, as requested.
PolyMet	The SDEIS states: "The quality of this aquifer inflow would reflect the quality of the pit lake water, which would gradually improve over time due to cycling through the WWTF." However, the West Pit water will not be cycled through the WWTF during reclamation. PolyMet suggest revising the text to: "The quality of this aquifer inflow would reflect the quality of the pit lake water, which would gradually improve over time due to the effectiveness of the reclamation activities at the site."	Change has been made, as requested.
PolyMet	The SDEIS states: "Cobalt was generally used to illustrate groundwater transport at the Mine Site because it is not attenuated and would enter the surficial flowpaths at concentrations higher than baseline groundwater." This statement is misleading. PolyMet suggests rewording to the following: "Cobalt was generally used to illustrate groundwater transport at the Mine Site because the model did not account for attenuation, and would enter the surficial flowpaths at concentrations higher than baseline groundwater."	Change has been made, as requested.
PolyMet	The first paragraph incorrectly states that flow augmentation must be at least 145 or 180 gpm, which is 80% of capture flow rate of the current south-side seepage. Table 5.2.2-40 shows 400 gpm, which is the correct rate for augmentation (see The Water Modeling Data Package – Volume 2 Plant Site v9). The same error is made in the last paragraph on Page 5-153 (Section 5.2.2.3.2).	No change made.
PolyMet	The first paragraph of this section only discusses quantities of seepage during closure and not operations. The paragraph below could be added to discuss these aspects during operation: "During operations, the Category 1 Stockpile would be uncovered. Infiltration would percolate to the bottom of the stockpile and be collected by the surrounding groundwater containment system. As the stockpile footprint is expanded, the total seepage during operations will increase up to a maximum annual flow of between 290 gpm and 440 gpm. Most of this seepage would be collected and sent to the WWTF for treatment; an estimated peak flow of 20 gpm to 30 gpm would pass below the containment system and be drawn by gravity into the dewatered West Pit."	Change has been made, as requested.

Sender	Comment	Response
PolyMet	This table [(5.2.2-28)] is consistent with what was provided in the AWMP, but the corresponding text on Page 5-125 leaves the inaccurate impression that the effluent targets were what was modeled as effluent concentrations. The text should be modified to match the table.	No change made.
PolyMet	The use of the term "non-contact stormwater" in this table [(5.2.2-29)] and elsewhere in the text is somewhat confusing, as it seems to imply that this is water being managed by PolyMet. PolyMet recommends using the more appropriate term "unimpacted watershed runoff."	No change made.
PolyMet	The first paragraph on this page should acknowledge that there is a low probability for exceedances caused by the project.	No change made.
PolyMet	Unnamed Creek should be included in the discharge locations for the WWTP effluent. SD006 is the location for Unnamed Creek, not Second Creek. The table organization contradicts language found in the last paragraph of page 5-177, which states "augmentation flow to Unnamed Creek would be via a single discharge near the current SD006 discharge."	Change has been made, as requested.
PolyMet	The text states: "The rate at which contaminants would move through the groundwater would be the same as the groundwater seepage velocity downgradient of the containment system for all but four constituents (arsenic, antimony, copper, and nickel)." ... Because no attenuation values are used for the constituents – other than arsenic, antimony, copper, and nickel – the modeled rate of groundwater transport will be faster than the actual rate of transport in the ground. PolyMet recommends noting this fact in the text.	Change has been made, as requested.
PolyMet	The second to last paragraph states: "…the concentrations of these metals in the WWTP effluent would be significantly higher than the concentrations in the current Tailings Basin seepage…" This sentence should be revised to use the term "modeled concentrations…" The modeled effluent concentrations from the WWTP are higher than the values reported in pilot testing of the proposed treatment systems for the WWTP, but were selected to be near, and slightly below, the potential effluent limit for the modeled constituents to provide a conservative assessment of potential consequences related to downstream water quality. PolyMet also recommends making this adjustment in Table 5.2.2-47 on page 5-188.	Change has been made, as requested.
PolyMet	The second to last paragraph states: "…the average aluminum concentration in the WWTP influent and effluent would be about 10 mg/L…" This should be 10 µg/L.	Change has been made, as requested.
PolyMet	The first paragraph following the bulleted list states: "This dilution effect is demonstrated by the increase in measured aluminum concentrations from	Change has been made, as requested.

Sender	Comment	Response
	upstream tributary locations (UC-1, TC-1, and MLC-3) to downstream locations (PM-11, PM-19, and MLC-2), where upstream locations would average less than 100 µg/L compared to downstream locations averaging about 142 µg/L." It is unclear whether this refers to observed or modeled conditions. The use of the term "measured" implies reference to actual, observed data, but stating that upstream locations "would average less than…" implies model results. It also is unclear whether the 100 µg/L and 142 µg/L figures are modeled or observed.	
PolyMet	There appears to be inconsistency in the chromium standard that is used in this chapter. The referenced pages state: "Among the six constituents with hardness-based evaluation criteria (cadmium, chromium (III), copper, lead, nickel, and zinc),…" and Table 5.2.2-4 lists chromium (III), as the evaluation criteria with a hardness based standard. However, later in the document, the standard for chromium (VI) is used in Tables 5.2.2-30 and 5.2.2-42 for example. Please clarify which standard was used for chromium, and why.	Change has been made, as requested.
PolyMet	The number of pit lakes should be 16, not 21 as reported in this table [(5.2.2-49)].	Change has been made, as requested.
PolyMet	The third paragraph states "…precipitation, which averages about 9.8 ng/L based on average volume-weighted mercury in precipitation as measured at the Marcell Experimental Forest deposition site in Itasca County (NADP 2013)." Barr's analysis, consistent with the table on the next page, is based on 13 ng/L deposition based on the Fernberg Road site. PolyMet recommends citing the Fernberg Road concentration of 13.2 ng/L instead of the Marcell concentration of 9.8 ng/L. This comment also applies to the SDEIS's cumulative impact discussion in the first paragraph of p. 6-31 and second paragraph of p. 6-33 (Section 6.2.3.3.4).	Change has been made, as requested.
PolyMet	The second bullet, when explaining the predicted increase in mercury loading to the Embarrass River, states: "Tailings Basin containment system, which would collect seepage from the Tailings Basin, with an estimated mercury concentration of 1.1 ng/L, and route it to the WWTP, which would discharge with an assumed mercury concentration of 1.3 ng/L, for a net increase of 0.2 ng/L of mercury as a result of wastewater treatment, which is a conservative assumption." PolyMet suggests explaining that the reason this is conservative is because the WWTP would reduce mercury concentrations, and any additional mercury removal from installing a greensand filter, are not accounted for.	Change has been made, as requested.
PolyMet	The second bullet under NorthMet Project Proposed Action Design Changes	Change has been made, as requested.

Sender	Comment	Response
	states: "The location of the Category 4 Stockpile was shifted such that seepage would be captured in the Central Pit and East Pit and would minimize effects on surficial groundwater." The terminology and locations used here are confusing. PolyMet suggests the following instead: "The location of the Category 4 Stockpile was shifted such that water contacting the stockpile would be captured in the East Pit and would minimize effects on surficial groundwater."	
PolyMet	The sixth bullet states: "Refined Hydrometallurgical Flowsheet – A single (rather two) autoclave would be fed with nickel concentrate and produce copper concentrate produced with beneficiation refinements. The production of hydrometallurgical residue would be cut approximately in half with this design change. Residual copper would be recovered by cementation (contacting the leach solution with copper concentrate) to further upgrade the copper concentrate and to further reduce the production of hydrometallurgical residue." To be more precise, the last phrase should be changed to: "…, and to potentially further reduce the production of hydrometallurgical residue."	Change has been made, as requested.
PolyMet	The first bullet discusses subaqueous disposal of reactive waste rock, but it does not mention subaqueous disposal of some of the Category 1 waste rock. Although Category 1 waste rock is considered the least reactive waste rock, it should still be mentioned here.	Change has been made, as requested.
PolyMet	The fourth bullet discusses the use of side dump cars to haul ore and states: "Ore Transport – PolyMet proposes to use side-dump rail ore cars that would minimize ore spillage (PolyMet 2013c)." Side dump rail cars were proposed as part of the DEIS, as documented in DEIS Section 3.1.3; therefore, this is not a design change and should not be included in this section.	Change has been made, as requested.
PolyMet	The seventh bullet discusses the tailings basin containment system and refers to it as being "on the western, northern, and northeastern sides of the existing LTVSMC Tailings Basin." The containment system is not located along the northeastern side of the tailings basin; it is located on the western and northern sides of the tailings basin, as described appropriately on SDEIS Page 3-116 (under Engineering Water Controls).	Change has been made, as requested.
PolyMet	The first bullet, as part of a tabulation of fixed engineering controls, states: "Process water management, including pipes, pumps, and process water ponds that would be used to separate and control stormwater and process waters." This statement does not account for the fact that the process water ponds are lined. Accordingly, PolyMet recommends inserting "lined" before "process water ponds."	Change has been made, as requested.

Sender	Comment	Response
PolyMet	The flow monitoring for stormwater has footnotes stating that flows would be monitored continuously. There are no pumps associated with this infrastructure, so continuous flow monitoring is not proposed for stormwater flows. Flows are proposed to be monitored on a monthly basis as specified in the Water Management Plan – Mine (v2) Section 5.2.	Change has been made, as requested.
PolyMet	table [5.2.2-53] includes water level monitoring for Whitewater Reservoir. This was not included in the Water Management Plan – Mine and has never been discussed with the agencies.	The FEIS has been revised to reflect most recent documentation.
PolyMet	The fourth bulleted item is misleading and should be clarified by changing the text in parentheses to say "within Area 1."	The FEIS has been revised to address this comment.
PolyMet	The first paragraph states "The analog approach was based on similar mine settings (e.g., within the glacial till region)." PolyMet proposes the following revision: "The analog approach used observations of groundwater response adjacent to iron range mines characterized by moderate to high hydraulic conductivity glacial and fluvial deposits overlying lower hydraulic conductivity bedrock."	The FEIS has been revised to address this comment.
PolyMet	The third sentence of the first full paragraph should be clarified by identifying the source and rationale behind using 675 square meters of watershed area per meter of track in the contributing watershed as the method for identifying potentially impacted wetlands.	The FEIS has been revised to address this comment.
PolyMet	In the second sentence of the third paragraph, it is an overstatement to suggest that wetlands represent pre-European settlement conditions, as the area was likely logged several times since settlement.	The FEIS has been revised to address this comment.
PolyMet	The second bullet should read: "In-kind mitigation means the replacement of the impacted aquatic site with the same wetland plant community type." See USACE, 2009, II.D.3.	The FEIS has been revised to address this comment.
PolyMet	The third bullet should read: "Out-of-kind mitigation means the replacement of an impacted aquatic site with a different wetland plant community type." See USACE, 2009, II.D.3.	The FEIS has been revised to address this comment.
PolyMet	In the second paragraph, the rule citation is incorrect as is the interpretation of the rule. The second paragraph should read: "The Federal Mitigation Rule also states that "difficult-to-replace" aquatic resources include bogs (33 CFR 332.3(e)(3) and Preamble, page 19633). The majority of the wetlands that would be affected by the NorthMet Project Proposed Action would be "difficult-to-replace" (coniferous bog and open bog) (USACE 2013). The Federal Mitigation Rule includes a provision for a case-by-case determination	The FEIS has been revised to address this comment.

Sender	Comment	Response
	of mitigation ratios higher than the minimum 1:1 where necessary to account for the difficulty of restoring or establishing the desired aquatic resource type and functions."	
PolyMet	The third sentence of the third paragraph is not supported by the data collected for the project. None of the wetlands proposed to be affected by the project were rated as having exceptional vegetative diversity/integrity ratings.	The FEIS has been revised to address this comment.
PolyMet	The second to last sentence in the fourth paragraph should read: "For effects on wetlands with rare or exceptional functions or difficult-to-replace bogs, the USACE may require additional compensation in accordance with District Policy and the Federal Mitigation Rule."	The FEIS has been revised to address this comment.
PolyMet	The first sentence of the second to last paragraph should read: "If none of these incentives are met, the minimum mitigation ratio required is 1.5:1."	The FEIS has been revised to address this comment.
PolyMet	The third paragraph states that base compensation ratios could be increased to 2:1. There is not rationale or reference provided for this statement, which is not specifically stated in the District Policy or Federal Mitigation Rule. The same comment applies to page 5-316 and page 5-321.	The FEIS has been revised to address this comment.
PolyMet	The 6 rows [in Table 5.2.3-17] beginning with "<50%..." and "<80%..." are not relevant to the PolyMet project and could be removed in order to maintain clarity.	The FEIS has been revised to address this comment.
PolyMet	The first paragraph after the list should read: "The financial assurance requirements would be part of the WCA permitting process for the NorthMet Project Proposed Action. Wetland replacement for the NorthMet Project Proposed Action is expected to be approved and constructed in advance of any authorized wetland effects (under the WCA approval) and, therefore, would not require financial assurance."	The FEIS has been revised to address this comment.
PolyMet	No reference is provided for the statements made in the fourth paragraph. Justification for why the wetland mitigation opportunities discussed in this paragraph were determined to not be practicable was provided in "Wetlands Mitigation Plan Supplement – Wetland Mitigation Planning and Siting Documentation," RS20T Draft-04, PolyMet, June 1, 2008. One additional difficulty with such wetland mitigation opportunities that was not discussed in the reference provided is the presence of severed mineral rights on many of those lands. In order to place restrictions on the land, as required for wetland mitigation, those mineral rights would need to be controlled.	The FEIS has been revised to address this comment.
PolyMet	In the last paragraph, the third sentence should read: "The mitigation would be considered in advance if the initial phases of restoration on all of the	The FEIS has been revised to address this comment.

Sender	Comment	Response
	proposed off-site wetland mitigation sites would be completed at least one full growing season in advance of the authorized wetland effects provided initial performance standards are met for which the mitigation would compensate." Also, in the last paragraph, 939.4 acres is stated with no reference. That number should be referenced to Tables 5.2.3-19 and 5.2.3-20 of the 404 permit application.	
PolyMet	In the fifth paragraph, the first sentence should read: "The minimum replacement ratio that would be allowed by the USACE is 1:1 (USACE, 2009) for those wetlands that would be replaced with the same wetland type, and at least one full growing season in advance of the authorized wetland effects provided initial performance standards are met; however, base compensation ratios could be increased to 2:1 (add reference) for effects on wetlands with rare or exceptional functions or difficult-to-replace bog wetlands."	The FEIS has been revised to address this comment.
PolyMet	The first sentence in the last paragraph (before the bullet), should read: "Under the Minnesota WCA, the replacement ratio that would likely be allowed is 1.5:1, because the Aitkin Site wetlands are out of the NorthMet Project area watershed (see Tables 5.2.3-18 and 5.2.3-20)."	The FEIS has been revised to address this comment.
PolyMet	The first sentence in the second paragraph should read: "The minimum replacement ratio that would be allowed by the USACE is 1:1 (USACE, 2009) for those wetlands that would be replaced with the same wetland type, and at least one full growing season in advance of the authorized wetland effects provided initial performance standards are met; however, base compensation ratios could be increased to 2:1 (add reference) for effects on wetlands with rare or exceptional functions or difficult-to-replace bog wetlands."	The FEIS has been revised to address this comment.
PolyMet	The first sentence in the third paragraph should read: "Under the Minnesota WCA, the replacement ratio that would likely be allowed is 1.5:1, because the Hinckley Site wetlands are out of the NorthMet Project area watershed (see Tables 5.2.3-18 and 5.2.3-20)."	The FEIS has been revised to address this comment.
PolyMet	The first sentence in the last paragraph should read: "The minimum replacement ratio that would be allowed by the USACE is 1:1 for those wetlands that are replaced with either the same wetland type, or at least one full growing season in advance of the authorized wetland effects provided initial performance standards are met; however base compensation ratios could be increased to 2:1 for effects on wetlands with rare or exceptional functions or difficult-to-replace bog wetlands."	The FEIS has been revised to address this comment.

Sender	Comment	Response
PolyMet	The first sentence on the page (continuing from the previous page) should read: "For low- to moderate-quality wetlands, the recommended base ratio of 1.5:1 would be reduced to 1.25:1 for in place and could be reduced to 1:1 if also either in-advance or in-kind."	The FEIS has been revised to address this comment.
PolyMet	The section on the Zim Site does not include any description of restoration methods and sequencing, which is included in the descriptions for the Aitkin and Hinckley sites. See "Zim Sod Wetland Mitigation Site Wetland Mitigation Plan" (PolyMet, November 2011) for an appropriate description.	The FEIS has been revised to address this comment.
PolyMet	A footnote should be added to the table [5.2.3-18] describing why there is 101.8 acres of on-site wetland mitigation shown in the second to last column but no associated wetland credits in the last column. Similarly, the same acreage is shown in the "On-Site (acres)" column, but no associated credits are shown in the "Total Credits" column.	The FEIS has been revised to address this comment.
PolyMet	The last paragraph states, "Approximately 72 percent of credits proposed would be located outside of the watershed." This statement is misleading because all of the proposed credits are above the minimum 1:1 replacement ratio. In fact, 48 percent of the proposed impacts are proposed to be replaced in-kind, in-place, and ahead of time. If the on-site wetland mitigation were factored in, approximately 56 percent of the wetland impacts would be replaced within the watershed.	The FEIS has been revised to address this comment.
PolyMet	The numbers in the second sentence of the second paragraph are inaccurate. In this sentence, 7,350.7 acres should be 1,771.5 acres (based on Table 5.2.3-3; excluding the "no effect" acres) and 6,498.1 acres should be 587.1 acres (based on Table 5.2.3-4; excluding the "no effect" acres).	No change was made.
PolyMet	In the third paragraph, the third sentence should read: "At The Mine Site, an additional 16 monitoring locations are proposed and are planned within all wetlands that have received effect factor ratings of 3, 4, or 5 near the North Met Project area features and in several wetland with effect factor ratings of 1 or 2 located throughout the areas of potential indirect wetland impacts." This is consistent with the information provided on page 5-336, second paragraph of the SDEIS.	The FEIS has been revised to address this comment.
PolyMet	The last sentence of the first full paragraph states: "Indirect effects were estimated by comparing the proximity of the NorthMet Project area infrastructure footprints to existing natural features." Polymet suggests revising the text to read: "Vegetation communities can be affected by more than one of these types of indirect effects. For this reason, indirect effects on vegetation cannot be	The FEIS addresses this comment by adding the following text: "Typically, indirect effects are more likely to occur and/or are more likely to be evident in vegetation communities that are closer to Project components and other infrastructure (e.g., roads). Indirect effects tend to diminish with increasing distance from Project components

Sender	Comment	Response
	precisely quantified, as this would result in double-counting of vegetation community acreage where multiple indirect effects are manifested. The relative magnitude of indirect effects on vegetation communities can, however, be estimated. Typically, indirect effects are more likely to occur and/or are more likely to be evident in vegetation communities that are closer to Project components and other infrastructure (e.g., roads). Indirect effects tend to diminish with increasing distance from Project components and other infrastructure."	and other infrastructure."
PolyMet	In the discussion of the NorthMet Project's effects on culturally important plants, the SDEIS discusses wild rice but notes that that "a distinct list of plant species important to the Bands is not available." The Bands were cooperating agencies in preparation of the SDEIS, and accordingly had every opportunity to provide a distinct plant species list. If such a list is not available, PolyMet recommends stating that the Bands have not identified culturally important plants not already identified and discussed in the SDEIS.	No change made.
PolyMet	The text describes indirect effects as a certainty, when there is no basis for determining the likelihood and/or magnitude of indirect effects. Where the text makes statements such as "[Species name] may be indirectly affected by changes in hydrology", the word "potentially" should be inserted ("may potentially be indirectly affected") to more accurately reflect the uncertainty over the likelihood and/or magnitude of indirect effects.	Change has been made, as requested.
PolyMet	The eighth sentence of the second paragraph states: "Disturbance-tolerant species may, in some cases, actually be disturbance-dependent." PolyMet recommends providing a citation for this claim or removing the sentence.	Change has been made, as requested. Sentence has been deleted.
PolyMet	In the second sentence of the eighth paragraph, it is misleading to state that "an average of 2,066 miles per day of vehicular traffic" would contribute to potential lynx impacts. The majority of those miles would be traveled within the pit/mine site and not along outside roads where lynx encounters would be far more likely.	No change made. The FEIS states that this traffic would primarily be from hauling ore within the Mine Site to rail siding and waste rock to the stockpiles. Further, the FEIS states that haul traffic would likely have little direct effect on lynx.
PolyMet	Second paragraph: The Transportation and Utility Corridor runs both parallel and perpendicular to the identified wildlife travel corridors.	Change has been made, as requested.
PolyMet	The last paragraph states: "Effects on aquatic biota from the lead exceedance due to changes in hardness are not well understood, but would likely increase the potential to adversely affect aquatic life." This statement does not acknowledge that the modeling results predict increased potential for a lead exceedance (due to the use of a probabilistic model); rather, the statement incorrectly implies that there will inevitably be a lead exceedance.	Sentence was removed when updating section with v6 modeling results.

Sender	Comment	Response
PolyMet	In the second paragraph, it should be noted that most of the floodplain on the federal land is outside of the Project Area.	No change made.
PolyMet	The right-most table column heading should be renamed "Non-FEMA regulated floodplains." A column should be added for "FEMA-regulated floodplains." This comment also pertains to Table 5.3.3-7.	FEIS language has been revised to refer to mapped and unmapped floodplains.
PolyMet	Table 5.3.3-5[:] The subtotal for open bog on non-federal lands is not accurate. The number should be 7.1 acres.	The FEIS has been revised to address this comment.
PolyMet	[In] Table 5.2.7-22… "Inhalation only acute" and "chronic non-cancer HI" should be displayed with 1 significant figure – i.e. 1 not 1.0.	The FEIS has been updated to address this comment.
PolyMet	In the last paragraph, the incremental risk at Wynne Lake for a recreational fisher should be as 0.07 in Plant Site AERA report, not 0.08.	No change made.
PolyMet	The third sentence of the first paragraph inaccurately states that H2SO4 was "screened out." The estimated risk was added to the other chemicals evaluated to obtain the total.	No change made.
PolyMet	The sixth sentence of the first paragraph inaccurately states that H2SO4 was "screened out." The estimated risk was added to the other chemicals evaluated to obtain the total.	No change made.
PolyMet	The third paragraph states: "Conceptual designs of the waste rock stockpiles, Tailings Basin, and Hydrometallurgical Residue Facility have been developed and shown by PolyMet, through an iterative design and model process, to meet the minimum safety factors and water quality criteria (see Section 5.2.2) acceptable to the Co-lead Agencies. PolyMet suggests changing the word 'conceptual' to 'preliminary'.	Change has been made, as requested.
PolyMet	The second bullet under Design Criteria states: "Factor of safety greater than or equal to 1.3 for short-term, undrained strength conditions for soils that are not prone to static liquefaction using undrained strength conditions." This sentence should be revised to indicate that this analysis does not include static liquefaction. Liquefaction is addressed subsequently.	No change made. The cited text is from the work-plan document.
PolyMet	The second paragraph uses the phrase "bulk tailings." PolyMet recommends defining "bulk tailings" to limit potential confusion. LTVSMC Coarse Tailings are proposed for use in dam construction but since the Coarse Tailings may have occasional inclusions of fine tailings and slimes, the term "Bulk Tailings" has been used by PolyMet to describe the planned tailings borrow. The same comment applies to page 5-562, which states: "The proposed dams would be constructed from mechanically placed and compacted bulk tailings	The use of bulk tailings is used respectively in context of NorthMet or LTVSMC.

Sender	Comment	Response
	taken from the existing LTVSMC Tailings Basin as needed to produce the desired dam lift height and geometry. LTVSMC bulk tailings are currently defined as a mixture of tailings from the existing LTVSMC Tailings Basin."	
PolyMet	The eighth paragraph states: "As dams are constructed, exterior slopes would be covered with bentonite and vegetated. Upon reaching….." This statement is not completely accurate. On the exterior face of new dams, bentonite will be integrated into the near-surface layer of tailings. The dams will not be "covered with bentonite."	No change made.
PolyMet	The second sentence states: "The predicted Factor of Safety values for Cross Section F at various stages of development of the Tailings Basin are summarized in Table 5.2.14-1. All slope stability factors are designed to meet the factors of safety required by the NorthMet Geotechnical Modeling Work Plan (PolyMet 2013n, Attachment A)." It is more appropriate to say that the slope stability factors are designed to meet the "applicable requirements of *Minnesota Rules* 6115.0300 through 6115.0520 and the factors of safety required by the Co-Lead agencies in the NorthMet Geotechnical Modeling Work Plan (PolyMet 2013n, Attachment A)." The first paragraph under Design Criteria on p. 5-556 contains similar language.	No change made.
PolyMet	The third paragraph states: "Modeling was undertaken to predict the long-term stability of the Tailings Basin. As shown in Table 5.2.14-1 and Table 5.2.14-4, the long-term closure slope stability Factors of Safety are above the minimum value required under the Work Plan." It is more appropriate to say that the slope stability Factors of Safety "are above the minimum value deemed acceptable to the Co-lead Agencies and required under the Work Plan." There is similar language in the last paragraph on p. 5-566.	No change made.
PolyMet	The second paragraph states: "Where monitoring or model updates indicate that the Factor of Safety for the Tailings Basin no longer meets design criteria, appropriate modifications to the Tailings Basin would be considered, modeled, and, if necessary, undertaken." This sentence leaves doubt that prompt action will be taken if Factor of Safety values fall below design requirements. PolyMet recommends clarifying that mitigating measures will be explored and implemented as needed if at any time it is determined that Factor of Safety values have fallen below design requirements.	Change has been made, as requested.
PolyMet	The first paragraph states: "PolyMet took the steps listed below in order to demonstrate that the design of the Hydrometallurgical Residue Facility would meet the respective geotechnical requirements and would be in accordance with the NorthMet Geotechnical Modeling Work Plan (PolyMet 2013n,	The section describing the Hydrometallurgical Residue Facility has been updated for the FEIS.

Sender	Comment	Response
	Attachment A):" PolyMet recommends revising the sentence to read: "PolyMet took the steps listed below in order to demonstrate that the design of the Hydrometallurgical Residue Facility would meet the Co-Lead Agencies respective geotechnical requirements and would be in accordance with the NorthMet Geotechnical Modeling Work Plan (PolyMet 2013n, Attachment A) which was reviewed by the Co-Lead Agencies."	
PolyMet	The third item under the first paragraph states: "Developed seepage and stability models using Geo-Slope International, Inc. modeling software (i.e., SLOPE/W, SEEP/W and SIGMA/W as necessary) for maximum facility dam height with minimum and maximum pond elevation, and post-closure – cover effective with minimum pond elevation the maximum." The last phrase is poorly written and confusing. PolyMet suggests using the following revised text: "Developed seepage and global stability models using Geo-Slope International, Inc. modeling software (i.e., SLOPE/W, SEEP/W and SIGMA/W as necessary) for hydrometallurgical residue facility dam lifts 1, 2 and 3; each with maximum pond elevation, and an infinite stability model to analyze facility liner stability."	Change has been made, as requested.
PolyMet	The text describing the figure [5.2.14-6] (see paragraph under "Identification of Design Cross Section" on p. 5-571) makes reference to Node A. Yet, Node A is not shown in the figure. There also is a blue dashed line (presumably denoting the phreatic surface in surrounding materials) that is not defined in the figure legend nor is the dashed line labeled in the figure.	Change has been made, as requested.
PolyMet	This Section [(5.2.14.2.3)] does not clearly distinguish between (1) the settlement of the Hydrometallurgical Residue Facility (HRF) foundation materials and resulting movement of the HRF liner system and (2) future consolidation of the residue deposited within the HRF and resulting movement of the residue surface. PolyMet recommends more detail to provide clarification.	The section describing the Hydrometallurgical Residue Facility has been updated for the FEIS.
PolyMet	The first paragraph states: "The results reported in Geotechnical Data Package Volume 2 Version 3 indicate that the proposed design of the Hydrometallurgical Residue Facility would meet all respective factors of safety as required (PolyMet 2012a). The modeling undertaken and results are summarized below." PolyMet suggests revising the statement to say that the design "would meet all of the Co-Lead agencies' respective factors of safety as required (PolyMet 2012a)."	No change made.
PolyMet	The first paragraph states: "Analysis of the new dams (i.e., those not supported by the existing LTVSMC Tailings Basin or natural topography) at	No change made.

Sender	Comment	Response
	their greatest height (at year 20) resulted in a computed Factor of Safety for the ESSA of 2.32, which is greater than the required minimum of 1.5." The sentence should be revised to state that the resulting Factor of Safety is "greater than the Co-Lead Agencies' required minimum of 1.5."	
PolyMet	The fourth sentence of the first paragraph states: "The minimum infinite slope stability safety factor for all Hydrometallurgical Residue Facility liner system components is 1.5." It would be more appropriate if the sentence was revised to read: "The Co-Lead Agencies' required minimum infinite slope stability safety factor for all…."	No change made.
PolyMet	The last sentence in this paragraph is inaccurate because Coyote Creek and Stony River on Tract 3-Wolf Lands are not comparable systems. The Stony River is a higher order, more diverse aquatic system than the first order, headwaters Coyote Creek. It cannot be assumed that the conclusions drawn from the studies for Stony River are applicable to Coyote Creek.	Minor edits to Section 5.3.6.2.4 were made to further indicate that the sites chosen to represent Tract 3 were only assessed qualitatively.
PolyMet	The fifth paragraph states: "The only two reasonably foreseeable actions with the potential to significantly affect flow within the Partridge River and Embarrass River are the Mesaba Energy Project East Range Alternative Site and the Mesabi Mining Project, which would result in a net increase in Lower Partridge River flow as a result of pit dewatering for the foreseeable future." This statement seems to ignore the eventual closure of the Northshore Peter Mitchell Pit (which is recognized elsewhere in the SDEIS). When that pit begins filling, Northshore will stop dewatering discharge to the Upper Partridge River. This would be a net decrease in flow relative to existing and modeled conditions. This action is anticipated within the modeling period but is not incorporated into the GoldSim model because the actual date of when this change would be made is not known. However, the potential for no discharge from Northshore to the Partridge River was considered in the sensitivity analysis conducted for the Project.	
PolyMet	The introduction to Section 6.2.3.4, "Wetlands," on page 6-34 states that the cumulative effects analysis "focuses on direct effects" on wetlands. Page 6-43 indicates that there will not be indirect cumulative effects on wetlands because water flows will not be changed. This discussion is in some tension with the effects analysis in Chapter 5, which anticipates the potential for some indirect effects on wetlands. PolyMet recommends referencing the discussion in Chapter 5 as part of the cumulative effects discussion.	The FEIS has been revised to address this comment.
PolyMet	Regarding the third sentence of the third paragraph, no federally-listed plant species would be affected by the project because there are no federally-listed	No change made.

Sender	Comment	Response
	plant species in all of St. Louis or Lake Counties. PolyMet recommends re-phrasing the sentence to read, "No federally-listed plant species are known to occur on the NorthMet Project site."	
PolyMet	In the final paragraph below Table 6.2-13, the qualifying statement regarding the lack of precision and the degree of uncertainty inherent in the evaluation methodology should be stated up front in Sections 4.2.4, 5.2.4 and 6.2.4.	No change made. This statement applies mostly to the cumulative analysis, as large habitat types are used in lieu of the NHIS database due to lack of data with reasonably foreseeable actions. This approach uses a best estimate based on available data.
PolyMet	The last paragraph states that "forestry management offers a greater range of options for ETSC plants to co-exist with the practice, as it can mimic natural disturbances." This statement seems to be based on the previous statement in Section 5.2.4.2.1, p. 5-348, that "Disturbance-tolerant species may, in some cases, actually be disturbance dependent." As stated in a prior comment, PolyMet believes this statement is misleading and that it is inaccurate to suggest that ETSC plants favor and/or are increased by disturbance regimes.	No change made. The statement regarding forestry management is accurate in that these practices can mimic windthrow or fire disturbances, which many native species are adapted to. Whereas many of the reasonably foreseeable projects would represent a complete land conversion. The statement in Section 5.2.4 was removed.
PolyMet	In the last sentence of the last paragraph, the increased percentage from the NorthMet Project Proposed Action alone should be 0.2 to 1.6 percent, not 0.2 to 1.8.	Change has been made, as requested.
PolyMet	PolyMet also recommends adding the following additional sentence at end of the paragraph at the top of the page: "This potential change is not likely statistically measureable and does not have any effect on the background fish Hg concentrations nor the current fish consumption advisories for the respective lakes."	The following text has been added at the end of the paragraph: "This potential increase is not expected to have an appreciable effect on fish tissue mercury concentrations in the Embarrass River or Partridge River and does not have any effect on the background fish mercury concentrations nor the current fish consumption advisories for the respective lakes."
PolyMet	In the first complete paragraph, the description of how the HQ is calculated does not reflect the calculations in the MMREM spreadsheet. To estimate the potential incremental HQ, the incremental methylmercury exposure in mg/kg body weight per day and the reference dose are accounted for in the calculation. The derivation of the incremental HQ can be described as noted below: The incremental HQ calculation in the MMREM Spreadsheet uses the following methodology: • Incremental daily mercury consumed (mg) = estimated incremental increase in fish mercury due to the Project (mg/kg) x the amount of fish consumed (e.g. 0.142 kg for a subsistence fisher)	Change has been made, as requested.

Sender	Comment	Response
	• Incremental methylmercury exposure (mg/kg BW – day) = Incremental daily mercury consumed x 1.07945 / adult body weight (70 kg) • Incremental HQ = Incremental methylmercury exposure (mg/kg BW – day) / Reference Dose of 1.00E-04 mg HgCH3/kg bw-day (i.e., the ratio of the incremental methylmercury exposure divided by the reference dose in the same units).	
PolyMet	[In] Table 6.2-22… The incremental result for Mesabi Nugget noncancer acute should be 0.03. The percentages at the bottom should be 9% for Cancer and 7% for Noncancer Chronic.	Changes made
PolyMet	The third paragraph under the heading "1854 Treaty Resources" states that the NorthMet Project Proposed Action could affect treaty resources through the bioaccumulation of mercury in fish tissue. This statement is inconsistent with the SDEIS's evaluation of cumulative effects on aquatic resources, which states that there will not be a significant increase of mercury in fish tissue. Because the subjective belief that such an effect may occur does not qualify as an effect under NEPA, the statement on page 6-95 should be removed from the SDEIS.	Increases of mercury in waterbodies from the NorthMet Project Proposed Action are discussed in FEIS Section 5.2.2, and cumulative increases are discussed in Section 6.2.3. Effects on the environment, including those from increased mercury, are all expected to meet the standards and regulations set forth by the appropriate state or federal agency or program. These laws are intended to protect important natural and cultural resources, and include but are not limited to the ESA, the CWA, and the CAA. Relative to 1854 Treaty resources and mercury, FEIS Section 6.2.3.10 is focused on the potential cultural cumulative effects on 1854 Treaty resources. Subsistence fishing and consumption is a common activity for the Bands in the 1854 Ceded Territory. Members of the Grand Portage and Fond du Lac bands are known to consume substantially more fish than the assumed statewide average. As such, increased cumulative mercury concentrations, and associated cumulative increases in mercury bioaccumulation in fish tissue, could therefore constitute an impact for Band members and other subsistence consumers of fish.
PolyMet	The final sentence in Section 7.3.1 indicates that the federal lands contain certain natural resources that are "culturally important" to the Bands. While it is accurate that these resources would be lost if the NorthMet Project Proposed Action moves forward, it is also true, and should be noted, that there is no evidence of the Bands accessing any resources at the Mine Site.	No change made.
PolyMet	The third sentence in the third paragraph of Section 7.3.1, "Irreversible or Irretrievable Commitment of Resources," states that while cultural resources	No change made.

Sender	Comment	Response
	may be adversely affected, those effects would be "minimized through avoidance." Under Section 106 of the National Historic Preservation Act, avoidance is not the only means of addressing adverse effects on historic properties, including the cultural resources identified in the SDEIS. Agencies may also choose to adopt minimization or mitigation measures. Those options should also be recognized in this paragraph.	
PolyMet	The final sentence in the first paragraph of Section 7.3.3, "Unavoidable Adverse Effects," states that effects on water quality would remain after the implementation of mitigation measures. The paragraph should note that these effects would be minor, and not qualify as significant environmental effects.	No change made.
PolyMet	The first paragraph of Section 7.4, "PREFERRED ALTERNATIVE," states that CEQ regulations do not require agencies to select a preferred alternative in a Draft EIS like the SDEIS. The same paragraph states that the USACE's NEPA regulations (Appendix B of 33 C.F.R. Part 325) supersede the CEQ regulations' "requirement to identify an agency-preferred alternative." This description of these requirements is confusing. Neither the CEQ regulations nor the USACE regulations require the selection of a preferred alternative in the SDEIS.	The FEIS has been updated to address this comment.
PolyMet	Appendix B, p. 1, 1.2 Assessment of Material[:] In the first sentence, "semi-qualitative" should be changed to "semi-quantitative."	The Underground Mining Alternative Position Paper has not been updated since the SDEIS.
PolyMet	Appendix B, p. 4, 2.2 Availability[:] The last sentence of this section should be changed to: "Notwithstanding economic considerations the underground mining alternative is available at the NorthMet Deposit."	The Underground Mining Alternative Position Paper has not been updated since the SDEIS.
PolyMet	Appendix B, p. 5, 2.4.1 Mineralization at the NorthMet Deposit[:] With respect to the bullet list of metal prices after the first paragraph, the referenced price for cobalt should be $17.69 per pound.	The Underground Mining Alternative Position Paper has not been updated since the SDEIS.
PolyMet	Appendix B, p. 7, 2.4.2 Underground Mining Costs[:] In Table 2, the Pre-production Capital Costs ($ million) of 300 should be changed to 250. The Profit: Metal Value – Costs ($ million) of -$193 should be changed to -$192 and -$364 should be changed to -$314.	The Underground Mining Alternative Position Paper has not been updated since the SDEIS.
USEPA	Comment# 23. Page 6-36, Table 6.2-8 and Pages 6-40 to 6-42, Table 6.2-11: There appear to be some inconsistencies between Table 6.2-8 and Table 6.2-11 with respect to reported future wetland and water resource numbers, including the bullet summaries for the Partridge River (Page 6-40) and Embarrass River (Page 6-42). For the Partridge River, Table 6.2-11 and bullet summary text note future condition with 3,516 acres of deepwater resources,	The FEIS has been revised as requested.

Sender	Comment	Response
	while Table 6.2-8 indicates 1,922 acres. Recommendation: The FEIS should resolve or explain these inconsistencies.	
USEPA	Comment# 24. Page 6-21, Section 6.2.3.3.2: the "Contributing Past, Present, and Reasonably Foreseeable Actions" section, lists twelve foreseeable future actions with potential cumulative effects on surface water hydrology and quality in the Partridge River and Embarrass River watersheds. There is some inconsistency between this list and Table 6.2-1 (Page 6-7). "Cliffs Erie, LLC-Hoyt Lakes Area (former LTVSMC)," and "Cliffs Erie, LLC- Area 5 NW Pit" are not included in the table, at least not by these names. Recommendation: The FEIS should resolve or explain these inconsistencies, and use consistent names for foreseeable future actions to simplify cross-referencing by the reader.	The FEIS has been revised to ensure consistency with project names.
USEPA	Comment # 26. Pages 6-22 to 6-25 and 6-27 to 6-28, Section 6.2.3.3.3: This text does not reference sources of hydrological effects data for each action. Recommendation: The FEIS should reference sources of hydrological effects data for each action.	Change has been made, as requested.
USEPA	Comment # 33. Pages 4-261 through 4-264 refer to cultural resources/Section 106 resources solely as historic properties. Recommendation: The FEIS should make it clear that cultural resources include archaeological resources.	Change has been made, as requested.
USFWS	The temporary nature of the projected 500 direct jobs created during construction and additional 631 "operations-phase" jobs may result in a substantial need for temporary lodging that could impact to Voyageurs-area visitors in the form of hotel or motel room shortages.	No change made.
USFWS	Finally, the major differences of opinion between the lead agencies and the Bands, the Great Lakes Indian Fish and Wildlife Commission (GLIFWC), and 1854 Treaty Authority regarding the effects of the proposed actions should be resolved before any permits are issued.	MDOs will be addressed during the appropriate permitting processes.
USFWS	This section needs maps to illustrate the location and extent of Minnesota Biological Survey (MBS) Sites of High Biodiversity Significance in order to support the claim that the number of sites within the project area is small, and to show how much of the 100 Mile Swamp and Upper Partridge River Sites will be impacted.	Change has been made, as requested.
USFWS	Stating that less than 1 percent of the state's Sites of High Biodiversity Significance would be affected is misleading because not all of these sites are of the same type.	No change made.

Sender	Comment	Response
USFWS	When referring to Canada lynx (Lynx canadensis), page 5-365 the SDEIS states that, "Although the NorthMet Project Proposed Action would result in a reduction and fragmentation of lynx habitat at the Mine Site, little to no effect on statewide lynx populations would occur as it is unlikely that an individual lynx or pair of lynx would be affected by the habitat decrease." This is unclear and misleading. Our suggested rewording of this is, "Although the NorthMet Project Proposed Action would result in a reduction and fragmentation of lynx habitat at the Mine Site, little to no effect on statewide lynx populations would occur even if individual lynx are affected by the habitat decrease."	No change made.
Water Legacy	[SDEIS, p. 4-45] there are no Foose and Cooper references listed in the SDEIS from either 1979 or 1980, so it is assumed the references and conclusions in this paragraph are from Foose and Cooper 1978 and 1981 which are cited in the list of references.	References to Foose and Cooper have been updated as requested.
Water Legacy	these statements [on pg 4-45] made relating to bedrock fractures are not supported by the references cited in the SDEIS. Neither of the two Foose and Cooper papers report that "the most extensive faults are largely filled with gouge." Their only mention of fault gouge in these two papers is that they used its presence to trace fault zones in the field. Neither paper discusses distance groundwater may flow through faults and fractures in the Duluth Complex - in fact neither mention groundwater flow at all.	The FEIS now states that extensive bedrock fault zones may or may not be filled with gouge (references) and the effect of gouge on groundwater flow is uncertain.
Water Legacy	The SDEIS presents a discussion of lineaments lower on page 4-45 that, contrary to current geologic literature, downplays the relationship of lineaments to bedrock fractures and therefore their significance to the hydrogeology of the NorthMet Site. "Numerous lineaments have been mapped over northeastern Minnesota, but these have been associated with glacial deposition and not fracturing in the underlying bedrock (Morey 1981; Heutmaker and Morey 1982)." (SDEIS, p. 4-45) The cited literature refers to glacial "processes," not glacial "deposition" (Morey, 1981; Heutmaker and Morey, 1982). These terms do not have the same meaning.	The FEIS now states the following: "Numerous lineaments have been mapped over northeastern Minnesota. An individual lineament may be related to glacial deposition/erosion (Morey 1981; Heutmaker and Morey 1982), a geologic contact between different bedrock types, and/or bedrock structures such as fault and fracture zones."
Water Legacy	The quote… [(starting with "One exploration" ending with "world")] from page 4-45 of the SDEIS stating that the upper fractured zone of bedrock has been removed by glacial scouring should be properly referenced or otherwise supported by data to be taken seriously. This statement is not supported by any of the cited references and is contrary to common knowledge that fractured bedrock is present at NorthMet. Drilling logs included in the SDEIS' supplementary materials (PolyMet, 2013i; RS-35, RS-42 and RS-46) show intervals of weathered bedrock at multiple locations thereby reducing	The FEIS now states that the top of bedrock has been scoured by glacial processes, but upper bedrock has not been necessarily removed.

Sender	Comment	Response
	the credibility of this statement.	
Water Legacy	A few pages above, the term "till" was used as a general term, now in this paragraph [on page 4-46] the term "alluvium" seems to be used as a replacement term for all surficial sediments. On page 4-149 the entire package of surficial sediments is referred to as "soil". This is more than semantics; it leads to confusion as to exactly which surficial sediments are being referenced: the entire surficial sediment section or only till units or only alluvium units or only the post-glacial soil that exists at the land surface? This usage promotes a simplistic understanding of surficial geology, which in turn is converted into overly simple and inaccurate inputs to predictive models.	Change has been made, as requested.
Water Legacy	A figure showing this isopach map [referred to on page 4-45] inserted at this point in the SDEIS would be very helpful in envisioning how the surficial sediment type and thickness varies across the Mine Site. But this map neither appears in the SDEIS or among cited reference documents. The Table of Contents for Golder Associates (2007) lists the isopach map, but the file does not appear in the MDNR DVD set and was not available for review.	No change made.
Water Legacy	A detailed bedrock topography map would also be useful at several places in the SDEIS to illustrate where features such as troughs and bedrock valleys are located on the bedrock surface and to assess pathways that may transmit contaminated groundwater at the interface of the overburden and bedrock.	A figure has been added to the FEIS to address this comment.
Water Legacy	in Table 4.2.2-5… laboratory-derived hydraulic conductivity values for reported "silty sand" are shown as ranging from 0.00043 ft/day to 0.0081 ft/day. The difference between laboratory-derived hydraulic conductivity values of up to 167 ft/day reported in PolyMet, 2013 or even higher in Stark (1977) should be reconciled with the results from a silty sand presented in Table 4.2.2-5 in the SDEIS.	Laboratory permeameter tests nearly always underestimate the in situ hydraulic conductivity of natural materials. While the laboratory test results are reported, they were not used in estimating the hydraulic conductiivity of surficial deposits. The estimated hydraulic conductivities of surficial deposits were based on a combination of borehole tests, model calibrations, and generic information.
Water Legacy	The SDEIS' claim [on page 4-43] of hydrologic separation from the Biwabik Iron Formation aquifer should be supported by a more robust reference than personal communication from one of PolyMet's consultants. The SDEIS should include an accurate geologic cross-section based on actual drilling information, showing the locations of faults and fractures, not a schematic or overly generalized cross-section where subsurface conditions can be so easily misrepresented.	Change has been made, as requested.
Water Legacy	The examples of incorrect usage of geologic terminology in the SDEIS below suggest the sections on geology were not given the level of editorial review appropriate for a scientific publication. "The NorthMet Deposit itself is below	Change has been made, as requested.

Sender	Comment	Response
	the surficial till in the layered mafic intrusive rocks of the Duluth Complex, which are part of the Partridge River intrusion." (SDEIS, p. 4-43) Actually the Duluth Complex is not part of the Partridge River intrusion. The Partridge River intrusion is part of the Duluth Complex.	
Water Legacy	[The examples of incorrect usage of geologic terminology in the SDEIS below suggest the sections on geology were not given the level of editorial review appropriate for a scientific publication.] "The oldest of the sedimentary rocks is the Pokegama Quartzite. These sedimentary rocks are underlain by Archean granite of the Giants Ridge batholith." (SDEIS, p 4-43) The correct terminology is Giants Range batholith, not Giants Ridge batholith. This same incorrect usage is repeated in several additional places on pages 4-94 to 4-95.	Change has been made, as requested.
Water Legacy	On page ES--- 42, the claim is made that alternatives were identified and screened in accordance with the requirements of 40 CFR 1505.1(e). This is an erroneous citation. The reference to 40 CFR 1505.1(e) refers to NEPA and agency decision-making procedures, not the preparation of an EIS. The correct citation is 40 CFR 1502.14, which states, "Alternatives including the proposed action. This section is the heart of the environmental impact statement. Based in the information and analysis presented in the sections on the Affected Environment (1502.15) and Environmental Consequences (1502.16), it should present the environmental impacts of the proposed action and the alternatives in comparison form, thus sharply defining the issues and providing a clear basis for choice among options by the decision maker and the public."	Change has been made, as requested.
Water Legacy	The PolyMet SDEIS misrepresents and overlooks available information regarding tailings site geology. The SDEIS states, "Jennings and Reynolds (2005) mapped the surficial deposits around and beneath the Tailings Basin as Rainy Lobe Till, which functions as the surficial aquifer and is generally a boulder-rich till with high clay content" (SDEIS p. 4-95). However, the cited reference reports the surficial Rainy lobe till mapped in the vicinity of the proposed NorthMet project as "clay-poor." Till matrix textures are reported to range from 48 to 87% sand, 9 to 40% silt and 0 to 13% clay, but "generally much less than 10% clay." (Jennings and Reynolds, 2005). This is a sandy till, not a till with high clay content.	Change has been made, as requested.
Water Legacy	Statements in the SDEIS regarding groundwater seepage on the south side of the tailings site appear to be inconsistent. In one section, the SDEIS states, "Groundwater currently seeps from the existing LTVSMC Tailings Basin to	Change has been made, as requested.

Sender	Comment	Response
	the headwaters of Second Creek." (SDEIS, p. 5-153) In another narrative, the SDEIS claims that there would be no impacts on wetlands resulting from changes in groundwater flow since, "All of the seepage from the south side of the Plant Site is surface water." (SDEIS, p. 5-297).	
William K. Dustin	p.5-152 The evaluation criteria are not shown on the graph.	Change has been made, as requested.

A.7 INDIVIDUAL COMMENTS AND THEME ASSIGNMENTS

Each of the 16,920 unique, substantive comments identified within the submissions provided for the SDEIS is provided in Attachment 1 of Appendix A. The list is alphabetized by the sender's name, and also includes the theme(s) to which each comment was assigned.

A.8 DEIS COMMENT THEMES AND RESPONSES

The DEIS was made available to the public in the November 2009, with a 90-day comment period that ended on February 3, 2010. Following the release of the DEIS, public meetings were held in Aurora, Minnesota, on December 9, 2009 and Blaine, Minnesota, on December 10, 2009, to gather public comments on the DEIS.

The Co-lead Agencies received approximately 3,800 DEIS submissions from government agencies (federal, state, and local), tribal entities, local businesses, NGOs, private individuals, and PolyMet. These submissions generated approximately 5,900 distinct substantive comments. The comments were analyzed using a thematic approach, similar to the methodology described in Section A.2 of this appendix. Key issue areas identified by DEIS comments included cultural resources, air quality, wetlands, geotechnical stability, socioeconomics, and water resources.

Individual DEIS submissions, comments and theme assignments are included in Attachment 1 of this appendix.

SDEIS Appendix A listed the thematic statements and responses for public comment received on the 2009 DEIS. Table A-5 repeats these DEIS themes and responses, and also indicates which SDEIS theme(s) best respond to each DEIS theme. This listing does not necessarily include *all* applicable SDEIS themes. The relevant sections of the FEIS should be consulted for more detailed information.

Table A-5 DEIS Comment Themes and Relationship to SDEIS Themes

DEIS Theme Code	DEIS Theme Statement	DEIS Thematic Response	Corresponding FEIS Theme(s)
Section: Comparison of Alternatives (ALT)			
ALT1	The DEIS does not adequately define or study the No-Action Alternative.	The No Action Alternatives for the NorthMet Project Proposed Action and the Land Exchange Proposed Action are defined in Sections 3.2.3 and 3.3.3 of the SDEIS, respectively. The environmental consequences of the NorthMet Project No Action Alternative are addressed in the respective sections of Chapter 5. Comparisons of the NorthMet Project Proposed Action and the alternatives, including the No Action Alternative, are shown in Chapter 7.	ALT 14
ALT2	The DEIS does not adequately evaluate the Mine Site alternative and it fails to look beyond the proposed Mine Site.	The NorthMet Project Proposed Action and the alternatives have changed substantially since preparation of the 2009 DEIS. The "Mine Site Alternative" was incorporated into the Proposed Action and is no longer applicable as an alternative (refer to Section 3.2.3 of the SDEIS for more information). The Mine Site location depends on the presence of the viable NorthMet Deposit. The location of the Mine Site and alternatives are discussed in Section 3.2.3 of the SDEIS.	ALT 06, ALT 07, ALT 16
ALT3	The DEIS does not adequately evaluate the underground mining alternative. This alternative should not be eliminated from consideration on the basis of costs.	The underground mining alternative was revisited and determined not to be a viable alternative; therefore, it remains eliminated from further evaluation. The Co-lead Agencies prepared a position paper on the underground mining alternative; this document is attached as an appendix to the SDEIS. Alternatives considered for the NorthMet Project Proposed Action in the SDEIS are described in Section 3.2.3.	ALT 01, ALT 02
ALT4	The DEIS does not adequately evaluate the tailings basin alternative and fails to consider the reactions between seepage and the existing tailings.	The SDEIS NorthMet Project Proposed Action (including tailings management) and the alternatives have changed substantially since preparation of the 2009 DEIS. There is no longer a tailings basin alternative. Management of tailings as part of the NorthMet Project Proposed Action is addressed in Section 3.2.2 of the SDEIS. Environmental consequences are addressed in Section 5.2.	ALT 10, ALT 11
ALT5	The DEIS should provide additional details regarding mitigation and long-term management of the site, particularly related to water treatment.	The NorthMet Project Proposed Action has changed substantially since preparation of the 2009 DEIS. Mine Site and Plant Site water management are addressed in Section 3.2.2 of the SDEIS. Environmental consequences on water resources are discussed in Section 5.2.2.	ALT 04, ALT 13, PD 01
ALT6	The DEIS fails to include quantitative	The NorthMet Project Proposed Action and the alternatives have changed	ALT 22

DEIS Theme Code	DEIS Theme Statement	DEIS Thematic Response	Corresponding FEIS Theme(s)
	information, such as numbers from key indicators for each resource, in the comparison of alternatives table.	substantially since preparation of the 2009 DEIS. The NorthMet Project Proposed Action and alternatives are described in Chapter 3 of the SDEIS; Chapter 7 of the SDEIS provides a comparison of alternatives.	
ALT7	The DEIS fails to adequately identify a preferred alternative.	Chapter 7 of the SDEIS provides a comparison of alternatives and discusses the agency position on offering a preferred alternative. Consistent with the CEQ regulations, the federal Co-lead Agencies are required to identify an agency-preferred alternative in a DEIS, if one exists, and in the FEIS unless another law prohibits the expression of such a preference. At this time, the Co-lead agencies have not identified a preferred alternative, and for the USACE, 33 CFR Part 325, Appendix B, supersedes identification of an agency-preferred alternative. No similar requirement to identify a preferred alternative exists for the MDNR under state law.	ALT 20
ALT8	The DEIS fails to consider a full range of alternatives to meet the intent of NEPA.	CEQ requires that a “reasonable range of alternatives” be analyzed. These may include those not carried forward for detailed analysis. The NorthMet Project Proposed Action in the SDEIS represents a project that has incorporated a number of previous alternatives and mitigation measures considered as alternatives at earlier stages of the EIS process. Many other alternatives have been identified but eliminated from detailed analysis because they didn’t offer potentially significant environmental benefits, did not meet the project’s purpose and need, or were not otherwise reasonable (technically or financially viable) in accordance with CEQ guidance. The NorthMet Project Proposed Action and alternatives are described in Chapter 3 of the SDEIS. Various other alternatives identified but eliminated in the DEIS are discussed in Section 3.2.3.	ALT 21, ALT 23
ALT9	The DEIS must address modifications and mitigation methods with less uncertainty.	The NorthMet Project Proposed Action, alternatives, and mitigation measures have changed substantially since preparation of the 2009 DEIS. Proposed mitigation measures are discussed in the respective parts of Section 5.2 and summarized in Chapter 7 of the SDEIS.	PD 01
Section: Air Quality (AQ) [Please note that “AQ” in the SDEIS applies to Aquatic Species]			
AQ1	The DEIS did not adequately address the potential for fugitive emissions from reactive waste rock, rail cars, tailings basin, or road travel. Further data is needed to evaluate the issue.	Based upon the comments provided on the DEIS, the analyses in Section 5.2.7 of the SDEIS were developed in the Co-lead Air IAP Workgroup. These include revised air emissions protocols for Class I, Class II, mercury deposition, AERA, and GHG assessments. Waste rock acidification was previously addressed and was updated as part of the SDEIS refinements. Based upon the Co-lead Air IAP workgroup, it was determined that any	AIR 04

DEIS Theme Code	DEIS Theme Statement	DEIS Thematic Response	Corresponding FEIS Theme(s)
		effects on air quality from fugitive dust from rail transport would be minimal due to the coarse nature of the ore. The potential for acidification effects associated with deposition of fugitive dust from rail car hauling was addressed under Water Resources. Surface Water IAP workgroup evaluated this issue and recommended that surface water quality data be collected to address this issue. Emissions from other fugitive emissions including mobile sources are also evaluated.	
AQ2	The evaluation that the NorthMet Project Proposed Action would be a "new" rather than an "existing" source of air emissions was made incorrectly or needs further analysis.	Due to the 9-year inactivity of taconite-processing equipment currently owned by Cliffs Erie, LLC and backed by USEPA's well-established reactivation policy, the MPCA has made a preliminary determination that those units would need to go through PSD applicability and new permitting if they were to be restarted by PolyMet.	SDEIS comments did not raise this topic.
AQ3	The potential for GHG emissions that contribute to climate change was not thoroughly analyzed in the DEIS, including the effects on carbon sequestration resulting from the disturbance of peat and the resulting impact on wildlife.	To address these comments, GHG issues have been assessed in a manner consistent with USEPA and MPCA guidance, and the CEQ's Draft NEPA Guidance on Climate Change and Greenhouse Gas Emissions (February 18, 2010). This assessment is addressed in Section 5.2.7 and 5.3.7 of the SDEIS.	AIR 01
AQ4	Air quality modeling and analysis was not complete, lacks accurate data, did not consider all comments, or needs further explanation.	The procedures for inclusion of sources were described in the DEIS. Sources have been evaluated for inclusion based upon their potential to contribute to a significant effect. The proposed facility has not been determined to be a major source under the CAA for any of the criteria pollutants. Therefore, the analysis is consistent with MPCA requirements for permitting. Since the DEIS, the USEPA and federal courts have recently modified major source determination to include GHG emissions. The SDEIS revaluated the major source status for the NorthMet Project Proposed Action and has shown that the proposed facility would not be determined a major source for GHG, or any other regulated pollutant, and thus, no formal major NSR is required, including federal-mandated modeling and BACT requirements. This assessment is addressed in Section 5.2.7 of the SDEIS. The Class I, Class II, AERA, mercury deposition, and cumulative modeling analyses protocols for the SDEIS were updated to include the latest air quality regulations, including 1-hour NO2 and SO2 analyses, PM2.5 requirements, and GHG evaluations. The modeling protocols were revised in collaboration with the Co-lead Air IAP Workgroup and are incorporated as part of the SDEIS.	AIR 09

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AQ4A	Further modeling or studies, including a BACT analysis, should be completed.	There are no current requirements for federal BACT analysis for minor sources (see Theme AQ4). However, PolyMet conducted the equivalent of a major source BACT evaluations for PM2.5 (a minor source) and mercury. These evaluations contributed to the SDEIS analysis of the AERA, mercury bioaccumulation, PM2.5, and asbestos-like fibers. The analyses are summarized in Section 5.2.7 of the SDEIS.	AIR 09
AQ4B	The cumulative impacts analysis for air quality lacked complete analysis. Specific contributing projects should be included.	The procedures for inclusion of sources were described in the DEIS. Sources are evaluated for inclusion based upon their potential to contribute to a significant effect. Specific contributing projects are identified in Chapter 6 of the SDEIS.	CU 02
AQ4C	Evaluation of the potential for asbestiform fibers and amphibole fibers must be completed for the assessment of impacts to be considered complete.	Based upon the revised project, a qualitative evaluation of the effects from asbestiform fibers is included in Section 5.2.7 of the SDEIS.	AIR 03
AQ4D	The potential for acid rain and the resulting impacts should be addressed and analyzed.	The potential for acid rain is evaluated in the Class I regions nearby the NorthMet Project area. Effects of acidification were addressed in the DEIS. An expanded discussion of these effects, including additional lake communities, is included in Section 5.2.7 of the SDEIS.	SDEIS comments did not raise this topic.
AQ4E	The geographical scope of the DEIS is not sufficient to capture potential impacts.	Air quality effects are addressed based upon statewide established criteria for significant effects. Additional analyses were conducted for all representative Class I regions, including visibility and mercury deposition. Expanded acidification assessment for additional lake communities surrounding the NorthMet Project area is assessed in Section 5.2.7 of the SDEIS.	AIR 06, AIR 08, AIR 09
AQ5	Air quality monitoring plans and mitigation measures are insufficient or should be more thoroughly explained in the EIS document. Further mitigation measures should be pursued.	As discussed in the SDEIS, air emissions from the NorthMet Project Proposed Action would be less than PSD major source thresholds for all criteria pollutants. The MPCA is responsible for ensuring that the NorthMet Project Proposed Action would not exceed applicable standards during the permitting process. Permit requirements needed to ensure compliance with standards will be included in any future permits. There will be an opportunity for public participation in the permitting process, as well.	PD 01
AQ6	The NorthMet Project Proposed Action's potential to exceed standards for air quality or endanger the health of humans and wildlife should be more thoroughly addressed. More risk	Air quality impact analyses in the DEIS follow State of Minnesota and federal guidelines, and effects were addressed in the DEIS. Based upon comments received on the DEIS and the availability of more recent information, additional analyses were conducted for the Class I, Class II,	HU 03, WI 03

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	assessment for human health impacts should be completed.	MAAQS, and NAAQS. In addition, updated AERA and mercury assessments were conducted to address risk assessment of human health effects. The updated analyses are addressed in Section 5.2.7 of the SDEIS.	
AQ6A	The potential for mercury emissions to exceed standards or endanger the health of humans and wildlife was not adequately addressed.	PolyMet has revised the Mercury Deposition Analysis in collaboration with the Co-lead Air IAP Workgroup to include an expanded area up to 10 km from the facility, and includes potential sources up to 25 km from the facility. This expanded analysis incorporates several new lake regions, including Sabin Lake, Wynne Lake, Heikkila Lake, Colby Lake, and Whitewater Lake. Results of this analysis are discussed in Section 5.2.7 of the SDEIS.	AIR 05, AIR 06
AQ7	Permitting questions regarding emission thresholds and permitting criteria should be addressed.	As discussed in the SDEIS, air emissions from the NorthMet Project Proposed Action would be less than PSD major source thresholds for all criteria pollutants. The MPCA is responsible for ensuring that the NorthMet Project Proposed Action would not exceed applicable standards during the permitting process. Permit requirements needed to ensure compliance with standards will be included in any future permits. There will be an opportunity for public participation in the permitting process, as well.	AIR 13
AQ8	Issues regarding Class II classifications were inadequately addressed.	The analysis in the DEIS was based upon the most current available data and guidance. The SDEIS updates the existing analysis with the most current information and reflects the most recent review of potential mitigation measures (See Theme AQ4).	AIR 09
AQ9	Issues regarding Class I classifications were inadequately addressed.	Please see response to Theme AQ8.	AIR 08
Section: Compatibility with Plans and Land Use (CPLU)			
CPLU1	The NorthMet Project Proposed Action is inconsistent with biodiversity and habitat policies, such as those in the MFRC Landscape Plan.	Although an informative plan, per NEPA, the MFRC Landscape Plan is not part of the legal framework to which the SDEIS must conform. The Land Use Sections of SDEIS Chapters 4, 5, and 6 address the NorthMet Project Proposed Action's performance with respect to the land use aspects of the legal framework.	PER 35
CPLU2	The NorthMet Project Proposed Action is inconsistent with water quality, recreation, and cultural resources policies, such as those in the St. Louis River Management Plan.	Conformance with water quality, recreation, and cultural resources policies is addressed in the Water Resources, Socioeconomics, Land Use, Recreation/Visual, and Cultural Resources sections of SDEIS Chapters 5 and 6.	SDEIS comments did not raise this topic.
CPLU3	The NorthMet Project's compatibility with the	The Land Use sections of SDEIS Chapters 4, 5, and 6 evaluate compatibility	LU 05

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	Superior National Forest's Forest Plan should be specifically considered.	with the Superior National Forest Plan.	
CPLU4	The Land Exchange Proposed Action with USFS should be concluded and evaluated before the EIS is completed.	The Land Exchange Proposed Action is fully evaluated as part of the SDEIS. See Chapter 5.3 of the SDEIS.	NEPA 13
Section: Cultural Resources (CR)			
CR1	The DEIS does not adequately address impacts to and mitigation measures for cultural resources, including those that relate to 1854 Treaty rights and tribal resource gathering.	The federal Co-lead Agencies are actively consulting with the federally recognized bands that have expressed an interest in consulting for the NorthMet Project Proposed Action to identify and address these and other related concerns. Consideration of effects on cultural resources or culturally significant natural resource that do not qualify for the NHPA addressed in SDEIS Chapters 4, 5, and 6.	CR 01
CR2	Section 106 consultation is needed prior to the completion of the EIS to address the presence of cultural sites and use of resources by tribal members.	The federal Co-lead Agencies have actively consulted with the three federally recognized Bands that have expressed an interest in consulting for the NorthMet Project Proposed Action, including interviews with Band members. Effects to cultural resources and culturally significant natural resources are addressed in the Cultural Resources section of SDEIS Chapters 4, 5, and 6.	CR 06
CR3	The 1854 Treaty Ceded Territory should be considered a traditional cultural property and the NorthMet Project Proposed Action's area of potential effect should be expanded to include 1854 Treaty Ceded Territory.	At the time the 2009 DEIS was prepared, the Co-lead Agencies had not yet formally determined the area of potential effect determination. The Cultural Resources section of SDEIS Chapters 4 and 5 address the Co-lead Agencies' determination of the NorthMet Project Proposed Action's area of potential effect, as well as the Co-lead Agencies' consideration of the 1854 Ceded Territory as a traditional cultural property.	CR 04
CR4	The EIS should discuss the federal government's trust responsibility as part of the 1854 Treaty and address potential impacts and proposed mitigation/compensation for loss of access to resources.	The Cultural Resources section of SDEIS Chapters 4 and 5 addresses the federal Co-lead Agencies' federal tribal trust responsibilities as part of the 1854 Treaty. These sections, along with relevant sections of Chapter 6, also address effects on, and any proposed mitigation for effects on cultural resources and culturally significant natural resources that do not qualify for listing on the NRHP.	CR 01
CR5	The EIS should further evaluate and/or remove reference and use of the draft work known as, "The Protocol to Assess Expanded Cumulative Impacts to Native Americans."	This document has been reviewed and protocol discussed. The SDEIS complies with CEQ guidance for the cumulative effects analysis.	CR 08

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Section: Fish and Macroinvertebrates (FM) [FEIS Section Now Titled "Aquatic Species"]			
FM1	The DEIS does not adequately analyze the impacts from the Mine Site operation on fish and macroinvertebrate species. Particular concerns include seepage of mercury and other constituents, alteration of flow conditions, water quality exceedances, and bioaccumulation.	Effects on aquatic resources, such as fish and macroinvertebrate species, as a result of mercury seepage and potentially harmful constituents, alteration of flow, and bioaccumulation are discussed in detail in Sections 5.2.6 and 5.3.6 of the SDEIS.	AQ 05, AQ 06, AQ 07, AQ 11, AQ, 12, AQ 13, AQ 14, AQ 18, AQ 23, AQ 24, AQ 25, AQ 28
FM2	The DEIS does not provide sufficient baseline characterizations, including sampling and modeling, to effectively describe populations and potential effects on fish and macroinvertebrates.	Existing conditions, including baseline characterizations and any additional threatened or endangered species listed after the DEIS was released, are discussed in detail in Sections 4.2.6 and 4.3.6 of the SDEIS. Potential effects on these species are detailed in Sections 5.2.6 and 5.3.6 of the SDEIS.	AQ 01
FM3	The cumulative effects analysis needs to be expanded to include the effects of sulfate and mercury, bioaccumulation, climate change, and habitat degradation on the fisheries and macroinvertebrates of the region.	Cumulative effects on aquatic species and the metrics used for analysis of potential effects are included in Chapter 6 of the SDEIS.	AQ27
FM4	The DEIS lacks sufficient monitoring, adaptive management, and mitigation measures for aquatic species.	Monitoring plans and potential mitigation measures for the NorthMet Project Proposed Action are discussed in Sections 5.2.6 and 5.3.6, and Chapter 7 of the SDEIS.	AQ 30
FM5	The DEIS does not provide sufficient information to demonstrate compliance with federal and state permitting and guidance requirements including the CWA, state water quality standards, TMDL levels, and fish consumption advisories.	Existing aquatic habitat and species are described in Section 4.2.6 and 4.3.6 of the SDEIS. Effects to aquatic resources as a result of the NorthMet Project Proposed Action are described in Sections 5.2.6 and 5.3.6. The evaluation of the NorthMet Project Proposed Action's potential environmental effects against EIS evaluation criteria is included in Sections 5.2.2, 5.2.6, 5.3.3, and 5.3.6 of the SDEIS. The Adaptive Water Management Plan addresses the wastewater treatment systems that would be used to manage water (see Section 3.2.2 of the SDEIS).	PER 26
Section: Geotechnical Stability (GT)			
GT1	Detailed mitigation, alternatives, stability analysis, and contingency plan information must be included in the EIS, not deferred to permitting.	The NorthMet Project Proposed Action has changed substantially since preparation of the 2009 DEIS and design and stability of the geotechnical features are further analyzed and addressed in Sections 3.2.2 and 5.2.14 of the SDEIS.	GT 07
GT2	Environmental consequences of dam failures	The NorthMet Project Proposed Action, including the design and	GT 15

DEIS Theme Code	DEIS Theme Statement	DEIS Thematic Response	Corresponding FEIS Theme(s)
	must be disclosed in the EIS.	geotechnical stability of the Tailings Basin and Hydrometallurgical Residue Facility, has changed substantially since preparation of the 2009 DEIS. The design of the Tailings Basin and Hydrometallurgical Residue Facility is discussed in Section 3.2.2 of the SDEIS. The structural integrity of the Tailings Basin and Hydrometallurgical Residue Facility and the proposed maintenance and adaptive management measures of these facilities to maintain that integrity is discussed in Section 5.2.14 and Chapter 7 of the SDEIS. Because the proposed design would meet the minimum factor of safety requirements, the potential for failure of the dams is considered low. Discussion of effects associated with such failure would be speculative and thus outside the scope of the SDEIS.	
GT3	The EIS must address disposal of coal ash and other non-taconite tailings materials in the existing LTVSMC Tailings Basin and any implications to Tailings Basin stability.	The NorthMet Project Proposed Action, including the design and geotechnical stability of the Tailings Basin and Hydrometallurgical Residue Facility, has changed substantially since preparation of the 2009 DEIS. The existing conditions at the existing LTVSMC Tailings Basin, and the structural integrity of the proposed Tailings Basin and Hydrometallurgical Residue Facility, are discussed in section 4.2.14 and 5.2.14 of the SDEIS.	HAZ 02
Section: Hazardous Materials (HM)			
HM1	The DEIS does not adequately address the assessment of operational type chemical waste for recycling.	Section 5.2.13 of the SDEIS addresses the preparation of a Hazardous Materials Management Plan. The Hazardous Materials Management Plan will describe the methods for handling, storage, and disposal. This may also include recycling of materials used or generated during the operations.	ALT 09, HAZ 02
HM2	The DEIS does not properly characterize ore and waste rock piles from the mining process as hazardous materials and hazardous waste in accordance with Minnesota Rules, nor does it adequately discuss the cumulative effects of these materials as "hazardous materials".	Based on the *Minnesota Rules*, Chapter 7045.0120, Identification and Listing of Hazardous Waste-Exemptions and Special Requirements, this waste is exempted. Also see Chapter 7045.0214: Evaluation of Wastes, Subpart I, "Any waste evaluated and exempted under part 7045.0075 or 7045.0120 does not need to be re-evaluated under this part." Other waste in question will be properly evaluated and managed per the Hazardous Materials Management Plan for the facility. These issues are described in Section 5.2.13 of the SDEIS.	HAZ 02
HM3	The DEIS does not adequately analyze and address the risk associated with the transportation of materials of a hazardous nature.	Transportation of materials of a hazardous nature will be addressed in more detail in the NorthMet Project Proposed Action plan and the Hazardous Materials Management Plan (when developed), and is discussed in Section 5.3.13 the SDEIS.	HAZ 06
HM4	The chemical composition, toxicity, use, impact,	As described in Section 5.2.13 of the SDEIS, hazardous materials and	HAZ 03

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	and mitigation of chemical products discharged in wastewater and in the hydrometallurgical residue must be further addressed in accordance with federal and Minnesota hazardous waste regulations.	potentially hazardous wastes will be characterized, managed, and disposed of or recycled per the Hazardous Materials Management Plan (to be completed), which will follow requirements of Minnesota Rules, Chapter 7045: Hazardous Waste.	
HM5	The DEIS does not adequately assess the nature and characteristics, including radioactivity, of cobalt.	Hazardous materials are addressed in Section 5.2.13 of the SDEIS. If present, cobalt-60 and other hazardous or potentially hazardous materials or wastes will be characterized and managed per the Hazardous Materials Management Plan (to be completed), which will follow requirements of Minnesota Rules, Chapter 7045: Hazardous Waste.	HAZ 03
HM6	The DEIS does not adequately consider the cumulative impacts of hazardous materials from other projects, including hazardous materials already in the watershed.	Evaluation of cumulative effects of hazardous materials on the watershed, as well as those from other projects, are addressed in further detail as appropriate in Chapter 6 of the SDEIS.	CU 15
Section: Irreversible and Irretrievable Commitment of Resources (IRR)			
IRR1	The DEIS does not adequately characterize the fossil fuels consumed during mine development, operation, and closure.	Irreversible and irretrievable commitments of these resources are discussed in Chapter 7 of the SDEIS.	AIR 02
IRR2	The DEIS does not adequately characterize the loss of natural and cultural resources, such as high-quality forests, wetlands, and traditional cultural activities.	Effects on cultural resources and the relationship between natural resources and cultural resources are discussed in Section 5.2.9 and 5.3.9 of the SDEIS. Irreversible and irretrievable commitments of these resources are discussed in Chapter 7 of the SDEIS.	NEPA 14
Section: Noise (N)			
N1	Noise impacts from operation of the NorthMet Project Proposed Action on the surrounding region are not properly modeled or explained in the DEIS.	To address this issue, Section 5.2.8 of the SDEIS includes a visual representation of noise contours to show the extent of noise effects on sensitive receptors within the surrounding region.	N 06
N2	The DEIS does not adequately address noise mitigation.	Noise mitigation measures and monitoring plans are addressed in Section 5.2.8 and Chapter 7 of the SDEIS.	PD 01
N3	The DEIS does not adequately characterize the cumulative effects of noise, including vibration, from the NorthMet Project Proposed Action and other activities.	Further modeling of the potential cumulative noise and vibration effects on the surrounding environment has been conducted since the preparation of the 2009 DEIS. Cumulative noise and vibration effects, and the metrics used for analysis of potential effects, are discussed in Chapter 6 of the SDEIS.	N 03
N4	The DEIS does not adequately characterize the	NorthMet Project Proposed Action--related noise effects on wildlife,	N 04, N 05

DEIS Theme Code	DEIS Theme Statement	DEIS Thematic Response	Corresponding FEIS Theme(s)
	effects of NorthMet Project Proposed Action-related noise, including blasting, on wildlife.	including blasting, are discussed in detail in the Section 5.2.5 of the SDEIS.	
N5	The DEIS does not adequately characterize the effects of project-related noise, including blasting, on human health.	NorthMet Project Proposed Action-related noise effects on human health, including blasting, are discussed in detail in the Section 5.2.7 of the SDEIS.	N 01
N6	The DEIS does not adequately characterize the impacts of discontinuous noise, such as blasting, on people who use the NorthMet Project area for recreation, fishing, and hunting.	The effects of discontinuous noise, such as blasting, on people who use the NorthMet Project area for recreation, fishing, and hunting are discussed in detail in Section 5.2.8 of the SDEIS.	N 02
Section: Project Description (PD)			
PD1	The DEIS does not adequately explain the Land Exchange Proposed Action, which is a connected action.	The Land Exchange Proposed Action is addressed as part of the NorthMet Project Proposed Action and alternatives throughout the SDEIS.	LAN 01
PD2	The DEIS NorthMet Project Description does not adequately describe the potential for release of contaminants, hazardous wastes, or acid rock drainage from waste rock, the Tailings Basin, or failure of liner systems on surface and groundwater quality standards.	The NorthMet Project Proposed Action, including management of waste rock and tailings, has changed substantially since preparation of the 2009 DEIS. Management of waste rock and tailings is addressed in Section 3.2.2 of the SDEIS. The potential effect of waste rock and tailings on surface and groundwater quality is addressed in Section 5.2.2 of the SDEIS.	GT 15
PD3	The DEIS does not adequately analyze the scope or effectiveness of closure and reclamation plans.	The NorthMet Project Proposed Action has changed substantially since preparation of the 2009 DEIS. Closure and reclamation of the NorthMet Project area is described in Section 3.2.2 and long term environmental consequences are described in Section 5.2 of the SDEIS.	PD 02, PD 06, PD 20
PD4	The DEIS does not adequately describe financial assurance.	Financial assurance for closure and remediation of the NorthMet Project area is addressed in Section 3.2.2.4 of the SDEIS.	FIN 01
PD5	The DEIS does not adequately describe the WWTF, including the seepage/discharge collection from the Tailings Basin or Hydrometallurgical Residue Facility.	The NorthMet Project Proposed Action, including details of water management at the Tailings Basin has changed substantially since preparation of the 2009 DEIS, and is further addressed in Section 3.2.2 of the SDEIS.	PD 03, PD 07, PD 11, PD 12, PD 13, PD 18
PD6	The DEIS does not fully evaluate geotechnical stability, including a stockpile stability analysis.	The NorthMet Project Proposed Action has changed substantially since preparation of the 2009 DEIS. The existing geotechnical conditions at the NorthMet Project area are discussed in Section 4.2.14. The design and structural integrity of the proposed geotechnical features is addressed in Sections 3.2.2 and 5.2.14 of the SDEIS.	All GT themes

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PD7	The DEIS does not adequately describe the transportation of ore between the Mine Site and Plant Site or the necessary transportation infrastructure.	The transportation of ore between the Mine Site and Plant Site is discussed in Section 3.2.2 of the SDEIS.	PD 36
PD8	The DEIS contains insufficient baseline data, monitoring measures, mitigation methods, and modeling, and does not include newly identified issues.	Existing environmental conditions including results of baseline modeling are discussed in Chapter 4 of the SDEIS. Management and mitigation measures of the NorthMet Project Proposed Action and alternatives are described in Chapter 3. Environmental consequences are addressed in Chapter 5. A summary and comparison of the mitigation and management measures for the NorthMet Project Proposed Action and alternatives and the environmental consequences is provided in Chapter 7 of the SDEIS.	Addressed throughout the FEIS.
PD9	The DEIS NorthMet Project Description is not complete, and/or is not consistent with the PDEIS.	The NorthMet Project Proposed Action has changed substantially since preparation of the 2009 DEIS, and the description of the NorthMet Project Proposed Action and alternatives has been updated in the SDEIS.	All PD themes
PD10	The DEIS does not adequately describe the NorthMet Project Proposed Action's relationship to plant and wildlife species, habitat, and high quality forests and wetlands.	The existing environmental conditions and the potential environmental consequences relating to the NorthMet Project Proposed Action are addressed in Chapters 4 and 5 of the SDEIS, respectively.	All WI, VEG, and WET themes
PD11	The DEIS does not adequately describe the placement of waste rock piles and stockpiles of overburden.	The NorthMet Project Proposed Action, including management of waste rock and overburden, has changed substantially since preparation of the 2009 DEIS. Management of waste rock and overburden is addressed in Section 3.2.2 of the SDEIS.	PD 15
PD12	The DEIS does not adequately describe Superior National Forest plans and regulations or whether they will be adhered to.	The Land Exchange Proposed Action is described in Section 3.3. The potential effect of the proposed change in land use at the NorthMet Project area and the considerations for existing and surrounding land management are addressed in Sections 5.2.1 and 5.3.1 of the SDEIS.	PER 35
PD13	The DEIS does not adequately address due diligence on the NorthMet Project Proposed Action.	Due diligence for the NorthMet Project Proposed Action is addressed in Chapter 3 of the SDEIS.	All PD Themes
PD14	The DEIS does not adequately describe the moratorium on sulfide mining in Wisconsin.	The moratorium in Wisconsin is outside the scope of the NorthMet Project Proposed Action, and is therefore not discussed in the SDEIS.	SDEIS comments did not raise this topic.
Section: Process (PRO)			
PRO1	The DEIS does not adequately adhere to the	Chapter 1 of the SDEIS provides information about the Cooperating	NEPA 08

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	EIS/NEPA process or involve appropriate agencies.	Agencies that were included during the scoping period for the DEIS, as well as other agencies involved in development of the SDEIS. The three Co-Lead Agencies (MDNR, USACE, and USFS) each ensured that federal and state environmental impact processes were followed, and that the process adhered to each agency's internal requirements.	
PRO2	The DEIS does not adequately analyze project alternatives, as there is too much uncertainty.	The NorthMet Project Proposed Action and the alternatives have changed substantially since preparation of the 2009 DEIS. Alternatives (including the NorthMet Project No Action Alternative) are described in Chapter 3 of the SDEIS; a comparison of alternatives is provided in Chapter 7.	ALT 16, ALT 21
PRO3	The DEIS contains insufficient data/studies, explanations of methodologies, and proposed mitigation measures.	New data and studies, methodologies, and mitigation measures are discussed in detail in the SDEIS. Individual resource-specific sections incorporate new data or studies and explanations of methodologies in Chapter 4, while mitigation measures are discussed in resource-specific sections of Chapter 5 of the SDEIS.	NEPA 08
PRO4	The DEIS does not adequately incorporate all connected actions and other actions into the cumulative effects analysis.	All connected actions, including the Land Exchange Proposed Action, are included in the cumulative effects analysis in Chapter 6 of the SDEIS. Resource-specific effects of the Land Exchange Proposed Action are included in Chapter 6 of the SDEIS.	CU 02, CU 08, CU 09, CU 13
PRO5	Analysis regarding the Cultural Resources section was not appropriately completed, as Section 106 consultation was incomplete.	The federal Co-lead Agencies are actively consulting with federally recognized Bands that have expressed an interest in consulting for the NorthMet Project Proposed Action. Consultation includes interviews with tribal members. Effects on cultural resources are addressed in the Section 5.2.9 of the SDEIS. The Section 106 evaluation must be complete before the federal agencies can complete their respective RODs.	CR 06
PRO6	The DEIS process did not allow adequate public participation, and specifically lacked adequate public comment periods or meetings. All issues of public opposition should be addressed.	The NEPA public participation process for the DEIS is discussed in detail in Section 2.2 of the SDEIS. Two meetings and a 90-day comment period were provided for the DEIS. A separate scoping period for the Land Exchange Proposed Action occurred in the fall of 2010. For the SDEIS, the number of public meetings and length of the comment period will be determined by the Co-lead Agencies. Public comments and positions voiced in the record at both public meetings and through written comments have been considered in the development of the SDEIS.	NEPA 11
PRO7	The DEIS does not adequately evaluate potential violations of laws or standards, such as the CAA, CWA, etc.	As described in Section 1.4 of the SDEIS, the NorthMet Project Proposed Action must comply with all applicable laws and standards. Resource-specific laws and regulations are discussed in the corresponding resource	PER 26

DEIS Theme Code	DEIS Theme Statement	DEIS Thematic Response	Corresponding FEIS Theme(s)
		sections.	
PRO8	The DEIS does not adequately incorporate the Feasibility Study for the Land Exchange Proposed Action.	The Land Exchange Proposed Action is discussed in detail throughout the SDEIS. Individual chapters incorporate information from the USFS Land Exchange Feasibility Study, as well as other sources.	LAN 06
PRO9	The DEIS does not fully include tribal Cooperating Agency comments.	The federal Co-lead Agencies are actively consulting with the three federally recognized bands that have expressed an interest in consulting for the NorthMet Project Proposed Action. Discussion of tribal comments and concerns are a part of this consultation. These comments are addressed in the SDEIS and through ongoing consultation.	CR 06
PRO10	The DEIS does not adequately describe any financial assurance for the project or implications of an environmental disaster.	Financial assurance for closure and remediation of the NorthMet Project area is addressed in Chapter 3 of the SDEIS. A Co-lead Agency document dated August 23, 2011, describes the mechanism for addressing financial assurance in the SDEIS.	FIN 05
Section: Socioeconomics (SE)			
SE1	The DEIS incorrectly implies that there are no economic benefits from the NorthMet Project No Action Alternative.	The SDEIS more clearly states that there would be no additional economic benefits from mining activity in the NorthMet Project No Action Alternative, but that other economic activity in the region would remain unaffected. Existing non-mining economic activity is described in greater detail in Section 4.2.10 the SDEIS.	SDEIS comments did not raise this topic.
SE2	The EIS should include a full EJ evaluation, focused specifically on impacts to local tribes.	The EJ analysis has been expanded, and is presented in Section 5.2.10.2.6 of the SDEIS, based on input from the Socioeconomic IAP Workgroup.	SO 09
SE3	The DEIS overestimates the NorthMet Project Proposed Action's relatively short-term employment benefits, and does not adequately address long-term, post-closure costs, or the "boom and bust" cycle associated with extractive industries.	These issues are addressed in Section 5.2.10 of the SDEIS, based on input from the Socioeconomic IAP Workgroup.	SO 04
SE4	The DEIS does not adequately account for the NorthMet Project Proposed Action's adverse long-term impact on the region's tourism and real estate economies, which are based on high environmental quality (actual and perceived).	Please see response to Theme SE3.	SO 02, SO 03
SE5	The EIS should evaluate the long-term community health impacts associated with	Effects on human health are primarily addressed in Section 5.2.7 and 5.3.7 of the SDEIS. These include health effects from airborne, water-borne, and	HU 01

DEIS Theme Code	DEIS Theme Statement	DEIS Thematic Response	Corresponding FEIS Theme(s)
	pollution from the NorthMet Project Proposed Action.	other sources related to the NorthMet Project Proposed Action.	
SE6	The low-grade character of the ore body is not adequately addressed.	Calculations in the DEIS Socioeconomics Section already take the quality of the ore into account. These inputs are more clearly stated in Section 5.2.10 of the SDEIS.	SDEIS comments did not raise this topic.
SE7	The EIS should address whether the NorthMet Project Proposed Action will emphasize hiring of local workers, therefore ensuring economic benefits to local communities.	Please see response to Theme SE3	SO 04
SE8	The DEIS did not discuss the specifics regarding inputs of the IMPLAN model and other economic data.	The inputs and methodology of the IMPLAN model are described in Section 5.2.10 of the SDEIS.	SO 08
SE9	The DEIS does not adequately evaluate socioeconomic impacts.	Potential socioeconomic effects on population, housing, employment, transportation, etc., are addressed in Sections 5.2.10 and 5.3.10 of the SDEIS. A Multi-agency (Co-lead and cooperating agencies) Workgroup met during 2011to help define the scope of the socioeconomics analysis.	SO 04, SO 06
SE10	The DEIS does not adequately evaluate mineral rights.	Mineral rights for the NorthMet Project Proposed Action are discussed in Section 3.2.2 of the SDEIS.	LAN 04
Section: Vegetation (VE)			
VE1	The DEIS does not provide sufficient baseline characterizations of vegetation and other factors related to vegetation, such as groundwater modeling.	Existing conditions, including baseline characterizations and any additional threatened or endangered species listed after the DEIS was released, are discussed in detail in Sections 4.2.4 and 4.3.4 of the SDEIS. Details regarding inputs to modeling are included in resource-specific Sections of SDEIS Chapter 5.	VEG 09
VE2	The DEIS does not adequately address impacts to wild rice, aquatic vegetation, and farming from sulfates, sulfides, mercury methylation, and other constituents.	Effects resulting from vegetation exposure to potentially harmful constituents are discussed in detail in relevant Sections of SDEIS Chapter 5, such as water resources.	VEG 04, VEG 07
VE3	The DEIS reclamation plans are not sufficiently detailed. They do not adequately consider impacts from non-native and invasive species and should instead include native species.	Issues such as the spread of non-native and invasive species and potential effects on vegetation resources are addressed in Section 5.2.4 of the SDEIS. Reclamation plans, revegetation plans (including plant species proposed to be used during closure and reclamation activities), monitoring plans, and potential mitigation measures for the NorthMet Project Proposed Action are discussed in SDEIS Chapter 3.	VEG 05

DEIS Theme Code	DEIS Theme Statement	DEIS Thematic Response	Corresponding FEIS Theme(s)
VE4	The DEIS does not adequately consider the cumulative effect on non-listed flora populations, in addition to threatened and endangered species, in northeast Minnesota from other similar projects, and does not discuss the extent and prevalence of these species in the region.	Cumulative effects on vegetative species, and the metrics used for analysis of potential effects, are discussed in Chapter 6 of the SDEIS.	VEG 08
VE5	The DEIS contains insufficient information to support its discussion of effects to threatened and endangered plant species, nor does it describe a plan to maintain these populations.	Potential effects on state-listed and RFSS plant species are discussed in Sections 5.2.4 and 5.3.4 of the SDEIS. A Biological Evaluation will be developed to address RFSS. There are no federally listed plant species in the NorthMet Project Area.	VEG 01
VE6	The DEIS does not adequately evaluate tribal utilization of important plant resources (wild rice, cedar, sage, etc.) at the Mine Site and Plant Site, since the Section 106 NHPA consultation was not finished at time of publication and documentation of these uses is often not available or recorded.	Section 106 consultation is ongoing. Potential effects on vegetation and plant species are discussed in Sections 5.2.4 and 5.3.4 of the SDEIS. Tribal utilization of plant species is discussed in the Cultural Resources sections of SDEIS Chapters 4 and 5.	CR 05, CR 06
VE7	The DEIS does not adequately identify the proposed organic nutrient amendments to the Tailings Basin and how these would promote the development of shoreline and near-shore aquatic vegetation.	Potential mitigation methods regarding vegetation are addressed in Section 5.2.4 of the SDEIS. This includes revegetation of the Tailings Basin and development of aquatic vegetation. Reclamation plans, revegetation plans, monitoring plans, and potential mitigation measures for the NorthMet Project Proposed Action are discussed in Chapter 3 of the SDEIS.	VEG 05
VE8	The DEIS does not adequately characterize impacts from sulfuric acid formation on vegetation, during transportation of the rock from the Mine Site to the Plant.	Spillage from rail cars is expected to be minimized through the use of mitigation methods such as seals on rail car doors and a different design than previous operations. Effects on vegetation resulting from rail car spillage are discussed in Section 5.2.4 of the SDEIS.	VEG 04, VEG 06
Section: Visual Resources (VI)			
VI1	The DEIS visual impact assessment does not provide sufficient characterizations of baseline conditions or impacts. A visual impact assessment that is comparable to past USACE practices should be provided.	Section 4.2.11 of the SDEIS includes an expanded discussion of baseline visual conditions.	SDEIS comments did not raise this topic.
VI2	The DEIS should include a discussion on the potential adverse visual impacts from the	This topic is discussed in Sections 5.2.11 and 5.3.11 of the SDEIS.	SDEIS comments did not raise this

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	introduction of non-native species as a revegetation measure.		topic.
VI3	The DEIS' conclusions regarding the extent and impacts of light pollution are inadequate.	This topic is discussed in Sections 5.2.11 and 5.3.11 of the SDEIS.	SDEIS comments did not raise this topic.
VI4	The DEIS should evaluate the potential for haze and haze-related impacts on the BWCAW as a result of the NorthMet Project Proposed Action.	Haze and related effects are discussed in Section 5.2.7 and 5.2.11.	AIR 08
Section: Wetlands (WE)			
WE1	The DEIS does not adequately characterize the wetland baseline information; the wetland delineation and characterization of wetland areas /species should be reevaluated.	Characterization of wetland resources at the Mine Site has been reevaluated since the DEIS. Existing conditions, including baseline characterizations of wetland resources, are discussed in detail in Section 4.2.3 of the SDEIS. Further details regarding inputs to modeling are discussed in Section 5.2.3 of the SDEIS.	WET 07, WET 21
WE2	The DEIS does not adequately characterize the direct and indirect impacts to wetland resources from the NorthMet Project Proposed Action.	Direct and indirect effects on wetland resources from the NorthMet Project Proposed Action are discussed in detail in Section 5.2.3 of the SDEIS. Further analysis of the potential direct, indirect, and cumulative effects on wetland resources has occurred since the development of the DEIS and a Wetlands IAP Workgroup was formed to address the concerns raised on the DEIS. Related discussions are included in other Sections of SDEIS Chapter 5 (such as water resources).	WET 07, WET 08, WET 10, WET 11
WE3	The DEIS does not adequately address wetland mitigation for the NorthMet Project Proposed Action.	Wetland monitoring plans are discussed in Section 5.2.3 of the SDEIS. Wetland mitigation methods, including wetland ratios and justification for mitigation site locations, are also addressed in Section 5.2.3. PolyMet has now proposed a compensatory wetland mitigation site in the St. Louis River Watershed and one in an adjacent watershed, in addition to the two other sites identified in the DEIS.	WET 01, WET 03, WET 04, WET 05
WE4	The DEIS provides insufficient information to demonstrate compliance with federal and state wetland permitting requirements.	Existing wetland habitat, including wetland/habitat quality, is described in Sections 4.2.3 and 4.3.3 of the SDEIS. Effects on wetland resources at the Mine Site and Plant Site are included in Section 5.2.3 of the SDEIS. This discussion includes (where applicable) information to show how the effects of the NorthMet Project Proposed Action compare with federal and state wetland permitting requirements, which includes justification for mitigation site locations.	COE 02, COE 04

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WE5	The DEIS does not adequately address the cumulative effects for wetland resources and the analysis should be redone.	Further analysis of the potential cumulative effects on wetland resources has occurred since the development of the DEIS and a Wetlands IAP Workgroup was formed to address the concerns raised in the DEIS. Cumulative effects on wetland resources, and the metrics used for analysis of potential effects, are included in Chapter 6 of the SDEIS.	WET 18
WE6	The DEIS does not adequately analyze the effectiveness of the wetland treatment system (i.e., WWTF and passive wetland treatment system) and the potential for a longer duration. The SDEIS needs to further analyze the effectiveness and possibility for a longer duration.	Further analysis of the potential effects on wetland resources has occurred since the development of the DEIS, including formation of a Wetlands IAP Workgroup to address the concerns raised in the DEIS. The NorthMet Project Proposed Action no longer includes a wetland treatment system. See Chapter 3 for a description of the mechanical wastewater treatment systems planned for the Plant Site and Mine Site, as well as other wetland monitoring plans. Wetland monitoring plans and other wetlands effects are discussed in Section 5.2.3 of the SDEIS.	SDEIS comments did not raise this topic.
WE7	The DEIS does not adequately address the value of wetlands since the Land Exchange Proposed Action was not included in DEIS and the covenants on the Mine Site (Weeks Act) are being ignored.	Information on the Land Exchange Proposed Action, including conformance to the Weeks Act, Federal Land Policy and Management Act, the Forest Plan, and EOs 11998 and 11990 are included in Chapter 1 and Section 5.3.3 of the SDEIS.	WET 14, WET 17
WE8	The DEIS is inadequate in demonstrating how the water quality and release of mercury would impact wetlands.	Since publication of the DEIS, additional analysis of indirect wetland effects has been conducted, including effects on wetland water quality. A Wetlands IAP Workgroup was formed to address concerns raised in the DEIS. Potential wetland effects associated with degraded water quality and mercury release from the NorthMet Project Proposed Action have been further evaluated, and further analysis of potential effects on wetland resources has been conducted since the development of the DEIS. These effects are discussed in detail in Sections 5.2.3 and 5.3.3 of the SDEIS, and in related Sections of SDEIS Chapters 4 and 5 (such as water resources).	WET 11
Section: Wildlife (WI)			
WI1	The DEIS does not adequately incorporate the findings of biological assessments or comments prepared by other agencies (USACE, USFWS, USFS) related to impacts on threatened and endangered species or RFSS.	A BA and Biological Evaluation will be developed to address federally listed and RFSS, respectively. Discussions of potential effects on federally listed, state-listed, and Regional Forester Sensitive Species (wildlife) are included in the Vegetation and Wildlife Sections of SDEIS Chapter 5.	WI 11
WI2	The DEIS does not adequately analyze the direct and indirect effects (including habitat loss) on	Please see response to Theme WI1. Updated special-status species lists are included in Sections 4.2.5 and 5.2.5 of the SDEIS. Additional wildlife	WI 01, WI 03

DEIS Theme Code	DEIS Theme Statement	DEIS Thematic Response	Corresponding FEIS Theme(s)
	wildlife species including special-status species (e.g., endangered species). More surveys need to be completed for these species, and more emphasis should be placed on the effect on specific areas such as the One Hundred Mile Swamp and Mud Lake/Yelp Lake.	surveys were completed for the non-federal land exchange parcels and are discussed in Sections 4.3.5 and 5.3.5 of the SDEIS.	
WI3	The DEIS does not adequately evaluate tribal utilization of important and treaty-protected wildlife species (moose, furbearer species, etc.), because the Section 106 NHPA consultation was not finished at time of publication and documentation of these uses is often not available or recorded.	Section 106 consultation is ongoing. Discussion of potential effects on wildlife species is included in Sections 5.2.5 and 5.3.5 of the SDEIS. In addition, potential effects on 1854 Treaty resources have been addressed in Sections 4.2.9 and 5.2.9.	WI 09
WI4	The DEIS does not adequately consider the cumulative effect on non-listed wildlife populations (in addition to threatened and endangered species) in northeast Minnesota from other similar projects, including synergistic impacts of bioaccumulation of contaminants.	Cumulative effects on wildlife species, including RFSS and SGCN, are discussed in Chapter 6 of the SDEIS. Further discussion of reclamation and post-closure activities are discussed in Chapter 3 of the SDEIS. Non-federal lands to become federal/public are addressed in topic-specific discussions in Section 5.3 and Chapter 6 of the SDEIS. Mitigation for and restoration of wildlife corridors is discussed in Chapter 6 of the SDEIS.	WI 08
WI5	The DEIS does not adequately address the habitat value of quality for restored wetlands, particularly the Hinckley and Aitkin sites. These would not offer the same habitat for northern wildlife species since they are located so far south.	Existing wetland habitat, including wetland/habitat quality, is described in Sections 4.2.3 and 4.3.3 of the SDEIS. Wetland mitigation methods, including justification for mitigation site locations, are addressed in Sections 5.2.3, 5.3.3, and Chapter 7 of the SDEIS.	SDEIS comments did not raise this topic.
Section: Water Resources (WR)			
WR1A	The plan for post closure management to prevent pollution of groundwater or surface water is inadequate or unclear and given the inherent uncertainty in hydrology and geochemistry, and the Mine's long term potential to degrade water quality. The post-closure plan should include contingencies, mitigation strategies, and a detailed reclamation plan and financial assurances.	The Proposed Action has changed substantially since preparation of the 2009 DEIS and water quality modeling has been revised accordingly. PolyMet has developed Adaptive Water Management Plans that include contingencies and mitigation strategies if actual water effects turn out to be greater than modeled. Post-closure management is addressed in Section 3.2.2 and Chapter 7 of the SDEIS. During plant closure activities, demolition and reclamation of Plant Site infrastructure would be completed according to federal, state, and local agency permits and regulations. Financial assurance for closure and remediation of the NorthMet Project	WR 21, WR 35, WR131, WR 132

DEIS Theme Code	DEIS Theme Statement	DEIS Thematic Response	Corresponding FEIS Theme(s)
		Proposed Action is addressed in Chapter 3 of the SDEIS. A Co-lead agency document dated August 23, 2011, describes the mechanism for addressing financial assurance in the SDEIS.	
WR1B	The overall NorthMet Project Proposed Action monitoring plan for water quality is not adequate or described in sufficient detail.	Monitoring is addressed in detail in Section 5.2.2.3.6 of the SDEIS. Groundwater specific monitoring points will be located to evaluate the accuracy of predicted water quality effect. These prediction points were selected based on groundwater flow paths between Mine Site facilities (e.g., waste rock, tailings, pits, etc.) and the nearest surface waters (i.e., the Partridge River and Embarrass River). Surface water quality must be monitored and water quality standards met in all Embarrass River and Partridge River tributaries and main branches of these rivers, as determined by the MPCA.	WR 21
WR1C	Leaching of contaminants from waste rock stockpiles is problematic.	The NorthMet Project Proposed Action has changed substantially since preparation of the 2009 DEIS. The most reactive waste rock will be temporarily stored on liners, then placed in the East Pit and flooded with water before closure. Discussions of water resources effects (Section 5.2.2 of the SDEIS) account for temporary pollutant release by leakage through these liners. The less-reactive Category 1 waste rock pile that remains permanently on the surface will be surrounded with a water containment trench to capture seepage during and after mining. Water captured in the trench would be treated. A proposed geosynthetic cover would decrease water infiltration. The issue is addressed in Sections 3.2.2 and 5.2.2 of the SDEIS.	WR 01, WR 17
WR1D	The potential for pollution from railroad car ore spillage needs analysis.	The estimate of water quality effects in the SDEIS includes the release and transport of pollutants from ore spilled from rail cars. A monitoring plan for characterization of background water quality and evaluation of effects during operations has been developed. Mitigation strategies are part of the monitoring plan. Sections 4.2.2 and 5.2.2 of the SDEIS address this issue.	WR 151
WR1E	Studies and sampling were inadequate to assess and characterize baseline conditions of acid mine drainage, pollution (including sulfates, mercury, and methylmercury), groundwater (including flows), surface water, wetlands, wild rice, wildlife, and financial risks. As a result, the impact analysis is of the NorthMet Project	Environmental sampling and analysis has continued into 2012, expanding the set of baseline environmental data since the 2009 DEIS. Updated baseline environmental conditions are presented in Section 4.2.2 (water quality, wild rice, and mercury), and Section 4.2.3 (Wetlands). The water quality model used to estimate effects of the project has been calibrated to these current conditions, and the deviation between the calibrated models and observed conditions are considered as one measure of prediction	WR 03, WR 05, WR 08, WR 14, WR 25

DEIS Theme Code	DEIS Theme Statement	DEIS Thematic Response	Corresponding FEIS Theme(s)
	Proposed Action is inadequate.	uncertainty (Section 5.2.3).	
WR1F	The proprietary models of pollutant production and transport cannot be independently evaluated.	The proprietary models used in the DEIS to estimate the release and transport of pollutants under NorthMet Project Proposed Action have been replaced in the SDEIS with a model that, though still proprietary, is essentially transparent and can be viewed and executed independently. The technical review included independent assessment to confirm that the model used the parameter values agreed upon by the Co-Lead Agencies, and that the major model results could be reproduced using independent calculations. See Section 5.2.2 of the SDEIS.	WR 60, WR 61, WR 106
WR2A	The hydrogeology of the NorthMet Project site is not well understood. Therefore, the DEIS cannot reliably determine reliably aquifer drawdown from dewatering or whether pollutants from the Mine could travel in groundwater and degrade water in wells, lakes or rivers.	The NorthMet Project Proposed Action has changed substantially since preparation of the 2009 DEIS and water balance studies. In particular, the number of wells used to characterize the Mine Site alluvium (the main area affected by dewatering) has been increased (Section 4.2.2), and the new information on water levels and water quality gained from these data have been used in the calibration of the updated water quality model (Section 5.2.2).	WR 07, WR 08, WR 10
WR2B	Climate change could increase (beyond assumptions in the DEIS) the volume of water flowing through the Mine causing increased transportation of pollutants in surface and groundwater.	This issue is addressed in Sections 5.2.2 and 5.3.2 of the SDEIS. Estimates of pollutant transport from the NorthMet Project Proposed Action use results of "down-scale" climate models (i.e., nested models that refine the estimated effect of climate change on local water balance using larger-scale model results) to estimate the range in pollutant migration from mine waste. The effects of extremely wet periods are included in the modeling.	WR 77, WR 180, WR 188, WR 196
WR2C	Pollutants released by the NorthMet Project Proposed Action could contaminate groundwater. These effects need to be estimated.	The NorthMet Project Proposed Action has changed substantially since preparation of the 2009 DEIS and water quality modeling has been revised accordingly. Estimating the rate at which pollutants from mine waste could leach into groundwater is given high priority in the SDEIS modeling and is specifically discussed in Section 5.2.2 of the SDEIS. Pollutant concentrations in groundwater were estimated using probabilistic models; descriptions of predicted effects on groundwater and surface water quality are presented along with a discussion of uncertainty in model parameters.	WR 10, WR 12
WR2D	The liners under waste rock and waste facilities and /or hydrometallurgical waste cells may fail over time and may need to be replaced.	The NorthMet Project Proposed Action has changed substantially since preparation of the 2009 DEIS and the SDEIS has changed accordingly. In particular, the lowest-sulfide (Category 1) waste rock that will be permanently stored in unlined facilities will be surrounded completely by a groundwater containment system that will capture seepage during and after	WR 67, WR 126, WR 138

DEIS Theme Code	DEIS Theme Statement	DEIS Thematic Response	Corresponding FEIS Theme(s)
		mining to prevent discharge before it has been treated to meet discharge standards. After closure, the Category 1 waste rock will be covered with a geomembrane to reduce water percolation and pollutant transport. The more reactive (Category 2, 3, and 4) rock will be stored temporarily in lined facilities, before being placed in the East Pit for permanent stabilization under the water table. Hydrometallurgical waste will be blended with lime to reduce metal solubility prior to disposal, and this material will be placed in double-lined facilities, which have been shown to have negligible leakage.	
WR2E	The model of pollutant transport from Mine Site facilities to groundwater and surface water does not adequately represent the NorthMet Project Proposed Action. The model does not adequately consider water flow through the Mine Site, all of the chemical constituents that may be leached from mine waste, or the known mechanisms of pollutant release and transport at hard rock sulfide mines.	The NorthMet Project Proposed Action has changed substantially since preparation of the 2009 DEIS and water quality modeling has been revised accordingly. Estimating the rate at which pollutants from mine waste could leach into groundwater is given high priority in the SDEIS modeling and is specifically discussed in Section 5.2.2 of the SDEIS. The SDEIS expands the number of constituents included in the modeling from eight in the DEIS to 20 to include all inorganic constituents with drinking water standards. Pollutant concentrations in groundwater were estimated using probabilistic models. Descriptions of predicted effects on groundwater and surface water quality are presented along with a discussion of uncertainty in model parameters.	WR 49, WR 61
WR2F	The WWTF may not be able to adequately treat Mine Site water to meet discharge standards and there is no contingency for this. It is also unclear whether the WWTF would treat nitrates.	The state has reviewed the WWTF effluent water quality targets provided by PolyMet and, based upon currently available data, including RO pilot results, believes these targets could be met. Nitrates would be treated if they are included in the discharge permit. The WWTF will also be of modular construction, such that additional modules can be added for increased capacity if necessary.	WR 32
WR2G	The water quality models for the NorthMet Project Proposed Action produced recharge rates through the glacial till that seem implausible, based on USGS data. This should be reconciled by measuring recharge from water table wells and including recharge from all pathways, including meteoric water.	The NorthMet Project Proposed Action has changed substantially since preparation of the 2009 DEIS and water quality modeling has been revised accordingly. Water quality modeling is specifically addressed in Section 5.2.2 of the SDEIS. Hydraulic characteristics of the glacial till, including hydraulic conductivity and recharge, were refined by reviewing data (including specific measurements of recharge through surficial till) from two nearby mines with similar hydraulic and geologic settings.	SDEIS comments did not raise this topic.
WR2H	Many of the wetlands in the NorthMet Project area may be hydraulically connected to groundwater, contrary to the assumption in the	The potential for indirect wetland effects at the Mine Site is discussed in Section 5.2.2 of the SDEIS. This discussion is refined and expanded, compared to the 2009 DEIS, in particular by evaluating the effects of	WR 53

DEIS Theme Code	DEIS Theme Statement	DEIS Thematic Response	Corresponding FEIS Theme(s)
	DEIS. Air photo interpretation is inadequate to assess impacts on wetlands and Mud Lake. Empirical data used to address indirect wetland impacts needs better disclosure in the EIS.	dewatering at two nearby mines with similar bedrock and surficial geologic conditions.	
WR2I	The point selected to evaluate impacts to surface or groundwater is inappropriate.	The NorthMet Project Proposed Action has changed substantially since preparation of the 2009 DEIS and water quality modeling, proposed monitoring points, and proposed model evaluation points have been revised accordingly. Water quality monitoring is specifically addressed in detail in Section 5.2.2.3.6 of the SDEIS. For groundwater, specific monitoring points will be located to evaluate the accuracy of predicted water quality effect. These prediction points were selected based on groundwater flow paths between Mine Site facilities (e.g., waste rock, tailings, pits, etc.) and the nearest surface waters (i.e., the Partridge River and Embarrass River). The surface water quality modeling includes 18 evaluation points along the main branch of the Embarrass River, its tributary streams, and the main branch of the Partridge River, plus one evaluation point in Colby Lake.	WR 64, WR 109
WR2J	The evapotranspiration capability of the vegetated soil layer on the stockpiles has not been demonstrated.	The NorthMet Project Proposed Action has changed substantially since preparation of the 2009 DEIS and no longer includes permanent stockpiles of Category 2, 3, or 4 waste rock where minimizing infiltration is important. The Category 1 Stockpile would be covered by a geomembrane liner, thereby dramatically reducing infiltration and the need to accurately model evapotranspiration. Section 5.2.2 of the SDEIS addresses this issue.	SDEIS comments did not raise this topic.
WR3A	The evaluation of tailings discharges is inadequate as there is a significant potential for oxidation from the tailings slurry discharge beach and the tailings pond, winter effects on tailings oxidation need better definition, and water quality and quantity leaving the tailings basin may be problematic, especially in the case of flooding.	The NorthMet Project Proposed Action has changed substantially since preparation of the 2009 DEIS and water quality modeling has been revised accordingly. Water quality modeling is specifically addressed in Section 5.2.2 of the SDEIS. In addition, the SDEIS now uses a more robust probabilistic modeling approach that incorporates current data and information to present sufficient additional analysis. Finally, the flotation tailings will now be surrounded with a water containment system to capture seepage for storage and eventual treatment prior to discharge. Sections 3.2.2 and 5.2.2 of the SDEIS address this issue.	WR 45, WE 50
WR3B	There are concerns about water quality effects beyond the immediate NorthMet Project area, including BWCAW, the overall St. Louis River Watershed, and Lake Superior.	There is no groundwater seepage or surface water drainage from the NorthMet Project area to the BWCAW or its waters. Groundwater seepage and surface runoff from the NorthMet Project area drains to either the Partridge River or the Embarrass River, both of which are tributaries of the St. Louis River and Lake Superior. All seepage and surface water runoff	WR 38, WR 42, WR 80

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		must meet applicable water quality standards at or before the property boundary. Section 5.2.2 of the SDEIS addresses this issue.	
WR3C	The DEIS' finding that there will be no surface water discharge is incorrect. The final EIS should acknowledge the application of NPDES permits to a variety of pathways for surface water discharge and to assess the potential for each, including the West Pit outflow.	The NorthMet Project Proposed Action has changed substantially since preparation of the 2009 DEIS and the SDEIS has changed accordingly. There will be groundwater seepage from the Tailings Basin and the East Pit after it fills with water. These seepages (which are quantified in Section 5.2.2 of the SDEIS) will eventually become surface water draining to tributaries of the Embarrass River and Partridge River. All applicable groundwater and surface water standards must be met. There may also be direct discharge from the WWTF, which would require a NPDES permit, if there is excess water after make-up water needs are met. Beginning in approximately year 40, there could also be direct discharges from the West Pit Overflow; this discharged water would be treated at the WWTF prior to diversion into the West Pit.	SDEIS comments did not raise this topic.
WR3D	The NorthMet Project Proposed Action could result in AMD and the potential for additive toxicity to Lake Superior.	The NorthMet Project Proposed Action has changed substantially since preparation of the 2009 DEIS. There is a discussion on the potential for effects as it pertains to the impaired status of the St. Louis River (which flows into Lake Superior) and/or the TMDL process in Section 5.2.2 and Chapter 6 of the SDEIS. See also response to theme WR3C.	WR 01, WR 08, WR 10, WR 19, WR 25
WR3E	Water level changes in the Partridge River and Embarrass River and wetlands downstream of the tailing basin in needs quantifying.	Changes in streamflow to the Partridge River and Embarrass River were modeled for the 2009 DEIS, and that modeling was revised for the SDEIS to reflect substantial changes in the NorthMet Project Proposed Action. These changes are addressed in Section 5.2.2 of the SDEIS. The small reduction in streamflow due to the NorthMet Project Proposed Action will result in an imperceptible change in river water level.	WR 45, WR 46, WR 47, WR 48
WR3F	Water quality and quantity impacts to Colby Lake and Hoyt Lakes' municipal water supply need better analysis. The DEIS should have discussed the following related issues: development of a TMDL or Manganese criterion for Colby Lake; effects on Colby Lake's water levels; quantity of water pumped to the WWTP; and levels of metals removal, including iron reduction, achieved by the Hoyt Lakes treatment plant.	These issues are addressed in Section 5.2.2 of the SDEIS. Colby Lake is one of the water quality modeling evaluation points downstream of the Mine Site. Effects on Colby Lake are discussed in Section 5.2.2.3.2.	WR 43, WR 123, WR 140

DEIS Theme Code	DEIS Theme Statement	DEIS Thematic Response	Corresponding FEIS Theme(s)
WR3G	In reference to lining the exposed Virginia Formation along the East Pit's north wall, literature citation notes that lime increases pH which, in turn, increases release of arsenic. The relationship between arsenic solubility and liming should be addressed.	The NorthMet Project Proposed Action has changed substantially since preparation of the 2009 DEIS. As described in Chapter 3 and Section 5.2.2 of the SDEIS, the more reactive waste rock and overburden would be backfilled to the East Pit, covering the Virginia formation, and would be permanently stored subaqueously, minimizing oxidation and the subsequent release of contaminants. Lime could be added to the East Pit during backfilling, as needed, in order to maintain circumneutral pH in the pit pore water, which would be pumped to the WWTF and returned to the East Pit as required to manage potential pollutant load. The volume of lime required would be determined through monitoring.	WR 27
WR3H	The DEIS needs to model for dissolved aluminum, not total, since dissolved is the standard.	Minnesota Rules 7050.0222 Subpart 1.B states that in the absence of a listed conversion factor for a particular metal to convert total to dissolved, the applicable conversion factor is one. Aluminum is not listed in Subpart 9; therefore, its conversation factor is one. That means, practically speaking, that total equals dissolved; therefore, modeling total aluminum is acceptable. Since the dissolved form of a metal, by definition, cannot be greater than the total metal, using total aluminum in the modeling can be considered conservative. Modeling criteria for aluminum and other constituents are discussed in Section 5.2.2.1.2, while future concentrations of aluminum are discussed in Section 5.2.2.3.2 (Partridge River) and Section 5.2.2.3.3 (Embarrass River).	WR 82
WR3I	There are potential exceedances of water quality standards due to the NorthMet Project Proposed Action, even after WWTF treatment. To demonstrate compliance with all applicable standards and regulations, the EIS should present additional analysis, suggest alternative designs and methods to prevent contamination that exceeds water quality standards, and should use more rigorous Impact Criteria imposed by downstream impaired waters (including TMDL and nondegradation criteria) for al chemicals on the GLI list.	The NorthMet Project Proposed Action has changed substantially since preparation of the 2009 DEIS and water quality modeling has been revised accordingly. Water quality modeling is specifically addressed in Section 5.2.2 of the SDEIS. In addition, the SDEIS now uses a more robust probabilistic modeling approach that incorporates current data and information to present sufficient additional analysis to compare predicted effects against applicable standards and regulations. Specific (i.e., numeric) evaluation criteria related to sulfate and methylmercury for the impaired portion of the St. Louis River do not exist. Section 5.2.2 of the SDEIS therefore discusses potential methylmercury-related effects in downstream impaired waters qualitatively.	WR 52, WWR 54, WR 60, WR 64, WR 70, WR 82, WR 83
WR3J	Lack of on or near-site streamflow data makes the DEIS' impact assessment questionable.	The Co-lead Agencies are comfortable with the modeling approach used for hydrologic impact assessment, especially since data collected during recent winters confirms that the model's baseflow estimates are conservatively	WR 03, WR 04, WR 05, WR 06, WR 81, WR 91,

DEIS Theme Code	DEIS Theme Statement	DEIS Thematic Response	Corresponding FEIS Theme(s)
		low. It is also important to note that the total watershed area consumed within the NorthMet Project area is less than 7 percent at any location along the Partridge River, meaning that actual changes in streamflow will be very small. One or more permanent gauging stations along the Partridge River will be required during operations to aide in the determination of compliance with water quality standards.	WR 101, WR 105
WR3K	Ditches and dikes are not 100 percent effective. The materials used in ditch and storm water leachate collection systems must preclude seepage and be resistant to freeze/thaw cycles.	It is understood that the ditches and dikes that are part of the Category 1 Stockpile seepage collection system are not 100 percent effective. However, they will be engineered to an acceptable level of efficiency considering the low reactive potential of the Category 1 waste rock, and the modeling used to estimate project effects on water quality have assumed leakage rates observed in similar systems. This issue is addressed in Sections 3.2.2 and 5.2.2 of the SDEIS.	WR 17, WR 127
WR3L	Wetland treatment in the East Pit is inadequate for water treatment.	The NorthMet Project Proposed Action has changed substantially since preparation of the 2009 DEIS and water quality modeling has been revised accordingly. Water quality modeling is specifically addressed in Section 5.2.2 of the SDEIS.	SDEIS comments did not raise this topic.
WR3M	The DEIS fails to analyze the impacts to water quality from the local deposition and run-off of metal emissions.	The NorthMet Project Proposed Action has changed substantially since preparation of the 2009 DEIS and water quality modeling has been revised accordingly. Water quality modeling is specifically addressed in Section 5.2.2 of the SDEIS. In addition, the SDEIS now uses a more robust probabilistic modeling approach that incorporates current data and information to present sufficient additional analysis. Projected mercury emissions from the Plant Site have been subjected to an AERA, where potential mercury-related risks were assessed for fishing and subsistence users, where chronic risks are based on fish consumption. The findings of the agency-approved AERA are presented in the SDEIS.	SDEIS comments did not raise this topic.
WR3N	The potential effects of the NorthMet Project Proposed Action on wetlands, bogs, and peatlands were not adequately evaluated in the DEIS.	Please see response to Theme WR3M.	WR 53, WR 64, WR 105, WR 112, WR 119
WR4A	The modeling used for the DEIS must consider mercury methylation and provide a quantitative analysis of the discharge of mercury from all pathways during and after mining based on	The NorthMet Project Proposed Action has changed substantially since preparation of the 2009 DEIS and water quality modeling has been revised accordingly. Water modeling is specifically discussed in Section 5.2.2 of the SDEIS. The SDEIS gives high priority to estimating the rate at which	WR 158, MERC 02, MERC 08, MERC 23

DEIS Theme Code	DEIS Theme Statement	DEIS Thematic Response	Corresponding FEIS Theme(s)
	realistic data. Modeling should also consider estimates of expected variation in measures under varied conditions (e.g., fluctuating water levels in reservoirs and flood plains).	pollutants from mining waste (e.g., tailings, waste rock, stockpiled ore, pit-wall rock, and hydrometallurgical process residue) could leach into groundwater. To ensure that the analysis for the SDEIS identified a realistic range for possible effects on water quality, the Water Resources IAP Workgroup identified ranges for values of most parameters used to estimate pollutant migration. The model of pollutant dissolution and migration considers water percolation rates through mine waste, leakage rates through lined facilities, and uses empirical tests on project materials to estimate dissolution rates for sulfide minerals and chemical attenuation by adsorption and precipitation (see Section 5.2.2.2.3). Quantitative modeling of methylmercury is beyond the scope of the SDEIS, due to the inherent complexity of the fate and transport of methylmercury in the environment. However, the potential for enhanced methylation of mercury and uptake in fish as a result of project discharges is qualitatively addressed in the SDEIS.	
WR4B	The DEIS fails to adequately address impacts of mercury and methylmercury, particularly on fish and humans. The DEIS should include an analysis of the impacts of methylmercury on fish communities, as well as on people and wildlife that consume the fish, social and economic impacts to fisheries, groundwater, surface water, wetlands, and sensitive areas and waterbodies with existing mercury impairments. The EIS should also explain why the addition of sulfates from the NorthMet Project Proposed Action will not result in additional mercury pollution, how the St. Louis River Watershed will be able to attain TMDL standards, and the potential for mercury demethylation and/or methylation in flooded mine pits.	The NorthMet Project Proposed Action has changed substantially since preparation of the 2009 DEIS and water quality modeling has been revised accordingly. Estimating the rate at which pollutants from mining waste could leach into groundwater is given high priority in the SDEIS modeling and is specifically discussed in Section 5.2.2. Pollutant concentrations in groundwater were estimated using probabilistic models. Descriptions of predicted effects on groundwater and surface water quality are presented along with a discussion of uncertainty in model parameters. The SDEIS specifically addresses possible effects on people, fisheries, and wildlife based on the estimates of pollutant concentrations from the models. Quantitative modeling of methylmercury is beyond the scope of the SDEIS, due to the inherent complexity of the fate and transport of methylmercury in the environment. However, the potential for enhanced methylation of mercury and uptake in fish as a result of NorthMet Project Proposed Action discharges are qualitatively addressed in the SDEIS.	MERC 02, MERC 03, MERC 24
WR4C	Monitoring, mitigation measures, and contingency responses for pollutant releases (especially sulfate and mercury) are inadequately described in the DEIS. The DEIS should explain how exceedances of these materials are to be regulated, define the goal of	These issues are addressed in Chapters 3 and 7 of the SDEIS. Under the SDEIS, the Category 1 waste rock facility and the Tailings Basin will be surrounded by containment systems to capture and treat seepage to reduce the pollutant load to groundwater. Groundwater monitoring points will be located to evaluate the accuracy of predicted water quality effect. During mine closure, the East Pit would be reclaimed as a wetland and the West Pit	WR 21, MERC 08, MERC 17

DEIS Theme Code	DEIS Theme Statement	DEIS Thematic Response	Corresponding FEIS Theme(s)
	maintenance-free closure, and any financial safeguards that are in place to address future problems to water and soil as a consequence of industrial action.	would flood with water to become a pit lake. Water from the West Pit will be treated as necessary at the WWTF and returned to the West Pit, or discharged to the Partridge River at concentrations that meet pollutant concentration thresholds. During post-closure, the WWTF will be used, as necessary, to treat effluent from the West Pit Lake, the Category 1 waste rock and the Tailings Basin to meet surface water quality standards before it is discharged. The WWTF will be run as long as necessary during operations and closure, until passive treatments are adequately demonstrated to meet water quality standards. During plant closure activities, demolition and reclamation of Plant Site infrastructure would be completed according to federal, state, and local agency permits and regulations.	
WR4D	The permitting of the NorthMet Project Proposed Action would violate the Great Lakes Compact of zero discharge of mercury to the basin and federal or state regulations that prohibit mixing zones (40 C.F.R. § 132, Appendix F, Procedure 3; Minn. R. 7052.0210, Subpart 3). The more rigorous Impact Criteria imposed by the downstream impaired waters and TMDL status and nondegradation under Minnesota Rules 7050 and 7052 should be used instead of the Great Lakes Initiative.	This issue is addressed in Chapter 1 of the SDEIS. Applicability of the Great Lakes Initiative is also discussed in Sections 5.2.2.1.2 (Evaluation Criteria), and Sections 5.2.2.3.4 (Mercury). The NorthMet Project Proposed Action has changed substantially since preparation of the 2009 DEIS, and water quality modeling has been revised accordingly. The SDEIS will use a more robust probabilistic modeling approach that incorporates current data and information to present sufficient additional analysis to compare predicted effects against applicable standards and regulations. Specific (i.e., numeric) evaluation criteria related to sulfate and methylmercury for the impaired portion of the St. Louis River does not exist. The SDEIS discusses potential methylmercury-related effects in downstream 'impaired' waters qualitatively in the Chapter 5 of the SDEIS. The water quality evaluation criteria in the SDEIS include the Lake Superior mercury standard.	WR 38, WR 125, WR 158, MERC 01
WR4E	Sequestration of mercury by soil, peatlands, and/or minerals is not adequately discussed in the DEIS. The EIS should include quantitative information on mercury sequestration from the MDNR study.	This issue was addressed in the DEIS. The NorthMet Project Proposed Action has changed substantially since preparation of the 2009 DEIS. The SDEIS uses a more robust probabilistic modeling approach that incorporates current data and information to present sufficient additional analysis. Quantitative modeling of mercury transport is beyond the scope of the SDEIS, due to the inherent complexity of the fate and transport of methylmercury in the environment. However, the potential for enhanced methylation of mercury are addressed in the SDEIS.	SDEIS comments did not raise this topic.
WR4F	The NorthMet Project Proposed Action could potentially elevate sulfate concentrations above the 10 mg/L wild rice standard and could promote AMD with potential impacts on the	The NorthMet Project Proposed Action has changed substantially since preparation of the 2009 DEIS. The MPCA staff have made a draft recommendation that portions of the Partridge River downstream of the Mine Site be treated as waters used for the production of wild rice, meaning	WR 149, WR 152, WR 156

DEIS Theme Code	DEIS Theme Statement	DEIS Thematic Response	Corresponding FEIS Theme(s)
	health of aquatic vegetation, especially wild rice beds, which have significant cultural and ecological value. The EIS should thoroughly evaluate impacts on wild rice standards.	that the 10 mg/L sulfate evaluation criterion would apply to these reaches from April 1 to August 31. The NorthMet Project Proposed Action includes controlled outflow from the West Pit to comply with this standard. Modeling of the NorthMet Project Proposed Action indicates that sulfate concentrations in tributaries north of the basin and at PM-13 would decrease in comparison to the Continuation of Existing Conditions modeling scenario. These aspects of the NorthMet Project Proposed Action are described in Chapter 3, Chapter 7, and Section 5.2.2 of the SDEIS.	
WR5A	Inadequate consideration has been given to the long-term impact of mercury and sulfate emissions from the NorthMet Project Proposed Action, in combination with other cumulative impacts, on water resources (including groundwater, water supplies, exceedances of water quality standards, metal leaching, flow fluctuations, and hardness), wetlands, wild rice beds, changes in cover, and hydrology.	This issue is addressed Chapter 7 of the SDEIS. The estimates of effects from the NorthMet Project Proposed Action include release of sulfate and mercury from mine waste to groundwater and surface water. Additional mitigation described in the SDEIS includes groundwater containment systems around the Category 1 waste rock and Tailings Basin. Also, Category 1 waste rock will be covered with a geosynthetic layer to reduce infiltration, and the Tailings Basin surface and slopes would be amended with bentonite to reduce oxygen and water flow and thus reduce pollutant releases. The tailings system is designed with a goal of eventual discontinuation of groundwater seepage collection.	WR24, WR 159
WR5B	The cumulative impacts of the NorthMet Project Proposed Action with other mining projects must be addressed, especially the capacity of the rivers to assimilate wastewater effluent.	This issue is addressed Chapter 6 of the SDEIS.	WR 24, WR 159
WR5C	The applicant's assessment of uniquely affected communities is incorrect and cumulative effects of the NorthMet Project Proposed Action on health and biological resources, including wild rice, and wildlife populations (e.g., fish, moose), must be considered. These impacts could disproportionately affect minority communities, low income persons, and Indian tribal members, whose diets rely on fish to a greater extent than their non-Indian neighbors.	These concerns are addressed in the topic-specific portions of Chapter 6 of the SDEIS, including Water Resources, Wildlife, Fish and Macroinvertebrates, and Socioeconomics.	WR 156, WR 159

ATTACHMENTS

Attachment 1 – EIS Public Submissions and Comments:

SDEIS Submissions - Copies of all unique and variant submissions (plus one each non-variant template) received on the SDEIS

SDEIS Comments - Copies of all individual comments, and theme assignments for the SDEIS submissions

DEIS Submissions - Copies of all unique and variant submissions (plus one each non-variant template) received on the DEIS

DEIS Comments - Copies of all individual comments, and theme assignments for the DEIS submissions

Appendix B

Underground Mining Alternative Assessment for the NorthMet Mining Project and Land Exchange Environmental Impact Statement

Underground Mining Alternative Assessment for the NorthMet Mining Project and Land Exchange Environmental Impact Statement

Co-lead Agencies:

Minnesota Department of Natural Resources

United States Army Corps of Engineers

United States Forest Service

September 27, 2013

Table of Contents

List of Figures

List of Tables

1.0 INTRODUCTION

Section 1502.14 of the National Environmental Policy Act requires that Environmental Impact Statements (EISs) examine all reasonable alternatives to the proposed project. The Council on Environmental Quality defines reasonable alternatives as those that are practical or feasible from technical and economic standpoints and use common sense (Council on Environmental Quality 1981).

Under the Minnesota Environmental Protection Act, an EIS shall compare the potentially significant impacts of the proposed action with other reasonable alternatives to the project. However, *Minnesota Rule* 4410.2300 states that an alternative may be excluded from analysis in the EIS if it would not meet the underlying need or purpose of the project (State of Minnesota 2009).

In the Draft Environmental Impact Statement (DEIS) for the NorthMet Project, the Minnesota Department of Natural Resources (MDNR) and United States Army Corps of Engineers considered underground mining as an alternative to the proposed open pit(s) (MDNR and United States Army Corps of Engineers 2009). This alternative was eliminated because an underground mine would have a significantly reduced rate of operation that would not be considered economically feasible, and, therefore, would not meet the Purpose and Need of the NorthMet Project.

Following tribal and public comment on the DEIS, the Co-lead Agencies, who now include the United States Forest Service, reconsidered underground mining as an alternative to the NorthMet Project in preparation of a Supplemental Draft Environmental Impact Statement (SDEIS). This position paper provides an overview of the alternative screening process undertaken and the decision on whether to undertake a full evaluation of underground mining as an alternative in the SDEIS.

1.1 PURPOSE OF ASSESSMENT

Following its elimination from further consideration in the DEIS, tribal and public comments on the DEIS, as well as discussions during scoping of the Land Exchange, suggested the Co-lead Agencies reconsider underground mining as an alternative in the SDEIS.

The main reasons for reconsideration provided by the public and Bands were:

- the environmental benefits of underground mining compared to open pit mining, and
- that underground mining could be undertaken without the need for a Land Exchange.

1.2 ASSESSMENT MATERIAL

The information in the following subsections was used to inform a semi-qualitative screening analysis of the alternative. A detailed underground mine plan was not developed because PolyMet Mining Corporation (PolyMet) made the business decision to eliminate underground mining as a possible mining method at the NorthMet Deposit based on information that indicated it would not be economically feasible. Therefore, it was not possible to undertake a quantitative, side-by-side assessment of the underground mining alternative.

1.2.1 United States Steel

In the 1970s, the NorthMet Deposit was investigated by United States Steel (U.S. Steel) to evaluate the potential to mine the deposit using underground methods. The MDNR reviewed documentation relating to the U.S. Steel investigation (Patelke and Severson 2005; PolyMet 2007) and found the following was concluded by U.S. Steel:

- mineralization at the NorthMet Deposit was below the expected grades, and
- metallurgical technology available at that time was not sufficient to produce separate, distinct nickel and copper concentrates.

Consequently, the U.S. Steel information alone was not indicative of the potential economic viability of underground mining for the NorthMet Project.

1.2.2 PolyMet

PolyMet, through its consultant (Foth Infrastructure & Environment, LLC), assessed the economic feasibility of underground mining at the NorthMet Deposit based on the proposed open pit deposit (Foth 2012). The findings of this assessment are included in the *Economic Assessment of Conceptual Underground Mining Option for the NorthMet Project*, included with this paper as Attachment 1. A supplemental memorandum was also prepared by Foth to provide further information on the boundaries and model used in the analysis (Foth 2013). This memorandum, *Response to USEPA Questions Regarding: Economic Assessment of Underground Mining Report Dated October 2012*, is provided with this paper as Attachment 2. The information provided by PolyMet was reviewed by technical staff at the MDNR and was determined to be sufficient for a screening-level review of the feasibility of underground mining at the NorthMet Deposit.

2.0 SCREENING OF THE UNDERGROUND MINING ALTERNATIVE

The underground mining alternative for the NorthMet Project was reconsidered for the SDEIS using the same screening criteria as in the DEIS. The screening criteria were used to determine if the alternative would:

- offer significant environmental and/or socioeconomic benefits (over the Proposed Action or other alternatives),
- be available (legally, through surface access and mineral rights),
- be technically feasible (physically possible to construct and underground mine),
- be economically feasible (provide sufficient income to cover: operating, capital, and other costs with an adequate return to investors), and
- meet the Purpose and Need for the project.

The alternative would need to meet all of these criteria to merit further evaluation in the SDEIS. Evaluations of the underground mining alternative against each of the screening criteria are presented in the following subsections.

2.1 SIGNIFICANT ENVIRONMENTAL AND/OR SOCIOECONOMIC BENEFITS

Compared to the proposed open pit mine, the underground mining alternative would offer some significant environmental benefits, including:

- fewer direct effects on surface resources, including wetlands;
- less mine dewatering and, therefore, less water to be managed;
- less waste rock, which would result in:
  - a smaller surface footprint; and
  - reduced effects on surface water and groundwater.
- less ore mined at a slower rate, which would result in:
  - less tailings and hydrometallurgical residue to be managed;
  - fewer effects on surface water and groundwater; and
  - reduced air emissions from mining, transporting, and processing the ore, and constructing the Tailings Basin and Hydrometallurgical Residue Facility.

However, compared to the proposed open pit, an underground mining alternative for the NorthMet Deposit would have a reduced mining rate and life of mine. Consequently, a smaller mining operation would employ fewer workers for a shorter period of time, and would also reduce tax revenues to the state and localities (refer to Section 2.4, Economic Feasibility). Thus, the underground mining alternative would reduce the socioeconomic benefits, as compared to the proposed open pit.

Although the underground mining alternative would offer environmental benefits, it would result in reduced socioeconomic benefits. Additionally, because an underground mine at the NorthMet Deposit would not be profitable (refer to 2.4 Economic Feasibility), a for-profit company like PolyMet would not move forward with the project, thus any potential environmental or socio-economic benefits associated with this alternative are moot.

2.2 AVAILABILITY

Minerals are available for PolyMet to mine at the NorthMet Deposit through private mineral lease agreements. Surface use could be available through the Land Exchange or other United States Forest Service approvals if an underground mining alternative were deemed viable and adopted by PolyMet.

The underground mining alternative is available at the NorthMet Deposit.

2.3 TECHNICAL FEASIBILITY

Technical feasibility considers whether or not it would be physically possible to create an underground mine at the NorthMet Deposit, disregarding economic feasibility and other considerations.

The NorthMet Deposit is a shallow, large-tonnage, low- to medium-grade mineral resource. Such deposits typically require backfilling, if mined using underground methods, to prevent caving. PolyMet considers that the following methods of underground mining could be technically possible at the NorthMet Deposit:

- Long-hole open stoping (backfilled). This involves the development of large stopes or caved rooms within a steeply dipping orebody. Caving is accomplished by long drill holes and blasting to collection shoots below.
- Short-back open stoping (backfilled). This is similar to long-hole open stoping, but smaller-caved stopes are created within a moderately dipping ore deposit.
- Room and pillar (backfilled). This involves mining the ore deposit (steep or shallow dipping) in tabular layers, with pillars of ore left in place to support the roof (hang wall). Rooms are created by drilling horizontally, blasting, and rubber tired hauling away.
- Mechanized cut and fill (backfilled). This is similar to room and pillar, except that no pillars are left behind. Instead, backfill sand or rock is placed during mining to support the roof.

The underground mining alternative is technically feasible for the NorthMet Deposit.

2.4 ECONOMIC FEASIBILITY

Economic feasibility is based on the balance of costs and profit margins against the value of the mineable material. Since PolyMet is a private sector and for-profit company, the value of the saleable material would need to provide sufficient income to cover operating cost (which includes, but is not limited to, the cost of mining, processing, transportation, and waste management), capital cost (to build and sustain facilities), an adequate return to investors, reclamation, and closure costs and taxes.

While low-confidence mineralization is known to extend along the strike beyond the proposed open pit outline, this material has not been evaluated in detail, there is no mine plan for it, and it is not included as part of the proposed NorthMet Project. A mine plan has only been developed for the proposed open pit. The following discussion is based on qualitative information and the experience of PolyMet and its consultants.

2.4.1 Mineralization at the NorthMet Deposit

The NorthMet Deposit is considered to be a near-surface, bulk, low-grade mineralization of copper, nickel, cobalt, platinum, palladium, and gold. The contained metal value of mineralization at the NorthMet Deposit has been modeled with a high level of confidence in the area proposed to be mined as part of the NorthMet Project (20 year open pit), and with lower confidence beyond the proposed open pit outline. The metal prices used in calculating the contained metal values (dollars per ton) at the NorthMet Deposit for this assessment are listed below:

- Copper = $3.56 per pound,
- Nickel = $9.47 per pound,
- Cobalt = $11.69 per pound,
- Platinum = $1,689 per troy ounce,
- Palladium = $684 per troy ounce, and
- Gold = $1,485 per troy ounce.

These metal prices were calculated on June 30, 2012, and are consistent with the National Instrument 43-101 reporting standard that is used for public disclosure of information relating to mineral properties on bourses supervised by the Canadian Securities Administrators.

For each specific pre-extraction tonnage, an *in situ* average net metal value per ton was calculated based on the grade of ore and accounting for reasonable dilution and extraction losses (refer to Section 2.3, Technical Feasibility). Results showed that there is a generally linear relationship between the total cumulative tonnage of material and its average net metal value (Figure 1)—i.e., there is progressively less material available at higher net metal values. There are 85,614 short tons (cumulative) that have an average net metal value of $96.77 per short ton, and 227,017,162 short tons (cumulative) that have an average net metal value of $33.18 per short ton.

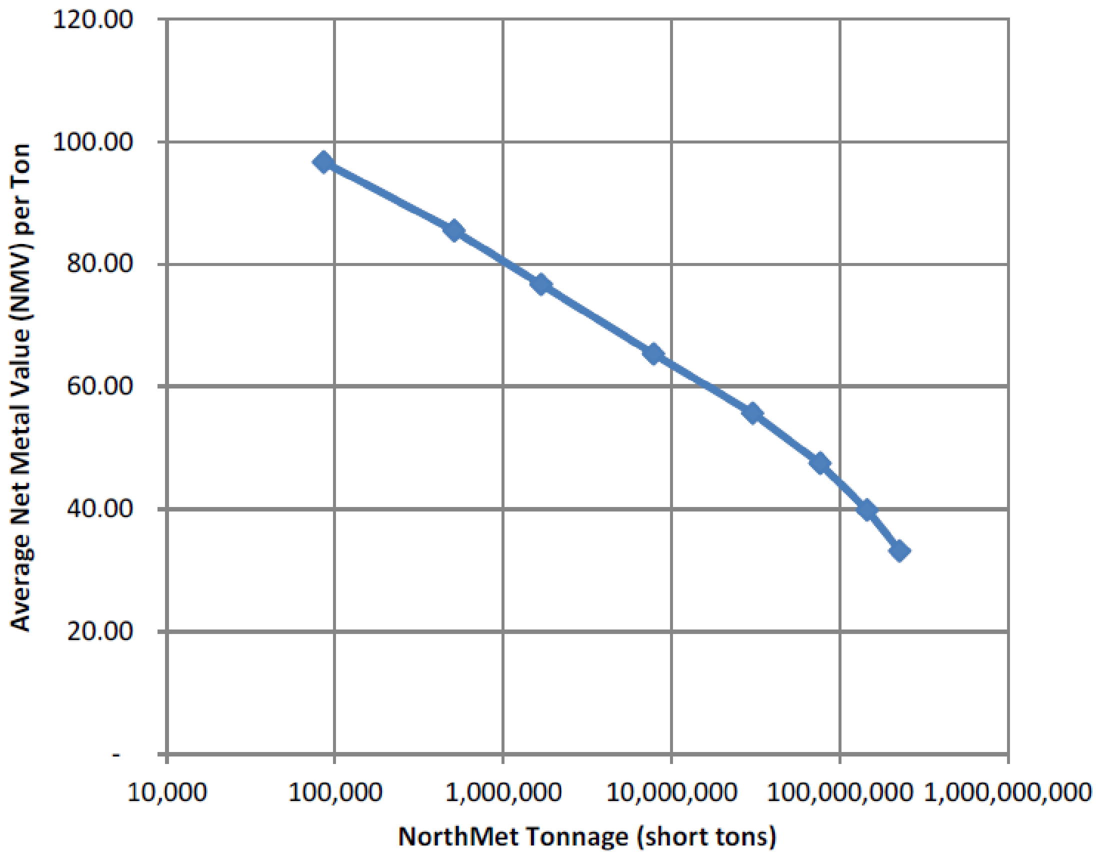

Figure 1 Tonnage vs. Average Net Metal Value

Using underground mining would result in most of the NorthMet Deposit left unmined because of its low metal value (i.e., less value than the cost of mining and mineral processing). Other material would have to be left in place for safety reasons, to prevent collapse. The underground rate of extraction for mining with backfilling is typically between 90 and 99 percent. PolyMet assumed a 95 percent rate of extraction for its economic assessment of the underground mining alternative. Mined ore could also be diluted between 5 and 30 percent by waste rock, as a result of overblasting and blending at ore-to-waste boundary lines. A dilution of 5 percent was used by PolyMet for the economic assessment of underground mining.

2.4.2 Underground Mining Costs

The estimated operating and capital costs vary depending on the rate and method of mining and processing. For the purpose of the economic assessment, PolyMet estimated operating costs and pre-production capital costs for underground mining and mineral processing at the NorthMet Deposit based on published cost models that were validated by comparable projects and mines (Table 1).

Table 1 Estimated Costs for an Underground Mine at the NorthMet Deposit

Tons per Day	Operating Mining and Mineral Processing Cost per Ton ($)	Pre-production Capital Costs ($ million)
2,000	74	125
5,000	56.5	200
7,500	49	250
10,000	48.5	300
15,000	47	400

2.4.3 Economic Feasibility

Based on an optimal formula, the productive life of an underground mine was determined for increments of tonnages, from fewer than 4 million to 100 million tons. From these numbers, the daily rate of production was calculated. The net metal value of that extracted material was calculated based on the average metal value for that tonnage minus 5 percent royalty costs that would apply at the NorthMet Deposit. To estimate the total operating cost, the extracted tonnage was multiplied by the total operating cost per ton. To calculate the life-of-mine profit balance, the total costs were subtracted from the net value of the mined material (Table 2).

Table 2 Economic Assessment of a Sample of Underground Mining Scenarios Considered

Extracted Tonnage (million short tons)	Net extracted net metal value ($ million)	Tons per Day	Productive Life of Mine (years)	Total Operating Cost ($ million)	Pre-production Capital Costs ($ million)	Profit: Metal Value – Costs ($ million)
5	302	2,000	7	370	125	-$193
20	1,077	5,000	11	1,130	200	-$253
30	1,552	7,500	11	1,470	250	-$168
50	2,386	10,000	14	2,450	300	-$364
100	4,143	15,000	18	4,700	400	-$957

Results show that for all tonnages the net profit is negative—i.e., underground mining is not economically feasible for the NorthMet Deposit.

2.5 PURPOSE AND NEED

The Purpose and Need of the NorthMet Project (Attachment 3) includes the ability to extract and process metals in a technically and economically feasible manner that generates sufficient income to cover: operating costs, capital costs, an adequate return to investors, reclamation, and closure costs and taxes.

Preliminary economic screening undertaken by PolyMet determined that the sale of metal precipitates and concentrates produced from an underground mining alternative would not be economically feasible to meet the requirements of the Purpose and Need. Because of this, the alternative was eliminated from further evaluation and a site-specific engineered underground mine plan was not developed.

The underground mining alternative does not meet the Purpose and Need for the project.

3.0 CONCLUSION

Alternatives need to meet all of the screening criteria to merit further evaluation. The summary of the screening results for the underground mining alternative are shown in Table 3.

The Co-lead Agencies found that while underground mining is technically feasible, available, and would offer significant environmental benefits over the proposed NorthMet Project, it would not be economically feasible and would not meet the Purpose and Need.

Since the underground mining alternative would not meet all of the screening criteria, it is not considered to be a reasonable alternative. Therefore, the underground mining alternative was eliminated from further evaluation in the SDEIS.

Table 3 Underground Mining Alternative Screening Table

Potentially Offer Significant Environmental or Socioeconomic Benefits?	**Available?**	**Technically Feasible?**	**Economically Feasible?**	**Meets the Purpose and Need?**
Yes*	Yes	Yes	No	No

*The underground mining alternative would offer significant environmental benefits, but would offer reduced socioeconomic benefits.

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ATTACHMENTS

Attachment 1 Foth 2012, Economic Assessment of Conceptual Underground Mining Option for the NorthMet Project

Attachment 2 Foth 2013, Memorandum: Response to USEPA Questions Regarding: Economic Assessment of Underground Mining Report Dated October 2012

Attachment 3 NorthMet Project and Land Exchange Purpose and Need Statement

Attachment 1
Foth 2012, Economic Assessment of Conceptual Underground Mining Option for the NorthMet Project

Report

Economic Assessment of Conceptual Underground Mining Option for the NorthMet Project

Project I.D.: 12P778

Poly Met Mining, Inc.
St. Paul, Minnesota

October 2012

POLYMET
MINING

Prepared by: Theodore J. Bornhorst, LLC

Foth

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October 2012

Economic Assessment of Conceptual Underground Mining Option for the NorthMet Project

Contents

Tables

Figures

Figure 3 Tonnage Versus Average Net Metal Value per ton for the NorthMet Deposit

Economic Assessment of Conceptual Underground Mining Option for the NorthMet Project

Executive Summary

This report assesses the prospects of the economic viability of extracting any portion of the NorthMet deposit by underground mining. While a Canadian National Instrument 43-101 (NI 43-101) compliant mineral resource has been published for NorthMet on the basis of open-pit mining, no mineral resource has been defined for NorthMet on the basis of underground mining. This report has been prepared to provide information to agencies preparing the Environmental Impact Statement (EIS) for the NorthMet Project, in order to help them comply with National Environmental Policy Act (NEPA) and Minnesota Environmental Policy Act (MEPA) by adequately considering alternative mine development methods, such as underground mining.

There is no prospect of economically viable extraction of a portion of the shallow large tonnage low-to-medium grade NorthMet deposit by underground mining based on the analysis in this report. The tonnage/volume and grade (amount of metals) of rock within the NorthMet deposit does not generate enough revenue to pay for all costs associated with underground mining. The analysis of economic viability demonstrates that the value of metals per ton of rock, using metal prices defined in 2012, is too low to cover reasonable total operating costs and total pre-production capital costs, defined by cost models, resulting in a negative operating profit (operating loss) or a negative project profit (capital loss). Underground mining is not economically viable for the NorthMet project which is consistent with early studies at NorthMet, general rules for assessment of economic viability and similar mining operations elsewhere.

List of Abbreviations, Acronyms, and Symbols

AGP	AGP Mining Consultants
CIM	Canadian Institute of Mining, Metallurgy and Petroleum
EIS	Environmental Impact Statement
Foth	Foth Infrastructure & Environment, LLC
MEPA	Minnesota Environmental Policy Act
MSL	Mean Sea Level
NEPA	National Environmental Policy Act
NI	National Instrument
Poly Met	Poly Met Mining, Inc.
SEC	Securities and Exchange Commission
SEDAR	System for Electronic Document Analysis and Retrieval

1 Introduction

NorthMet is a large tonnage and low-to-medium grade polymetallic copper-nickel-cobalt-palladium-platinum-gold deposit hosted by thick intrusive rocks located in St. Louis County in northeastern Minnesota (Poly Met, 2007). The concentration of metals occurs in four broadly defined horizons dipping between 15o to 25o to the southeast as determined by data from drill holes. Figure 1 shows the location of the deposit within the open-pit projected upwards to the surface. NorthMet was discovered in 1969 and early studies concluded that the tonnages and grades were not high enough to support underground mining. Subsequent work by Poly Met Mining, Inc. (Poly Met) has led to a delineated polymetallic mineral resource capable of being extracted by open-pit mining. The purpose of this report is to answer the question: Is there a prospect of economically viable extraction of a portion of the NorthMet deposit by underground mining?

1.1 Definition of a Mineral Resource

Poly Met's parent company, PolyMet Mining Corp., is a Canadian company and, therefore, reports under Canadian securities guidelines. Regulations and guidelines associated with National Instrument (NI) 43-101 establish the reporting standards of a mineral resource by a public Canadian company to the Canadian Securities Administrators.

While there are similarities between Canadian and U.S. reporting, there is an important distinction between the two standards for reporting resources and reserves. Poly Met's filings in the U.S. include the following cautionary note: the terms "measured and indicated mineral resource", "mineral resource", and "inferred mineral resource" used in this Management Discussion and Analysis are Canadian geological and mining terms as defined in accordance with NI 43-101, Standards of Disclosure for Mineral Projects (NI 43-101) under the guidelines set out in the Canadian Institute of Mining, Metallurgy and Petroleum (CIM) Standards on Mineral Resources and Mineral Reserves. U.S. investors are advised that while such terms are recognized and required under Canadian regulations, the Securities and Exchange Commission (SEC) does not recognize these terms. Mineral resources do not have demonstrated economic viability. It cannot be assumed that all or any part of a mineral resource will be upgraded to mineral reserves. Under Canadian rules, estimates of inferred mineral resources may not form the basis of or be included in feasibility or other studies. U.S. investors are cautioned not to assume that any part of an inferred mineral resource exists, or is economically or legally mineable. The terms mineral resources and reserves as used in this report conform to the definitions contained in NI 43-101. Mineral resources are not reserves and do not have demonstrated economic viability. Reserves are contained within the envelope of "measured" and "indicated" mineral resources. All economic calculations are done in U.S. Dollars.

NI 43-101 regulations and associated guidelines define a mineral resource as a concentration or occurrence of metals "in such form and quantity and of such a grade that it has reasonable prospects for economic extraction" (CIM, 2010). The reasonable prospect of economically viable extraction is determined by the total cost of extraction as compared to the total extractable value of the ore. The cost of extraction depends on, among other costs, the cost of mining and mineral processing. Since the cost of open-pit mining is considerably lower than the cost of underground mining, it is common that an economically viable open-pit mineral resource cannot be viably extracted by underground mining due to the higher cost of underground mining. Thus, a concentration of metals classified as a mineral resource under NI 43-101 by open-pit mining is not a mineral resource by underground mining unless proven to have a reasonable prospect of economically viable extraction by that mining method.

Those concentrations with a prospect for economically viable extraction are subdivided into three classifications on the basis of geological confidence. A “measured” mineral resource is “so well established that they can be estimated with confidence sufficient to allow the appropriate application of technical and economic parameters, to support production planning and evaluation of the economic viability of the deposit” (CIM, 2010). An “indicated” mineral resource is less well characterized but, is sufficiently characterized to support evaluation of economic viability. An “inferred” mineral resource is only reasonably assumed to exist and since it is not sufficiently characterized it “must be excluded from estimates forming the basis of feasibility or other economic studies” (CIM, 2010).

The amount of geological data, the geological and grade continuity, and the mining method are factors (and others) in classifying a mineral resource as “measured”, “indicated”, or “inferred”. An open-pit mineral resource classified as “measured” or “indicated” or “inferred” may be classified differently on the basis of underground mining. Since generally more data are needed to characterize an underground mineral resource, the degree of confidence is more likely to be lower on the basis of underground mining.

Poly Met has defined an open-pit mineral resource at NorthMet and has subdivided this open-pit resource into “measured”, “indicated”, and “inferred” categories (Poly Met, 2007). Since the cost of open-pit mining is considerably lower than the cost of underground mining, there is no reason to assume that any of this open-pit mineral resource has a reasonable prospect of economically viable extraction by underground mining. No underground mineral resource has been defined at NorthMet.

Although the NorthMet open-pit mineral resource includes “measured”, “indicated”, and “inferred” levels of geological confidence, one cannot assume that any of these resources would be classified at the same level with respect to underground mining. Using “measured” and “indicated” mineral resources classified on the basis of open-pit mining for economic assessment of underground mining will result in an optimistic economic assessment when underground mining criteria are applied.

1.2 Mining of Shallow Large Tonnage Low-to-Medium Grade Deposits

Shallow large tonnage low-to-medium grade deposits are typically mined by open-pit methods. Underground mining of low-to-medium grade materials may not be economically viable because of the much higher cost of extracting the rock by underground mining methods as compared to open-pit mining methods. Economic viability considerations would lead to only the higher grade sections of the open-pit resource being mined via underground mining methods leaving behind lower grade materials that could otherwise be utilized. From a socio-economic perspective, the value of the material left behind is lost. For comparison, Kevista Mine is a large tonnage and low-to-medium grade polymetallic copper-nickel-cobalt-palladium-platinum-gold deposit hosted by thick intrusive rocks in Finland and scheduled for production in 2012 (First Quantum, 2011). The tonnage and grades are similar to NorthMet and the Kevista mineral resource will be extracted using open-pit mining. While mineralized rock at Kevista extends below the open-pit, future extraction of it is speculative.

1.3 Disclaimer

This report relies upon information provided by Poly Met, AGP Mining Consultants (AGP), and publically available documents. The assessment of the prospects for economically viable extraction utilizes simplifications, generalizations, assumptions, and qualifications within the scope of the assignment and is believed to be substantially correct. While NI 43-101 reports are relied upon and referred to in this report; this independent report is not a NI 43-101 technical report.

2 Boundaries of the NorthMet Resources

The boundaries of the open-pit mineral resource as defined by NI 43-101 compliant technical report (Poly Met, 2007) are the same boundaries that will be used to assess the prospects of economic viability of extraction by underground mining (Figure 1). This underground evaluation will use “measured” and “indicated” open-pit mineral resources even though these may be an over statement of the sufficiently characterized volume/tonnage of mineralized rock with respect to underground mining or, in other words, using open-pit defined resource numbers may result in an overly optimistic economic assessment. “Inferred” open-pit mineral resources are excluded from this economic assessment. *The term NorthMet deposit used in this report will refer to NI43-101 compliant measured and indicated mineral resources within the open-pit.*

There is mineralized rock outside of the volume of rock contained within the proposed open-pit. This mineralized rock occurs below the open-pit. While this mineralized rock is excluded from this report, speculatively it may be possible for it to be economically viable to extract decades in the future. Only approximately 10% of the measured and indicated resource is below the open-pit (Poly Met, 2007). The majority of inferred resource defined by Poly Met (2007) is below the open-pit. There is a lack of geological data to characterize the deep mineralized rock that in turn results in a lack of geological confidence leading to the inferred classification. Mineralized rock below the open-pit is, in general, too poorly characterized to justify inclusion in this economic assessment.

3 Approach to Analysis of Economic Viability

To assess the prospect for economically viable extraction by underground mining of the NorthMet deposit, the total cost of extraction of the metals must be compared to the total revenue from the metals that are extracted. For underground mining to have the potential to be economically viable, the extracted net metal value must be greater than the total operating cost by a sufficient margin to pay for capital costs, taxes, and provide a reasonable profit.

At the earliest stages of evaluating a mineral occurrence, costs are approximated by using cost models, such as from InfoMine. The cost predicted using cost models will be compared to and supplemented by data from selected existing and proposed mines. At the next stage in project evaluation, scoping or preliminary economic assessment, costs are refined, but complete site data can be lacking. Cost models are still used at this stage to estimate costs as well as to validate site specific cost estimates. The costs used in this report for the economic assessment are comparable to the earlier stages of evaluation. The revenue estimates in this report use metal prices applicable to later, feasibility, stage of evaluation, and are of lesser error than cost estimates. The grade and tonnage are maximum estimates as they are defined by open-pit rather than underground mining criteria.

Wellmer (Wellmer, 1998) describes several general approaches for evaluating the productive life of a mine. Generally, mining companies will use a minimum of 10 years to average out the risk of the variation of metal prices. The optimal productive life of a mine calculated by empirical formula yields values such as extracted tonnage of 5 to 25 million tons mined for 9.5 to 14 years at a rate of production of about 1,250 to 6,000 tons per day upwards to extracted tonnage of 100 million tons mined for 21 years at a rate of production of about 14,000 tons (Wellmer, 1998). To simplify the economic assessment in this report, increments of total and daily production are used which are roughly similar to those obtained from the empirical formula.

4 Mining Method

Poly Met has proposed to mine the NorthMet deposit using open-pit mining which will result in the maximum economically viable recovery of the metals. Using underground mining would result in a significant fraction of the NorthMet deposit being left unmined because the unmined rock is too low of value to be viably extracted by underground methods. Underground mining is being assessed as an alternative to open-pit mining to ensure that the Environmental Impact Statement (EIS) is in full compliance with National Environmental Policy Act (NEPA) and Minnesota Environmental Policy Act (MEPA) and that alternative mine development methods, such as underground mining, are considered.

Underground mining of large tonnages at shallow depths has the potential to lead to collapse of the mine openings unless they are backfilled. If mine openings are allowed to collapse, the collapse is likely to result in caving and fracturing of the overlying bedrock and could lead to land surface subsidence. This in turn disrupts ground water and surface water (Kendorski, 2006). The NorthMet deposit has a shallow dip of between 15^o to 25^o to the southeast, a strike length of about 2.5 miles, with probable thickness of mining of 45 to 100 feet when extractable tonnage is on the order of 10 million tons (AGP, 2011) (Figure 2; blocks in open pit resource greater than $65 net metal value per ton represent approximately 8 million tons). To minimize environmental impact by underground mining, the chance of collapse of the overlying rock must be minimized. Thus, this report is based on the assumption that backfilling of the mine will be required to minimize the chance of collapse of the overlying rock.

AGP (AGP, 2011) has assessed the applicable mining methods and concluded that possible mining methods include long-hole open stoping (backfilled), room and pillar (no back fill), or short back open stoping (no back fill) for a mine on the order of 10 million extractable tons. The latter two are considered unacceptable in this report unless backfilled to minimize the chance of collapse; only methods including backfill will be considered in this report. Mechanized cut and fill (backfilled) is another possible mining method. The underground rate of extraction for mining with backfilling is typically between 90 and 99% removal of the resource. For this report, the rate of extraction is assumed to be 95% removal of the resource.

Several factors can result in dilution of the ore such as overbreaking of rock by drill and blasting during underground mining and poor estimation of the boundary between valuable rock to be mined and waste rock. Dilution results in more tons of material to process and lowering of the overall grade of the material to be processed. In general, dilution varies between 5 and 30% (Wellmer, 1998); a value of 5% will be used in this report. At NorthMet the impact of dilution is small as higher value rock is surrounded by successively lower value rock. The diluting rock is assumed to have a value equivalent to the rock adjacent to the extracted tonnage along the tonnage-value curve described in Section 7.

5 Metal Prices

Evaluation of a mining project at the earliest stages may use metal prices that are lower than at a later stage to compensate for unknown risks. At later stages of evaluation when the start-up of a mine is nearer, pre-feasibility or feasibility study, metal prices often closely reflect current market conditions. NI 43-101 compliant feasibility studies use the three-year average metal prices, but also often include forecasts of price and demand for the purpose of evaluating the validity of using such metal prices. For the purpose of this report, the only metal prices used will be the three-year average metal price to June 30, 2012 provided to Theodore J. Bornhorst, LLC by Poly Met (personal communication) (Table 1); these metal prices are consistent with prices currently used in NI 43-101 feasibility and pre-feasibility studies published on System for Electronic Document Analysis and Retrieval (SEDAR) operated by Canadian Securities

Administrators. These metal prices are consistent with or higher than long-term forecasts.

6 Rates of Metal Recovery

The valuable rock extracted by underground mining is crushed, ground to a fine grain size, and subjected to a sequence of mineral processing steps to concentrate the minerals containing the metals of value. Due to imperfect mineral processing, some minerals containing metals of value are lost to the waste tailings. Laboratory testing quantifies the rate of recovery during processing of the valuable rock (ore) to a mineral concentrate. The metals in the concentrate are recovered by further processing (smelting or hydrometallurgy and refining); these rates have been quantified. The rates of recovery from rock to concentrate and from concentrate to metal are those specific to NorthMet as given in Table 1.

7 Net Metal Value

Net metal value per ton of rock represents the value of metal recoverable and payable from the rock at the assumed metal prices model after accounting for the rates of recovery and deduction of refining costs (described in Poly Met, 2007).

The total cumulative tonnage with grades higher than a specific level can be quantified by rigorous study (described in Poly Met, 2007). Using the open-pit model described by Poly Met (2007), AGP (personal communication) provided Theodore J. Bornhorst, LLC with a series of cumulative tonnages and average grades for the NorthMet deposit. The average net metal value per ton was calculated for each of these average grades (Table 2). The log cumulative tonnage versus average net metal value per ton has a well-defined regular variation (Figure 3). This relationship is adequate for the prediction of cumulative tonnage and average net metal value per ton for an economic assessment of underground mining of the NorthMet deposit.

8 Operating Costs of Mining

For this economic assessment, operating costs are estimated from cost models, such as InfoMine USA, Inc. Selected operating and proposed mines are used to compare and supplement the operating costs assumed for this report. While adjustments are made to the comparables to account for obvious differences with a possible NorthMet setting, there is no assurance these adjustments are adequate.

Operating cost models are usually subdivided according to mining or processing method and daily rate of production. Operating costs are linearly related to daily rate of production for the range of 1,000 to 5,000-7,500 tons per day depending on mining method (InfoMine USA, 2009). Above 5,000-7,500 tons per day the rate of change in operating cost decreases as operating costs approach a ‘minimum’. All costs are inflated to 2012 level based on the average rate of change in InfoMine cost models from 1998 to 2009. Increments of extractable tonnage and daily rate of production will be used in this study and for each increment a 2012 total operating cost will be assigned;

total operating cost is the sum of underground mining, mineral processing, and "general and contingency" costs (general is not central to production of saleable metal and contingency is added to cover uncertainties in cost estimates).

8.1 Discussion of Operating Costs at Rates of Production up to 5,000 Tons Per Day

The operating cost of room and pillar underground mining using shaft access without backfill from InfoMine cost model (InfoMine USA, 2009) is approximately $40 and $32 per ton for 2,000 and 5,000 tons per day production respectively without "general and contingency". Cemented backfill typically represents roughly 20% of mining operating costs (Grice, 1998; Stebbins and Schumacher, 2001). The operating cost of room and pillar underground mining with backfill is projected to be about $50 and $40 per ton for 2,000 and 5,000 tons per day production without "general and contingency". Long-hole open stoping with sand backfill and shaft access from InfoMine (InfoMine USA, 2009) is about $32 and $20 per ton for 2,000 and 5,000 tons per day production respectively without "general and contingency", but at NorthMet cementing of backfill will likely be necessary which will increase the model cost. AGP (AGP, 2011) estimated that long-hole open stoping with backfill operating cost was in the range of $44 to $52 at 5,000 tons per day suggesting that the InfoMine estimates are too low. Mechanized cut and fill is about $49 for 2,000 tons per day. The Podolsky Mine, Levack Mine, McCreedy West Mine in the Sudbury district utilize a combination of long-hole open stoping with cemented and uncemented backfill, cut and fill, and shrinkage mining methods with a range of mining operating costs of $76 to $38 for 1,250 and 2,250 tons per day without "general, administration and contingency" (FNX, 2009). *The estimated 2012 underground mining operating costs for this report are $51 for 2,000 tons per day and $40 for 5,000 tons per day without "general and contingency".*

A three concentrate flotation mill cost model from InfoMine (InfoMine USA, 2009) is the closest approximation to mineral processing of a complex ore such as NorthMet with cost of about $19.5 and $13 per ton for 2,000 and 5,000 tons per day production respectively without "general and contingency". For comparison, a one concentrate mineral processing InfoMine cost model at 5,000 tons per day is about $12.5 per ton as compared to the one concentrate Copperwood, Michigan prefeasibility mill cost estimate of $11.75 per ton at 5,000 tons per day without "general, administration, and contingency" (Orvana, 2011). A preliminary economic assessment for Lac des Iles in Thunder Bay, Ontario for complex ore with a similar suite of metals uses a mineral processing operating cost of $14 per ton at about 6,000 tons per day production without "general, administration, and contingency" (North American Palladium, 2010). *The estimated 2012 mineral processing operating costs for this report are $19.5 per ton for 2,000 tons per day and $13 per ton for 5,000 tons per day without "general and contingency".*

For copper and nickel Lac des Iles in Thunder Bay, Ontario (North American Palladium, 2010) the "general" and administration costs used in preliminary economic assessment were $3.30 per ton and "contingency" was $2.00 per ton (not inflated to 2012). For

Copperwood, Michigan the “general” and administration prefeasibility estimate was $3.35 per ton (Orvana, 2011; not inflated to 2012). *The 2012 “general and contingency” for this report are $3.50 per ton.*

8.2 Total Operating Costs at Rates of Production up to 5,000 Tons Per Day

This report will use 2012 total operating costs of $74 per ton at 2,000 tons per day and $56.5 at 5,000 tons per day with an assumed rate of extraction of 95% removal of the resource. These costs will be linearly extrapolated and applied to rates of production between 1,000 and 5,000 tons per day. Based on the optimal life of mine formula as described above, 5,000 tons per day operating cost will be applied to total extracted tonnage of up to 26 million tons (Table 3).

For comparison, total operating costs at copper – nickel-PGE Lac des Iles deposit are estimated at about $56 per ton (scaled to include backfill) at about 6,000 tons per day (North American Palladium, 2010). The lead-zinc-silver-copper Pitarrilla property pre-feasibility study reported total operating costs adjusted for shaft access and inflation of $39.5 per ton for a combination of backfilled room and pillar and long-hole stoping mining at the rate of 4,000 tons per day (Silver Standard, 2009). The nickel-copper-PGE-gold Eagle’s Nest property has estimated total operating cost of $79 per ton for bulk stoping with cemented backfill at 4,500 tons per day production (Noront Resources, 2011). AGP (AGP, 2011) long-hole open stoping mining costs when combined with mineral processing and “general and contingency” costs yield total operating costs of between about $50 and $59 at 5,000 tons per day of production. The copper-nickel-PGE Podolsky Mine, Levack Mine, McCreedy West Mine in the Sudbury district utilize a combination of long-hole open stoping with cemented and uncemented backfill, cut and fill, and shrinkage have an average total operating cost of $88 per ton between 1,250 and 2,250 tons per day (FNX, 2009). The nickel-copper Lockerby Mine, in the Sudbury district, has estimated total operating costs of approximately $160 per ton using sublevel long-hole stoping with cemented backfill at approximately 1,000 tons per day production (First Nickel, 2011) as contrasted with the nickel-copper-cobalt-PGE-gold Bucko Mine, Manitoba which has estimated total operating costs of approximately $72 per ton using Long-hole stoping with cemented backfill at approximately 1,000 tons per day production (Crowflight Minerals Inc., 2009). In comparison, the linearly projected 1,000 ton per day total operating cost to be used in this report is approximately $80. While these comparisons demonstrate the difficulty in assigning a total operating cost lacking site specific data, they nevertheless support that the 2012 total operating costs used in this report are reasonable and within the level of error usually assumed at this level of assessment.

8.3 Discussion of Operating Costs at Rates of Production Between 5,000 to 15,000 Tons Per Day

The technical feasibility of mining of more than 50 million tons by underground methods from the shallow open-pit (Figure 2) is speculative. AGP (AGP, 2011) describes probable openings of 45 to 100 feet high for extracted tonnage on the order of 10 million tons. For larger amounts of extracted tonnage (> 26 million tons) larger cumulative openings will increase the difficulty of mining. In spite of this technical uncertainty, tonnages up to 100 million will be assessed with rates of extraction of up to 15,000 tons per day.

Above 5,000-7,500 tons per day the rate of change in operating costs decreases as operating costs approach a 'minimum.' Estimating the operating cost of underground mining large tonnages at such shallow depths while avoiding collapse is difficult. InfoMine cost models are for standard underground mining and thus, will provide a cost minimum that is likely to be too low as applied to mining large tonnages underground at NorthMet in the shallow confines of the open-pit. InfoMine cost models (InfoMine USA, 2009) demonstrate that operating cost for long-hole open stoping with sand backfill begins to approach a "minimum" cost at about 3,600 tons per day; the rate of change from 3,600 to 7,200 tons per day is less. The operating cost of room and pillar mining and other mining methods, including backfill, tend to approach a "minimum" cost between 4,000 to 10,000 tons per day production. Applying the rate of change associated with backfilled room and pillar mining to a $40 per ton mining operating cost at 5,000 tons per day, yields an estimated underground mining operating cost of $28 per ton at 7,500 tons per day. Applying the rate of change associated with long-hole open stoping with sand backfill, to a $40 per ton mining operating cost at 5,000 tons per day, yields an estimated operating cost of $39 per ton at 7,500 tons per day production. Since long-hole open stoping reaches a minimum operating cost near 5,000 tons per day the difference between the mining operating cost at 5,000 and 7,500 tons per day is small.

As daily production increases from 7,500 to 15,000 tons per day it is expected that operating costs may be lower due to increased efficiencies related to scale but equally likely it is expected that operating costs may be even higher than increased efficiencies due to complexities of removal of such a large thickness of rock at such shallow depths while avoiding collapse. *Hence, for this report the same underground mining operating cost estimate will be used for 7,500, 10,000 and 15,000 tons per day production; $33 per ton 2012 underground mining operating cost without "general and contingency".*

Comparisons of mining costs from operating or proposed mines for high daily rates of underground production are more difficult to obtain and large daily rates of underground extraction with backfill are less common. In addition, differences with a possible NorthMet setting may render the comparison invalid. The Young-Davidson gold mine in Ontario utilizes a combination of sublevel caving, long-hole shrinkage, and longitudinal retreat with paste backfill and unconsolidated rock fill (www.auricogold.com). The underground mining operating cost is $32 to $34 per ton at 8,000 tons per day (www.auricogold.com). The Blue River tantalum-niobium mine, BC Canada, proposes using room and pillar mining with paste backfill to recover 70% of the orebody at a 2012 estimated mining cost of $32 per ton at 7,500 tons per day (AMEC, 2012). A Press Release by Commerce Resources Corp. states that the $32 per ton mining cost can be lowered to $22 with the elimination of backfilling (www.commerceresources.com); the latter $22 is consistent with InfoMine (InfoMine USA, 2009) room and pillar mining with no backfill cost estimate of $23. These comparisons demonstrate the 2012 underground mining operating costs used in this report are reasonable and within the level of error usually assumed at this level of assessment.

Cost models for mineral processing at all levels of daily production are applicable for this economic assessment. A three concentrate flotation mill cost model from InfoMine (InfoMine USA, 2009) is the closest approximation to mineral processing of a complex ore such as NorthMet with costs of about $12.5, $12, and $10.5 per ton for 7,500, 10,000 and 15,000 tons per day production respectively without "general and contingency". *The 2012 operating cost for mineral processing used in this report will be $12.5, $12, and $10.5 per ton for 7,500, 10,000 and 15,000 tons per day production respectively without "general and contingency".*

The same "general and contingency" used for 1,000 to 5,000 tons per day production will be used for higher levels of daily production.

8.4 Total Operating Costs at Rates of Production Between 5,000 to 15,000 Tons Per Day

Total 2012 operating costs in this report will be $49, $48.5, and $47 per ton for 7,500, 10,000 and 15,000 tons per day production.

Comparisons of total operating costs from operating or proposed mines for high daily rates of underground production are more difficult to obtain. The Williams Mine, Marathon, Ontario uses long-hole stoping with paste backfill to underground mine and process simple gold ore with an average grade of about 2.35 g/ton gold at a daily rate of about 8,500 tons per day (www.barrick.com). The total cash operating cost (includes limited amount of lower cost open-pit mining) is about $775 per oz. for 2011 and $834 for the 1st quarter of 2012 (www.barrick.com). The estimated total operating cost is $58.5 per ton for 2011 and $63 per ton for the beginning of 2012. The Brunswick Mine, New Brunswick, Canada uses open stoping and end slicing with paste backfill to mine a zinc, lead, copper, and silver ore with about 8.3% zinc at the rate of about 10,000 tons per day (www.xstrata.com). Presentation materials by Xstrata shows that the Brunswick Mine has total cash operating costs higher than the other principal source of zinc for North America zinc operations and from a cash cost of $0.32 to 0.40 per lb of zinc, an estimated total operating cost is $53 to $66 per ton, but this is an uncertain estimate. The Young-Davidson gold mine in Ontario utilizes a combination of sublevel caving, long-hole shrinkage, and longitudinal retreat with paste backfill and unconsolidated rock fill with estimated total operating cost of $45 to 51 per ton 8,000 tons per day (www.auricogold.com). These comparisons demonstrate the 2012 total operating costs used in this report are reasonable and within the level of error usually assumed at this level of assessment.

9 Pre-Production Capital Costs

For this economic assessment, estimates of pre-production capital costs are made from cost models, such as InfoMine USA, Inc., and are compared to and supplemented by selected operating and proposed mines. All costs are inflated to 2012 level based on the average rate of change in InfoMine cost models from 1998 to 2009.

Capital cost models are usually subdivided according to mining or processing method and daily rate of production. Capital costs are linearly related to daily rate of production from about 1,000 to 7,500 tons per day depending on mining and processing method (InfoMine USA, 2009). Increments of extractable tonnage and daily rate of production will be used in this study and for each increment a single capital cost will be assigned.

The pre-production capital cost of room and pillar underground mining using shaft access without backfill from InfoMine (InfoMine USA, 2009) is about $60 million, $95 million, and $125 million for 2,000 and 5,000, 7,500 tons per day production respectively without “contingency”, environment, closure, and reclamation. The capital cost for long-hole open stoping with sand backfill and shaft access from InfoMine (InfoMine USA, 2009) is about $45 million, $80 million, and $115 million for 2,000 and 5,000, 7,500 tons per day production respectively without “contingency”, environment, closure, and reclamation. Capital cost for mechanized cut and fill is about $60 million for 2,000 tons per day production without “contingency”, environment, closure, reclamation. A three concentrate flotation mill cost model from InfoMine (InfoMine USA, 2009) is the closest approximation to mineral processing of a complex ore such as NorthMet with a capital cost of about $47 million, $71 million, and $98 million 2,000, 5,000, and 7,500 tons per day production respectively without “contingency”, environment, closure, reclamation. The InfoMine cost model estimates of total pre-production capital cost are about $110 million, $170 million, and $225 million without “contingency”, environment, closure, reclamation. For comparison, room and pillar mining without backfill and a one concentrate mineral processing plant at Copperwood, Michigan has a prefeasibility estimated pre-production capital cost of approximately $205 million at 7,500 tons per day without closure and sustaining capital (Orvana, 2011). A preliminary economic assessment for Lac des Iles in Thunder Bay, Ontario for complex ore with a similar suite of metals has an estimated pre-production capital cost of approximately $220 million at about 6,000 tons per day including “contingency” capital but without development and sustaining capital (North American Palladium, 2010). AGP (AGP, 2011) estimated that long-hole open stoping with backfill capital cost is approximately $190 million at 5,000 tons per day. The comparisons suggest that the pre-production capital cost InfoMine estimates are reasonable although more likely low because these estimates do not include “contingency” and pre-production expenditures especially exploration, permitting and environmental analysis. To develop underground mining at NorthMet a significant amount of additional exploration drilling is likely.

The 2012 pre-production capital costs with “contingency” for this report are estimated to be $125 million, $200 million, and $250 million for 1-2,000, 5,000, and 7,500 tons per day production but without environment, closure and reclamation. Linear extrapolation *yields 2012 pre-production capital cost of about $300 million and $400 million for 10,000 and 15,000 tons per day production.*

10 Other Considerations

Inflation during production is not considered in this report. Inflation of costs is assumed to be offset by increases in the metal prices. The estimated federal and state tax on operating profits after depreciation and depletion is a significant cost that will lower the internal rate of return in cases when operating profit exceeds pre-production capital costs. Pre-production capital costs are assumed to be equity financed and thereby eliminating the cost of debt. The royalty applicable to this report for NorthMet is 5%.

11 Analysis of Economic Viability

The economic assessment in this report for the NorthMet deposit uses tonnage and grades specific to NorthMet, rates of recovery and refining deductions specific to NorthMet, current metal prices consistent with NI 43-101 reporting standards, total operating costs and pre-production capital costs from published cost models that are validated by comparable projects and mines, and the actual royalty specific for NorthMet. Based on optimal formula, the productive life of an underground mine was determined for increments of tonnages from <4 to 100 million tons and from these numbers the daily rate of production was calculated (Table 3). For each increment the daily rate of production was fixed to simplify the analysis since total operating costs and total pre-production capital costs are closely related to the daily rate of production; for simple cash flow analysis the productive life of mine rounded to the nearest year based on the life of mine calculated from daily production and total tonnage. A total operating cost and total pre-production capital cost, as in Sections 8 and 9, was assigned to each increment based on daily rate of production (Table 3).

A spectrum of extracted tonnages was assessed (Table 4). For each specific pre-extraction tonnage, an *in situ* average net metal value per ton was calculated by log10 linear extrapolation between adjacent pairs on the tonnage-average net metal value per ton curve. A rate of extraction of 95% removal of the resource was used in determining the total extracted value without dilution. A 5% dilution was used with the diluting average net metal value per ton calculated by log 10 linear extrapolation assuming the diluting rock has a value in continuum with the pre-extraction tonnage. The total net metal value was calculated for the pre-extraction cumulative tonnage and dilution minus the yearly treatment charge (Table 4). The extracted tonnage was multiplied by the total operating cost per ton to estimate the total operating cost. Operating profit was calculated by subtracting total operating cost from total revenue minus royalty. Pre-tax operating profit minus pre-production capital costs is also calculated (Table 4).

The "rules-of-thumb" is that operating cost should be about ½ of the total net metal revenue after royalty and the remaining ½ is generally sufficient to cover taxes, capital costs, and profit (Wellmer, 1998). On this basis, underground mining is not likely to be economically viable at NorthMet.

For tonnages with a negative operating profit or a loss, underground mining is not economically viable. For all extracted tons, except 30 and 35 million, there is a predicted operating loss or underground mining at these tonnages is not economically viable. The total operating profit has to exceed the total pre-production capital cost else the mining project is not economically viable; the initial investment is not recovered. *At all tonnages the total operating profit minus the total pre-production capital cost is negative or in other words for all tonnages underground mining is not economically viable.*

12 Discussion and Conclusions

This report assesses the economic viability of extracting the NorthMet deposit by underground mining methods. Due to the higher cost of underground mining as compared to open-pit mining, if the NorthMet deposit was extracted by underground mining a significant amount of the lower grade materials would inevitability be left behind or lost from a socio-economic perspective. This economic assessment utilizes reasonable estimates of input variables to answer the question: Is there a prospect of economically viable extraction of a portion of the NorthMet deposit by underground mining?

The volume/tonnage and grade of mineralized rock are defined using open-pit defined resource numbers rather than potentially more restrictive underground mining criteria and may result in an overly optimistic economic assessment. The metal prices are defined using a three-year trailing average and do not account for the risk of lower prices with no change in costs. While the total operating costs are less precise, they are demonstrably within acceptable error for this level of economic assessment. The operating costs do not include operating capital expenditures. While the total pre-production capital costs are also less precise, they too are demonstrably within acceptable error for this level of economic assessment. These estimates are more likely to be too low than too high since they do not fully account for capital costs associated with the environment, closure and reclamation.

Early studies of the NorthMet deposit concluded that the tonnages and grades were not sufficient to support underground mining. *This economic assessment of conceptual underground mining of the NorthMet deposit demonstrates that underground mining methods are not economically viable. Based on this assessment, there is no prospect of economically viable extraction of a portion of the NorthMet deposit by underground mining.*

13 References

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Tables

Table 1
Metal Prices, Recovery, and Refining Costs Used for Economic Assessment of Conceptual Underground Mining at NorthMet

Metal	Pricing Units	Metal Price[1] $	Recovery from Ore[2] %	Third Party Processing Concentrate Recovery and Payout[2] %	Refining Cost[2] $
Cu	lbs	3.56	94.2	96.5	0.04
Ni	lbs	9.47	71.2	78.0	0.16
Co	lbs	17.69	41.2	55.1	0.00
Pt	troy oz	1,689	77.9	92.0	4.97
Pd	troy oz	684	74.4	81.9	4.17
Au	troy oz	1,485	71.7	67.7	1.83

Notes:

1 - Metal Price model calculated as of June 30, 2012 by PolyMet (personal communication).

2 - Recovery from ore to concentrate, third-party payout, refining cost and treatment charge of $3.5 million per year provided to Theodore J. Bornhorst, LLC by Polymet (personal communication); treatment charge applied during economic analysis.

Prepared by: SVK
Checked by: JSL

Table 2

Cumulative Measured and Indicated Tonnage

and Average Net Metal Value per Ton for NorthMet Deposit

Cumulative Measured and Indicated Short Tons[1]	Average Net Metal Value ($) per short ton
227,017,162	33.18
145,066,201	39.86
76,373,821	47.46
30,369,759	55.66
7,817,279	65.37
1,682,328	76.72
509,229	85.54
85,614	96.77

Notes:

1 - Cumulative measured and indicated tonnage and associated grade provided by AGP (personal communication).

Analysis by: TJB
Prepared by: SVK
Checked by: JSL

Table 3

Total Operating and Total Pre-Production Capital Costs Applied to Economic Assessment of Conceptual Underground Mining at NorthMet

Extracted Tonnage million short tons	Underground Daily Rate of Production tons/day	Productive Life of Mine ~ years	Total Operating Costs $/ton	Total Pre-production Capital Costs $
<4	1,000	5 to 11	80.00	125,000,000.00
4 to 6	2,000	6 to 8	74.00	125,000,000.00
7 to 13	3,000	6 to 12	68.20	150,000,000.00
13 to 18	4,000	9 to 12	62.30	175,000,000.00
18 to 26	5,000	10 to 14	56.50	200,000,000.00
26 to 50	7,500	10 to 18	49.00	250,000,000.00
51 to 75	10,000	14 to 21	48.50	300,000,000.00
75 to 100	15,000	14 to 18	47.00	400,000,000.00

Note:
Incremental extractable tonnages, total operating costs, and total pre-production capital costs based on text discussion.

Analysis by: TJB
Prepared by: SVK
Checked by: JSL

Table 4

Economic Analysis of Underground Mining of the NorthMet Deposit

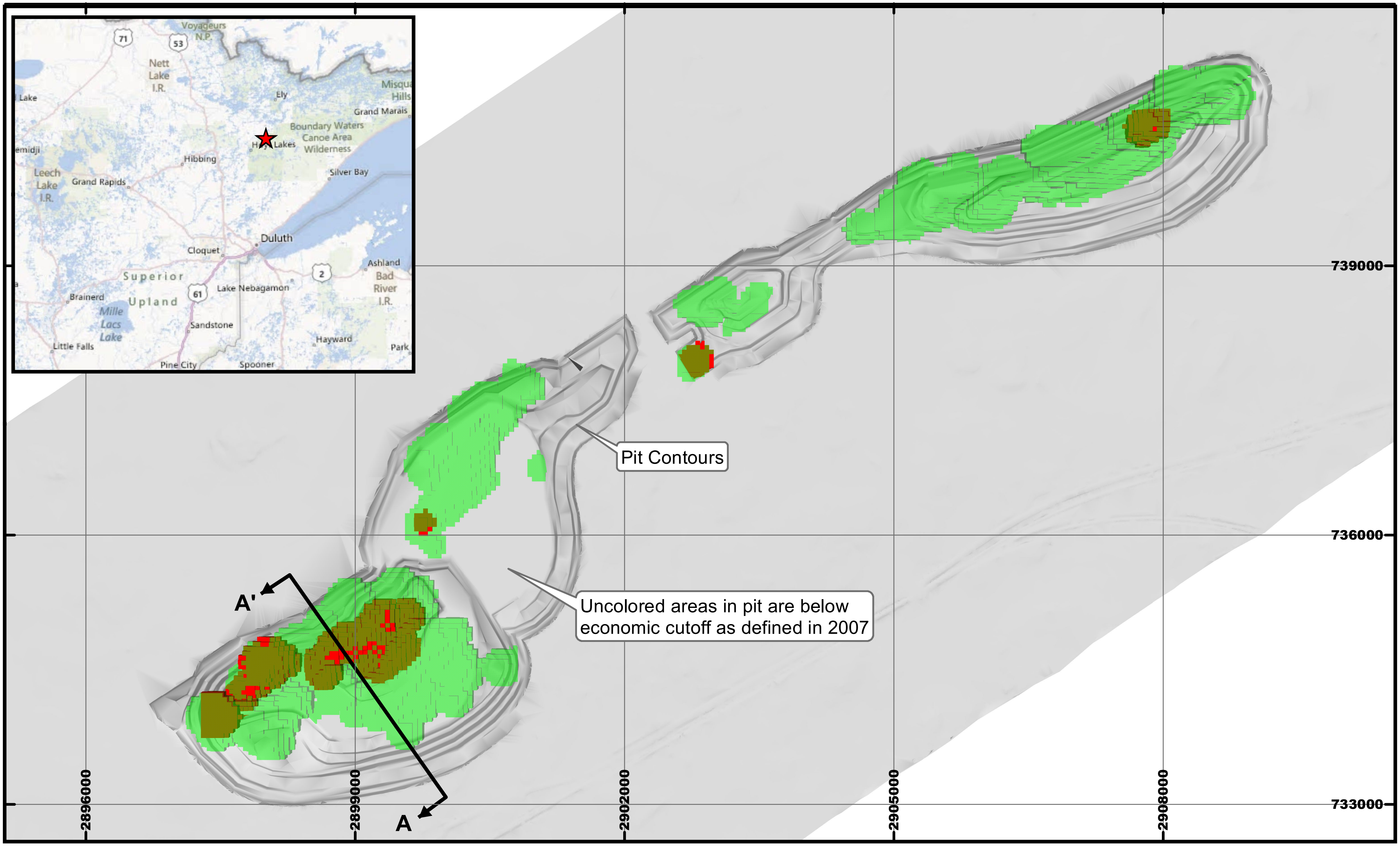
Extracted Tonnage at 95 % rate of extraction and 5 % dilution tons	Total extracted net metal value $	Total revenue (average net metal value minus 5 % royalty) $	Total Operating Cost $	Operating Profit (Revenue minus operating cost) $	Pre-production capital cost $	Operating Profit minus pre-production capital costs $	Daily production tons	Life of mine for economic analysis years
2,000,000	129,847,971.83	123,355,573.24	160,000,000.00	-36,644,426.76	125,000,000.00	-161,644,426.76	1,000	6
5,000,000	318,769,570.88	302,831,092.34	370,000,000.00	-67,168,907.66	125,000,000.00	-192,168,907.66	2,000	7
10,000,000	604,406,603.41	574,186,273.24	682,000,000.00	-107,813,726.76	150,000,000.00	-257,813,726.76	3,000	9
15,000,000	875,343,935.13	831,576,738.38	934,500,000.00	-102,923,261.62	175,000,000.00	-277,923,261.62	4,000	10
20,000,000	1,134,125,150.76	1,077,418,893.23	1,130,000,000.00	-52,581,106.77	200,000,000.00	-252,581,106.77	5,000	11
25,000,000	1,376,867,161.05	1,308,023,803.00	1,412,500,000.00	-104,476,197.00	200,000,000.00	-304,476,197.00	5,000	14
30,000,000	1,633,916,992.93	1,552,221,143.28	1,470,000,000.00	82,221,143.28	250,000,000.00	-167,778,856.72	7,500	11
35,000,000	1,857,679,184.93	1,764,795,225.68	1,715,000,000.00	49,795,225.68	250,000,000.00	-200,204,774.32	7,500	13
50,000,000	2,511,252,374.91	2,385,689,756.16	2,450,000,000.00	-64,310,243.84	250,000,000.00	-314,310,243.84	10,000	14
75,000,000	3,496,138,949.08	3,321,332,001.63	3,637,500,000.00	-316,167,998.37	300,000,000.00	-616,167,998.37	10,000	21
100,000,000	4,360,816,362.32	4,142,775,544.20	4,700,000,000.00	-557,224,455.80	400,000,000.00	-957,224,455.80	15,000	18

Notes:

- In situ average net metal value per ton from Table 2 determined for specific tonnage by log 10 linear extrapolation minus treatment charge.
- Applicable day rate of production and associated total operating costs and pre-production capital costs from Table 3. Economic analysis life of mine based on day rate of production rounded to even year; once life of mine is fixed daily rate of production allowed to vary to accommodate rounding in simple cash flow analysis.
- Rate of extraction and dilution discussed in text. Total extracted net metal value includes deduction for treatment charge as given in Table 1.

Analysis by: TJB
Prepared by: SVK
Checked by: JSL

Figures



LEGEND

- Blocks in Open Pit Resource less than $65/ton average net metal value and above economic cutoff as defined in 2007
- Blocks in Open Pit Resource where less than $65/ton average net metal value rock overlies greater than $65/ton rock
- Blocks in Open Pit Resource Greater than $65/ton average net metal value

NOTES

1. Data from block model used in PolyMet (2007) provided by AGP.

POLYMET MINING

Foth Infrastructure & Environment, LLC

REVISED	DATE	BY	DESCRIPTION

CHECKED BY: JSL	DATE: SEP. '12
APPROVED BY: TJB	DATE: SEP. '12
APPROVED BY:	DATE:

POLYMET MINING

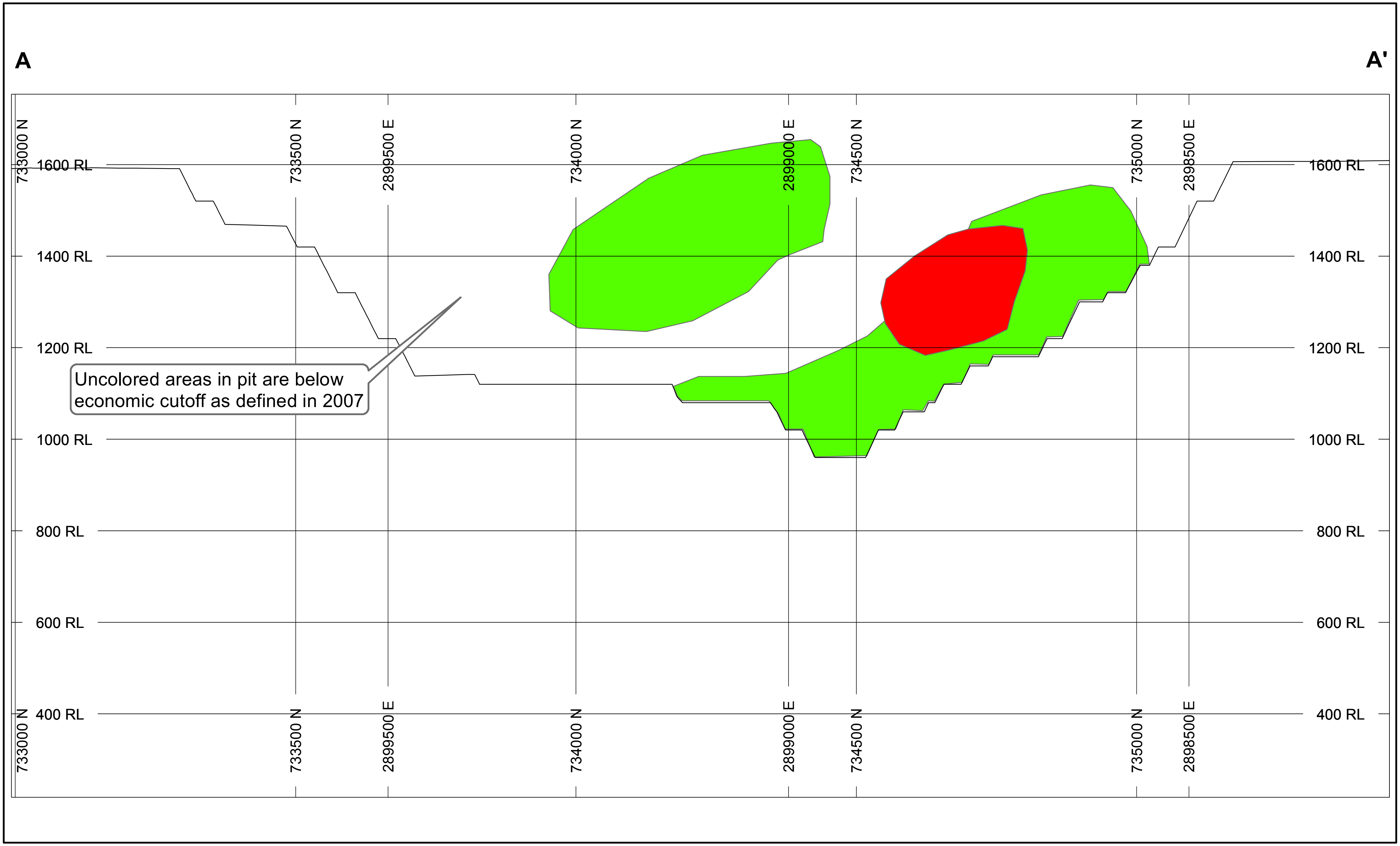
FIGURE 1

SURFACE PLAN VIEW
BLOCK MODEL FOR NORTHMET

Scale: 0 750 1,500 Feet | Date: AUGUST 2012

Prepared by: DAT | Project No: 12P778

Path: X:\GB\IE\2012\12P778\GIS\mxd\Figure1.mxd Date: 10/22/2012



LEGEND

- Blocks in Open Pit Resource less than $65/ton average net metal value and above economic cutoff as defined in 2007
- Blocks in Open Pit Resource Greater than $65/ton average net metal value

NOTES

1. Data from block model used in PolyMet (2007) provided by AGP.

Foth Infrastructure & Environment, LLC

REVISED	DATE	BY	DESCRIPTION

CHECKED BY: JSL	DATE: SEP. '12
APPROVED BY: TJB	DATE: SEP. '12
APPROVED BY:	DATE:

POLYMET MINING

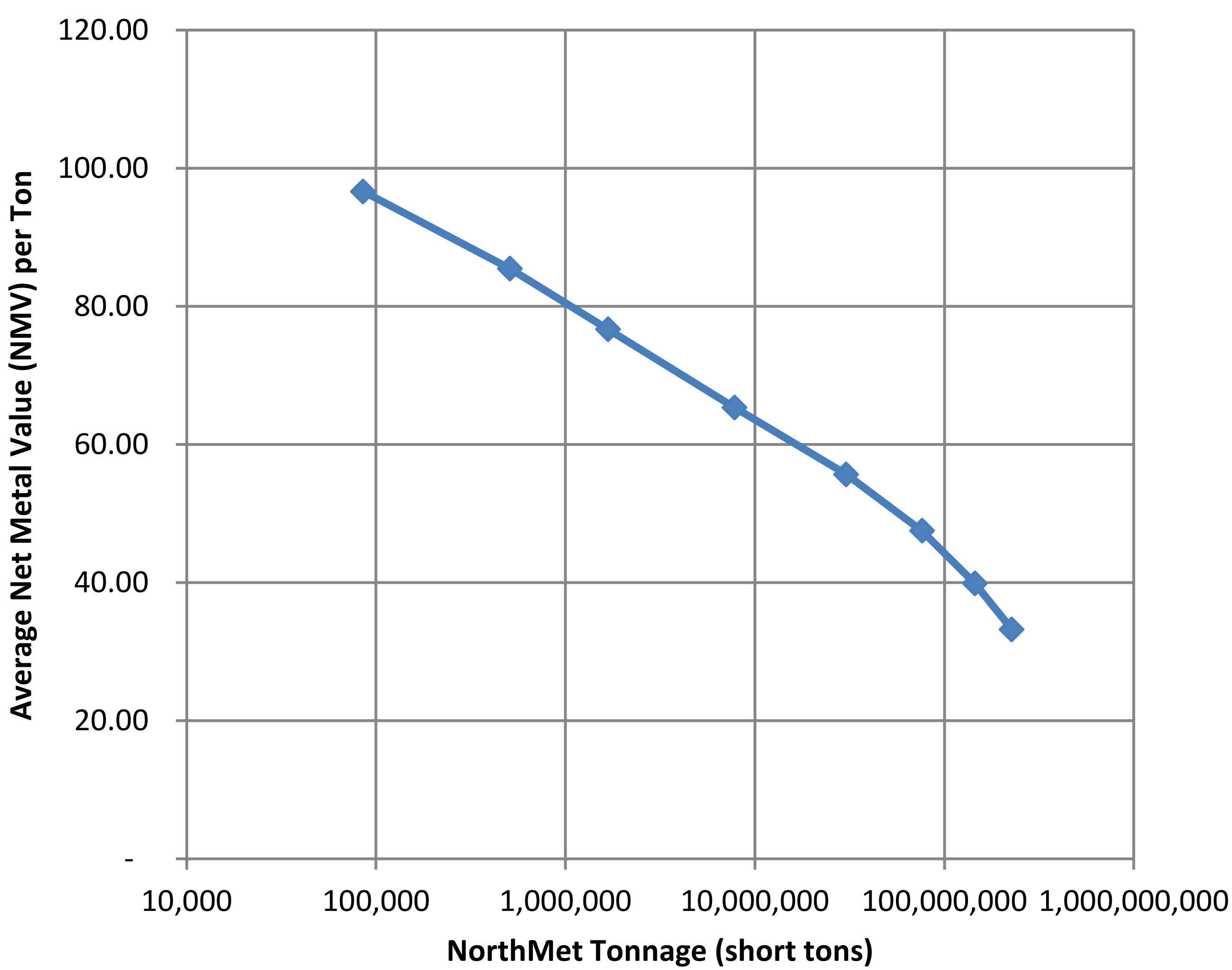
FIGURE 2

CROSS SECTION A-A'
BLOCK MODEL FOR NORTHMET.
LOCATION SHOWN IN FIGURE 1.

Scale: 0 750 1,500 Feet	Date: AUGUST 2012
Prepared by: DAT	Project No: 12P778

Path: X:\GB\IE\2012\12P778\GIS\mxd\Figure2.mxd Date: 10/22/2012

Fig 3. Tonnage vs. Average Net Metal Value



NOTES

1. Data from block model used in PolyMet (2007) provided by AGP.

Foth Infrastructure & Environment, LLC				POLYMET MINING	
REVISED	DATE	BY	DESCRIPTION	FIGURE 3	
				TONNAGE VERSUS AVERAGE NET METAL VALUE PER TON FOR NORTHMET DEPOSIT	
CHECKED BY: JSL			DATE: SEP, '12		
APPROVED BY: TJB			DATE: SEP, '12	Scale: AS SHOWN	Date: AUGUST 2012
APPROVED BY:			DATE:	Prepared by: DAT	Project No: 12P777

Attachment 2
Foth 2013, Memorandum: Response to USEPA Questions Regarding: Economic Assessment of Underground Mining Report Dated October 2012

Memorandum

Foth Infrastructure & Environment, LLC
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P.O. Box 12326 • Green Bay, WI 54307-2326
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May 10, 2013

TO: Brad Moore, Poly Met Mining, Inc.

CC: Steve Donohue, Foth Infrastructure & Environment, LLC
Master File: 12P778 - 5001

FR: Theodore J. Bornhorst, LLC
Jeff Lynott, Foth Infrastructure & Environment, LLC

RE: Response to USEPA Questions Regarding: Economic Assessment of Underground Mining Report Dated October 2012

The following document addresses the United States Environmental Protection Agency (EPA) comments and suggestions in their memo dated March 19, 2013 related to InfoMine, analog data, and inferred ore deposits.

InfoMine Parameters/Use of Analog Data

InfoMine cost data is a common source of information for mineral resource evaluation, but it has not been used exclusively to determine the economic viability of underground mining of the NorthMet Deposit. The October 2012 report also includes additional references to other mining project cost estimates to cross-validate the cost estimates used in the report.

The EPA response letter, dated March 19, 2013, requests additional documentation of the parameters and calculations with respect to the cost estimates. A list of costs used to arrive at the total cost is provided in the attached Table A. The mining, processing, and general and contingency costs are described in detail in the text of the report (Sections 8.1, 8.2, 8.3, and 8.4). The InfoMine cost models are given in increments of production rate. InfoMine model cost versus production rate graphs were used to estimate the cost at the production rate cited in the report. In some cases, the InfoMine cost estimates were adjusted to include cemented backfill as cited in the text. All InfoMine 2009 costs were inflated to 2012 levels based on the average rate of change in the InfoMine models from 1998 to 2009. The total operating costs given in Table 4 of the report are derived by multiplication of the extracted tonnage at 95% rate of extraction and 5% dilution column times the total operating cost from Table 3 for the applicable daily rate of production.

Models at all levels include a degree of uncertainty. The report includes cross-validation of the cost estimates to decrease the degree of uncertainty even though an analysis of uncertainty of the cost estimates is not usually done at the stage of defining a mineral resource as described in the report. However, as suggested in the EPA response letter, dated March 19, 2013, the economic analysis was completed using 5% lower costs (best economic case) as given in the attached Table B. Table C, attached, provides an economic analysis using data from the original Tables 1 and 2 in the report, and Table B provided here, and further demonstrates underground mining is not economically viable.

Inferred Ore Deposits

Economic evaluation of mineral prospects follows a progressive path beginning with initial determination of a mineral resource, followed by a scoping study or preliminary economic assessment, and then pre-feasibility, and feasibility studies. A mine feasibility study is typically done when there has been sufficient drilling to define an ore body of sufficient size to be economically as well as technically viable. In most cases there is not a hard boundary to the mineralization. Therefore, exploration to define the initial ore body will generally identify mineralization beyond the actual ore body.

The NorthMet feasibility study and all of the analysis in the environmental review and proposed permit applications relate to the ore body. The company has not considered whether mineralization outside the defined pit envelope may be economically recoverable or by what means it could be economically recoverable, or what additional work would be needed to establish a data base of sufficient statistical quality to be able complete a feasibility study on such mineralization.

In the analysis of underground mining potential, we deliberately used very favorable scoping numbers in order to show potential underground mining economics in a positive light, yet the project still fails on the most fundamental economic grounds – revenues from the sale of product would not cover the cost of building and operating the project. AGP included mineralization that is outside the pit envelope even though there is insufficient information on this mineralization to be able to do more than a speculative, conjectural analysis. As discussed in the report, this mineralization does not meet Securities and Exchange Commission standards to be described as reserves under any mining method. Additionally, inferred mineral resources are speculative and are not allowed in economic assessment studies that conform with NI 43-101.

Attachments

Table A

Total Operating and Total Pre-production Capital Costs Applicable for Underground Mining at Incremental Extractable Tonnages

Extracted Tonnage million short tons	Underground Daily Rate of Production tons per day	Productive Life of Mine ~ years	Mining Operating Costs dollars per ton	Processing Operating Costs dollars per ton	General and Contingency Costs dollars per ton	Total Operating Costs dollars per ton
<4	1,000	5 to 11	54.67[1]	21.67[1]	3.5	80[2]
4 to 6	2,000	6 to 8	51	19.5	3.5	74.0
7 to 13	3,000	6 to 12	47.33[1]	17.33[1]	3.5	68.2
13 to 18	4,000	9 to 12	43.67[1]	15.17[1]	3.5	62.3
18 to 26	5,000	10 to 14	40	13	3.5	56.5
26 to 50	7,500	10 to 18	33	12.5	3.5	49.0
51 to 75	10,000	14 to 21	33	12	3.5	48.5
75 to 100	15,000	14 to 18	33	10.5	3.5	47.0

[1] Linear extrapolation using tons per day

[2] Total rounded up 0.16

Prepared By: JSL
Checked By: TJB

Table B

Total Operating and Total Pre-production Capital Costs Applicable for Underground Mining at Incremental Extractable Tonnages

Extracted Tonnage million short tons	Underground Daily Rate of Production tons per day	Productive Life of Mine ~ years	Base Case Total Operating Costs dollars per ton	5% Below Base Case Total Operating Costs dollars per ton	Total Pre-production Capital Costs dollars
<4	1,000	5 to 11	$80.0	$76.0	$125,000,000
4 to 6	2,000	6 to 8	$74.0	$70.3	$125,000,000
7 to 13	3,000	6 to 12	$68.2	$64.8	$150,000,000
13 to 18	4,000	9 to 12	$62.3	$59.2	$175,000,000
18 to 26	5,000	10 to 14	$56.5	$53.7	$200,000,000
26 to 50	7,500	10 to 18	$49.0	$46.6	$250,000,000
51 to 75	10,000	14 to 21	$48.5	$46.1	$300,000,000
75 to 100	15,000	14 to 18	$47.0	$44.7	$400,000,000

Prepared By: TJB
Checked By: JSL

Table C

Five Percent Below Base Case Costs Economic Analysis of Underground Mining of the Open-pit Resource at NorthMet

Extracted tonnage at 95% rate of extraction and 5% dilution tons	Total extracted net metal value dollars	Total revenue (net metal value minus 5% royalty) dollars	Total operating cost 5% below base case dollars	Operating profit (revenue minus operating cost 5% below base case) dollars	Pre-production capital cost dollars	Operating profit minus pre-production capital costs with operating costs 5% below base case dollars	Daily production tons	Life of mine for economic analysis years
2,000,000	$129,847,972	$123,355,573	$152,000,000	-$28,644,427	$125,000,000	-$153,644,427	1,000	6
5,000,000	$318,769,571	$302,831,092	$351,500,000	-$48,668,908	$125,000,000	-$173,668,908	2,000	7
10,000,000	$604,406,603	$574,186,273	$648,000,000	-$73,813,727	$150,000,000	-$223,813,727	3,000	9
15,000,000	$875,343,935	$831,576,738	$888,000,000	-$56,423,262	$175,000,000	-$231,423,262	4,000	10
20,000,000	$1,134,125,151	$1,077,418,893	$1,074,000,000	$3,418,893	$200,000,000	-$196,581,107	5,000	11
25,000,000	$1,376,867,161	$1,308,023,803	$1,342,500,000	-$34,476,197	$200,000,000	-$234,476,197	5,000	14
30,000,000	$1,633,916,993	$1,552,221,143	$1,398,000,000	$154,221,143	$250,000,000	-$95,778,857	7,500	11
35,000,000	$1,857,679,185	$1,764,795,226	$1,631,000,000	$133,795,226	$250,000,000	-$116,204,774	7,500	13
50,000,000	$2,511,252,375	$2,385,689,756	$2,330,000,000	$55,689,756	$250,000,000	-$194,310,244	10,000	14
75,000,000	$3,496,138,949	$3,321,332,002	$3,457,500,000	$208,701,494	$300,000,000	-$91,298,506	10,000	21
100,000,000	$4,360,816,362	$4,142,775,544	$4,470,000,000	-$327,224,456	$400,000,000	-$727,224,456	15,000	18

Notes:

- All table references refer to the Economic Assessment of Conceptual Underground Mining Option for the NorthMet Project October 2012.
- In situ net metal value from Table 2 determined for specific tonnage by log 10 linear extrapolation.
- Applicable day rate of production and associated total operating costs and pre-production capital costs from Table 3. Economic analysis life of mine based on day rate of production rounded to even year; once life of mine is fixed daily rate of production allowed to vary to accommodate rounding in simple cash flow analysis.
- Rate of extraction and dilution discussed in text. Total extracted net metal value includes deduction for treatment charge as given in Table 1.

Prepared By: TJB
Checked By: JSL

Attachment 3
NorthMet Project and Land Exchange
Purpose and Need Statement

PURPOSE AND NEED

Applicant's Purpose and Need Statement

The applicant's stated purpose of the NorthMet Project is to exercise PolyMet's mineral lease to continuously mine, via open pit methods, the known ore deposits (NorthMet Deposit) containing copper, nickel, cobalt, and platinum group elements to produce base and precious metal precipitates and flotation concentrates by uninterrupted utilization of the former LTV Steel Mining Company (LTVSMC) processing plant.

The purpose of the proposed Land Exchange is to consolidate the surface and mineral ownership of the lands involved at the Mine Site. PolyMet has a lease to mine the minerals on its NorthMet Deposit, which is surrounded by active and abandoned taconite mines in the mining district near Hoyt Lakes. The surface of these lands is owned by the United States.

The need for the NorthMet Project is driven by domestic and global demand of these products. Demand continues to rise for these metals due to the expansion of the green economy and rising demand from developing countries like India, China, and Brazil. Based on the closure of LTVSMC and other job losses in northeastern Minnesota, there is also a need for jobs and economic development in the area.

Co-lead Agencies' Purpose and Need Statements

NorthMet Project and Land Exchange Purpose and Need Statement

The Purpose and Need for the Combined Proposed Action is:

- For PolyMet to utilize its leased mineral rights and recover commercial quantities and quality of semi-refined metal concentrates, hydroxides, and precipitates from the NorthMet ore body in northern Minnesota, and to process the recovered ore by reutilizing the former LTVSMC processing plant.
- To extract metals in a safe, environmentally responsible, energy-efficient, and economically feasible manner subject to mitigation measures designed to avoid or minimize environmental effects to the extent practicable.
- To extract and process metals in a technically and economically feasible manner, such that there would be sufficient income to cover: operating cost (which includes but is not limited to the cost of mining, processing, transportation, and waste management), capital cost (needed to build and sustain facilities), an adequate return to investors, reclamation, and closure costs and taxes.
- To eliminate surface and mineral conflicts within the Superior National Forest by exchanging federal lands for non-federal lands that have equal or greater value.

USDA, Forest Service

The purpose for the United States Forest Service (USFS) is to meet desired conditions in the Superior National Forest Land and Resource Management Plan (Forest Plan), including ensuring the proposed land exchange Proposed Action eliminates existing conflict and ensuring mineral resources are produced in an environmentally sound manner contributing to economic growth.

In regards to desired conditions for land exchange and mineral development, the Superior National Forest's Forest Plan includes the following direction:

> "D-LA-1 – The amount and spatial arrangement of National Forest System land within the proclamation boundary of the Forest are sufficient to protect resource values and interests, improve management effectiveness, eliminate conflicts, and reduce the costs of administering landlines and managing resources." (Forest Plan, Land Adjustment, pg. 2-51)

> "D-MN-2 – Ensure that exploring, developing, and producing mineral resources are conducted in an environmentally sound manner so that they may contribute to economic growth and national defense." (Forest Plan, Minerals, pg. 2-9)

PolyMet intends to exercise private mineral rights that were reserved when lands were conveyed to the United States and has proposed the development of a surface mine. This land was purchased by the USFS, for National Forest purposes, under the authority of the Weeks Act (16 USC 515). The USFS has taken the position that the mineral rights that were reserved do not include the right to surface mine as proposed by PolyMet.

In addition, allowing private surface mining would be inconsistent with USFS legal mandates for acquiring and managing these lands. The USFS needs to resolve this fundamental conflict.

U.S. Army Corps of Engineers

The Purpose and Need of the Proposed Action is to produce base and precious metals precipitates and flotation concentrates from ore mined at the NorthMet Deposit by uninterrupted operation of the former LTVSMC processing plant. The processed resources would help meet domestic and global demand by sale of these products to domestic and world markets.

Minnesota Department of Natural Resources

The Purpose and Need of the Proposed Action is to produce base and precious metals precipitates and flotation concentrates from ore mined at the NorthMet Deposit by uninterrupted operation of the former LTVSMC processing plant. The processed resources would help meet domestic and global demand by sale of these products to domestic and world markets.

Appendix C

Tribal Agency Position Supporting Materials

C1 INTRODUCTION

Appendix C contains Tribal Cooperating Agencies' comments and supporting documentation that represent major differences of opinion with the analyses as presented in the SDEIS. The information was submitted by the Bois Forte, Grand Portage, Fond du Lac, Great Lakes Indian Fish & Wildlife Commission, and the 1854 Treaty Authority. All materials in this appendix are Tribal views provided verbatim and have not been validated or approved by the Co-lead Agencies.

See Chapter 8, Major Differences of Opinion, in the SDEIS for a complete listing of the 18 Tribal issues and summaries, and the Co-lead Agency responses.

Hydrology Section:

The hydrology section of the Tribal SDEIS Appendix consists of documents and reports related to three topics:

1. **Baseflow predictions by XPSWMM vs. measurements of baseflow in the upper Partridge River.**
   The data reported and analysis contained in the five letters and memos in this sub-section highlight the lack of agreement between the low baseflow predicted by the surface water model XPSWMM and the baseflows measured in the field and by continuous stream gauging. Estimates of impacts to the Partridge River and estimates to other surface and groundwaters in the mine site area are dependent on accurate information on river baseflow.

2. **The inability of the GoldSim model to accurately predict current water quality at the mine site or the plant site.**
   The results of the Goldsim modeling highlighted in the email and figure of this sub-section demonstrate that Goldsim does a poor job in predicting current ground and surface water quality. In some cases GoldSim mis-predicts water quality by more than 400%. Accurate prediction of current water quality by a model such as GoldSim is an easier task than predicting future water quality, given the uncertainty of input variables in the future. GoldSim's inability to accurately predict <u>current</u> water quality indicates it is poorly suited for predicting <u>future</u> water quality.

3. **The lack of inclusion of reasonably foreseeable events in the SDEIS No-Action Alternative modeling.**
   The documents and email in this sub-section highlight the CEQ requirement that "where a choice of "no action" by the agency would result in predictable actions by others, this consequence of the "no action" alternative should be included in the analysis." The no-action alternative analysis of future water quality used in the SDEIS includes nothing except continuation of the current water quality. This SDEIS No-Action alternative is so extremely unrealistic so as to not even include the dilution effects of precipitation on existing tailings basin water when predicting future water quality.

Sub-section 1

Baseflow predictions by XPSWMM vs. measurements of baseflow in the upper Partridge River.

Subject:	Partridge River baseflow, draft analysis of new data suggest XP-SWMM estimate inaccurate
From:	"john.coleman" <jcoleman@glifwc.org>
Date:	7/2/2013 11:56 AM
Attachments:	Baseflow_calibration_v2012-03-02.pdf (32.2 KB), 2012-06-12_baseflow info re NorthMet EIS Mine Site Hydrology Teleconference.eml (2.8 KB), 2012-06-18_watershed ratio predicts baseflow of 1.2cfs at SW-004 Re Model Calibration, NorthMet EIS.eml (3.1 KB), 2008-09-28_further comments on RS22 AppenB Draft-03.htm (4.5 KB)
CC:	"Sedlacek.Michael@epamail.epa.gov" <Sedlacek.Michael@epamail.epa.gov>, "Grimes.James@epamail.epa.gov" <Grimes.James@epamail.epa.gov>
To:	thomas hingsberger <thomas.j.hingsberger@usace.army.mil>, Ross Vellacott <Ross.Vellacott@erm.com>, "Shirley Frank (USFS)" <safrank@fs.fed.us>, "Bill Johnson (MN-DNR)" <Bill.Johnson@state.mn.us>, "Lisa Fay (MN-DNR)" <lisa.fay@state.mn.us>

To: Polymet EIS Co-leads 2013-07-02

From: John Coleman, GLIFWC

Re: Partridge River baseflow, draft analysis of new data suggest XP-SWMM estimate inaccurate

We remain concerned that the basic hydrology of the mine site is mis-characterized as being very non-conductive. The baseflow in the Partridge is a fundamental parameter to which many flow and contaminant transport models are calibrated. Unfortunate the baseflow at the site used in impact prediction is an estimate make by XP-SWMM. XP-SWMM appears to do a poor job of predicting baseflow at the mine site, possibly because it is based on a data set collected 17 miles downstream.

As we note in our recently submitted PSDEIS comments, the MDNR winter flow measurements in the PSDEIS (Table 4.2.2-9) indicate substantially higher baseflow in the Partridge than predicted by XP-SWMM. This is true even when the flow data is corrected for any possible Northshore (NS) discharge to the Partridge by subtracting the farthest upstream measurement from measurements taken farther downstream.

Even more compelling than the winter MDNR flow measurements is the flow data that has been recorded at the Dunka Road gage over the last 2 years. I have again calculated some statistics on the flow measurements taken at the Partridge River & Dunka Road, also known as monitoring site SW003. (http://www.dnr.state.mn.us/waters/csg/site_report.html?mode=get_site_report&site=03155002)
Earlier comments on this topic are attached and previous analysis was submitted to the lead agencies by email on 2012-06-12, 2012-06-18, and on 2008-09-28 (attached).

The stage and flow values measured by stream gage are available at 15 minute intervals. Based on 66,581 stage records collected between May 2011 and April 2013 and the DNR rating curve, I found:

Q90 at SW003 = 2.32 cfs (90% of the time flow was greater than 2.32 cfs) Q90 is sometimes used as an indicator of baseflow

Using 586 daily average flows from 2011-05-26 to 2012-12-31 calculated by the DNR and accounting for winter ice conditions, I found:
Q90 at SW003 = 1.9 cfs

Given that Northshore Peter Mitchel (PM) pit intermittently discharges to the Partridge River, I also analyzed 3 months in 2011 (Jul,Aug,Sep) and 3 months in 2012 (Feb,Mar,Apr) **when Northshore (NS) discharged zero (0) gallons** into the Partridge River.
Based on average daily flows calculated by the DNR:
In the 3 months of no NS pit discharge in 2011 Q90 at SW003 = 1.8 cfs
In the 3 months of no NS pit discharge in 2012 Q90 at SW003 = 1.1 cfs

Given that both these 3-month periods are typically low flow times, it seems that a baseflow estimate for site SW003 of 1 - 2 cfs would be reasonable.
While analysis based on only 6 months of flow data is not ideal, it should be noted that the XP-SWMM model is calibrated to only 2 months when Northshore did not discharge to the Partridge in 1985 (PSDEIS page 4.2.2-44, 1st paragraph).

Neither the direct field observations (minimum of 3.4 cfs) nor the values calculated from the DNR rating curve, support the **baseflow predicted by XP-SWMM at SW003 of 0.51 cfs** (Water Modeling Data package Vol.1-Mine Site, ver12, p.130 and PSDEIS Table 4.2.2-8). XP-SWMM's low estimates of baseflow are used in calibration of the MODFLOW model and thus influence many aspects of the site characterization and impact prediction, including pit inflow, dewatering impacts to the Partridge River, water treatment needs, groundwater flow rates, contaminant transport times and concentrations, and contaminant dilution in the Partridge watershed.

Although it is now an unfortunate time in the NEPA process to try to adequately characterize basic site hydrology, if appears that predictions of effects of the project may be far from accurate. It is not easy to say how the mis-characterization of river baseflow would affect compliance predictions because, although more baseflow might mean more dilution of contaminants, it could also mean transport of greater quantities of pollutants to the river and more drawdown of the Partridge River. We have repeatedly asked that the data at the Dunka Road gage be formally analyzed for baseflow as a check of the accuracy of the XP-SWMM modeling. If that analysis indicates that the XP-SWMM predictions under-represents baseflow, as our draft analysis suggests, that result should be incorporated into all project model calibration and prediction.

Thank you in considering this issue when revising the SDEIS.

--
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Subject:	watershed ratio predicts baseflow of 1.2cfs at SW-004 Re: Model Calibration, NorthMet EIS
From:	john coleman <jcolema1@wisc.edu>
Date:	6/18/2012 9:09 AM
To:	thomas.j.hingsberger@usace.army.mil, "JMohr@barr.com" <JMohr@barr.com>, David Blaha <David.Blaha@erm.com>, "fmarinelli@interralogic.com" <fmarinelli@interralogic.com>, "John.Adams2@erm.com" <John.Adams2@erm.com>, "Poleck.Thomas@epamail.epa.gov" <Poleck.Thomas@epamail.epa.gov>, "erik.carlson@state.mn.us" <erik.carlson@state.mn.us>, Michael Sedlacek <Sedlacek.Michael@epamail.epa.gov>, James Grimes <Grimes.James@epamail.epa.gov>, Tina Pint <TPint@barr.com>, Greg Williams <GWilliams@barr.com>, 'Marty E Rye' <mrye@fs.fed.us>, "Liljegren,Michael W (DNR)" <Michael.Liljegren@state.mn.us>, "'Nancy Schuldt (nancyschuldt@fdlrez.com)'" <nancyschuldt@fdlrez.com>, "Margaret Watkins (watkins@boreal.org)" <watkins@boreal.org>, "wagener.christine@epa.gov" <wagener.christine@epa.gov>, "'Darren Vogt (DVogt@1854treatyauthority.org)'" <DVogt@1854treatyauthority.org>, Rose Berens <rberens@boisforte-NSN.gov>, Esteban Chiriboga <edchirib@wisc.edu>, Ann McCammon_Soltis <amsoltis@glifwc.org>, Neil Kmiecik <nkmiecik@glifwc.org>

The watershed upstream of SW-004 makes up 22% of the SW-006 watershed (23 of 103 sq.miles), yet XP-SWMM predicts that the watershed contributes only 17% (0.92 of 5.3 cfs) of the baseflow.

Using a ratio of watershed areas to extrapolate baseflow up from the USGS gage (SW-006) would suggest that baseflow at SW-004 is 1.2 cfs (5.3 X .22).

While using the watershed ratio technique is uncomplicated compared to XP-SWMM, it appears to give a prediction of baseflow at SW-004 closer to the flows actually observed at the site.

It seems that the Partridge River may be over-modeled with the use of XP-SWMM. Such a parameter-heavy model as XP-SWMM needs substantially more data from near the mine site in order to be justified. A more parsimonious approach appears to be a better fit.

Notes:
watershed areas from Table 1 of RS73B Sept. 2008
SP-SWMM predicted baseflows from Table 5-10 of CDF012
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Subject:	baseflow info re:: NorthMet EIS: Mine Site Hydrology Teleconference
From:	john coleman <jcolema1@wisc.edu>
Date:	6/12/2012 3:23 PM
CC:	"JMohr@barr.com" <JMohr@barr.com>, David Blaha <David.Blaha@erm.com>, "fmarinelli@interralogic.com" <fmarinelli@interralogic.com>, "John.Adams2@erm.com" <John.Adams2@erm.com>, "Poleck.Thomas@epamail.epa.gov" <Poleck.Thomas@epamail.epa.gov>, "erik.carlson@state.mn.us" <erik.carlson@state.mn.us>, Michael Sedlacek <Sedlacek.Michael@epamail.epa.gov>, James Grimes <Grimes.James@epamail.epa.gov>, Tina Pint <TPint@barr.com>, Greg Williams <GWilliams@barr.com>, 'Marty E Rye' <mrye@fs.fed.us>, "Liljegren, Michael W (DNR)" <Michael.Liljegren@state.mn.us>, "'Nancy Schuldt (nancyschuldt@fdlrez.com)'" <nancyschuldt@fdlrez.com>, "Margaret Watkins (watkins@boreal.org)" <watkins@boreal.org>, "wagener.christine@epa.gov" <wagener.christine@epa.gov>, "'Darren Vogt (DVogt@1854treatyauthority.org)'" <DVogt@1854treatyauthority.org>, Rose Berens <rberens@boisforte-NSN.gov>, Esteban Chiriboga <edchirib@wisc.edu>
To:	"Hingsberger, Thomas J MVP" <thomas.j.hingsberger@usace.army.mil>

As a contribution to the discussion tomorrow, I calculated some statistics on the flow measurements taken so far at the the Partridge River & Dunka Road. (http://www.dnr.state.mn.us/waters/csg/site_report.html?mode=get_site_report&site=03155002)

The stage and flow values are available at 15 minute intervals starting in February of 2012. Based on 10,300 records I found Flow stats of:
Q70 = 6.9 cfs (70% of the time flow was greater than 6.9 cfs) Q70 is sometimes used as an indicator of baseflow
Q90 = 2.8 cfs (90% of the time flow was greater than 2.8 cfs) Q90 is sometimes used as an indicator of baseflow
Q10 = 28.3 cfs (10% of the time flow was greater than 28.3 cfs)

Q99 = 0.4 cfs (99% of the time flow was greater than 0.4 cfs)

minimum 7day average flow was 2.37 cfs (this is sometime also used as an indicator of baseflow)

These flow values are based on a rating curve that is still being developed and cover less than a year, but neither the direct observations (minimum of 3.8 cfs) nor the values calculated from the rating curve support the XP-SWMM predicted baseflow 4 miles downstream of the gage (i.e. 0.76 cfs) and used in modeling.

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● MEMBER TRIBES ●

MICHIGAN	WISCONSIN		MINNESOTA
Bay Mills Community	Bad River Band	Red Cliff Band	Fond du Lac Band
Keweenaw Bay Community	Lac Courte Oreilles Band	St. Croix Chippewa	Mille Lacs Band
Lac Vieux Desert Band	Lac du Flambeau Band	Sokaogon Chippewa	

Via Electronic Mail / Original by Mail

March 2, 2012

Memorandum

To: Thomas Hingsberger USACE
Erik Carlson Minnesota DNR

From: John Coleman, Environmental Section Leader

Re: Polymet model calibration to Partridge River low flows

The hydrologic models for the Polymet mine site have been calibrated to targets that under-represent true baseflow. Models should be calibrated to a strong set of observational data. Construction of the site's basic hydrologic model to unrealistically low baseflows has ramifications for all the flow and contaminant modeling at the site.

Under-representation of Partridge River baseflow.

Review of the winter baseflow measurements and comparison to predictions made by XP-SWMM indicate that XP-SWMM substantially underpredicts baseflow (Barr June 9, 2011, Comparison of MDNR winter flow gauging to Partridge River XP-SWMM model). This has ramifications throughout the parameter sets being used in models characterizing hydrology at the Polymet mine site.

In the above referenced memo, Barr points out that the average measured baseflow at Dunka Rd. was 5.0 cfs while the XP-SWMM predicted baseflow is 0.4 cfs. Even when discharge from Northshore Mining was taken into account, the average baseflow measured at Dunka is 4.3 cfs while XP-SWMM predicts 0.42 cfs.

In its memo, Barr correctly points out that: "At all locations along the main stem of the Partridge River, the XP-SWMM-estimated baseflow is less than the MDNR-measured baseflow. The XP-SWMM model provides a conservative estimate of Partridge River baseflow for the purposes of modeling water quality impacts (e.g., less dilution of loads from the Mine Site)." What is not acknowledged in the Barr memo is that calibration of hydrologic models to an underestimate of baseflow produces models that characterize the groundwater hydrologic system as moving an unrealistically small quantity of water.

Additional flow measures over the last 9 months on the Partridge River at the Dunka Road (site SW-003) further support the position that baseflow predicted by XP-SWMM under-represents true baseflow. The least flow measured at the Dunka Road site was 3.8 cfs. While there have so far been only 7 measurements taken at that site, the flow measured and the stage recorded by the gauge do not appear to support XP-SWMM's low baseflow predictions for the upper Partridge River.

Mis-calibration of groundwater flow models.

The calibration of the Modflow model to a Partridge River baseflow of 0.76 cfs predicted by XP-SWMM results in a model that moves very little water through the groundwater system. This can result in low predicted rates of inflow to the mine pit and slow movement of contaminants from sources (stockpiles or reflooded pits) to points of evaluation. More generally, an incorrect baseflow calibration target results in excessively low estimates of recharge and likely incorrect estimates of horizontal and vertical conductivity. These hydrologic parameters are interrelated and getting one wrong, as appears to be the case with baseflow, will almost certainly result in the other parameters being incorrectly estimated. Although there has been little sensitivity analysis conducted in the Polymet modeling efforts, flow models tend to be sensitive to these interrelated parameters.

Based on Modflow model calibration to a baseflow of 0.76 cfs and recharge values set at 0.3 and 1.5 in/yr (see page 61 of Water Modeling Data Package Vol 1-Mine Site v9 DEC2011.pdf and page 11 of RS22, Appendix B), some horizontal and vertical conductivities (K) were calculated by Barr using PEST (see Table 1 of Attachment B of Water Modeling Data Package Vol 1-Mine Site v9 DEC2011.pdf). These K values are likely to be inaccurate since they are calculated with a model that is calibrated to a baseflow that appears to be almost an order of magnitude too low. It is unlikely that any accurate predictions of water movement, transport of contaminant mass, or contaminant levels can be made when the characterization of the hydrologic system is so out-of-kilter.

Unusually low recharge and vertical K:

The low values used for recharge (0.3 and 1.5 in/yr) and the low wetland and till vertical K (0.0000033 ft/day [$1.16X10^{-9}$ cm/s]) used in the Modflow model are a reflection of a model constructed and calibrated to move an unrealistically small amount of water through the hydrologic system. For context, note that engineered clay liners in landfills typically aim for $1.0X10^{-7}$ cm/s hydraulic conductivity. I was unable to find any reference in the literature to wetland soil vertical conductivity as low as is used in the Modflow model. The lower end of the spectrum I found for wetland soil vertical conductivity was $1X10^{-6}$ cm/s.

Our long standing concern that the mine site hydrologic models incorporate incorrect assumptions about recharge are supported by Fred Marinelli's comment on line 39 and elsewhere of: "Agency Responses MS and PS WP and Waste Characterization Data package V7 2-7-12.xls". His comment states that "A net infiltration (recharge) range of 0.3 to 1.5 in/yr represents 1.1 to 5.4 percent of mean annual precipitation (MAP). This range for local net infiltration is unrealistically low for this area of the US." These low recharge values and the low vertical K values are related to calibration of the Modflow model to low baseflow. Until Modflow, and by extension the other related models XP-SWIMM and GoldSim, are calibrated to data from the site (e.g. observed baseflow and an adequate number of observed heads) and incorporate reasonable recharge rates, the results from the models are unlikely to accurately simulate current or future conditions.

Recalibration of models needed:

The Modflow model, in particular, needs to be calibrated with targets based on observed baseflow and observed well water heads. Calibration to projections by XP-SWMM, that appear to be incorrect, means that the fundamental characterization of the site hydrology is likely to be faulty. In the document referenced above (Agency Responses ...) Barr Engineering states that many hydrologic model parameters were "discussed as part of the IAP process and will not be considered further at this time." While some parameters were discussed in the groundwater IAP process, the discussion was almost exclusively concerning water quality parameters, not flow model parameters such as recharge, baseflow and Kv and Kh. The focus on water quality parameters to the near exclusion of hydrologic flow parameters is reflected in the Groundwater IAP summary memo of June 2011. Groundwater flow modeling underpins contaminant transport modeling and is interrelated to surface flow models. Without adequate vetting of flow model parameters and predictions, it is impossible to have confidence in predictions of contaminant movement and water quality.

Now that the hydrologic models have been more fully articulated by Barr and additional data are available, the models must be calibrated to observed baseflow and well water levels. <u>This should include the new water level data from the newly installed mine site wells</u>. PEST can then be used to more reasonably estimate values for recharge and conductivity. The observed baseflow and the PEST estimated recharge and conductivity values should then be used in the XP-SWMM and GoldSim modeling efforts. Modeling efforts that are based on faulty initial assumptions and not on field observations will not be able to reasonably predict impacts. The current Polymet modeling effort needs to be well founded on a strong base of observations of the physical conditions at the site.

Thank you for considering this issue. Please contact me at 608-263-2873 if you have questions.

cc: Mike Olson, Minnesota DNR
Fred Marinelli, Interralogic
Mike Sedlacek, USEPA
James Grimes, USEPA
Marty Rye, USFS
Nancy Schuldt, Fond du Lac Environmental Program
Neil Kmiecik, GLIFWC Biological Services Director
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Date: Sun, 28 Sep 2008 10:24:02 -0600
To: Stuart Arkley <Stuart.Arkley@dnr.state.mn.us>
From: John Coleman <jcolema1@wisc.edu>
Subject: further comments on RS22 Appen.B Draft-03
Cc: "Ahlness, Jon K MVP" <jon.k.ahlness@usace.army.mil>, Nancy Schuldt <nancyschuldt@fdlrez.com>, Ann McCammon_Soltis <amsoltis@glifwc.org>, Esteban Chiriboga <edchirib@wisc.edu>
Bcc:
X-Attachments:
In-Reply-To:
References:

Stuart,
Here are additional issues related to RS22-Appen.B and RS73

1) The Kv of the wetland and drift materials are unrealistically low:
The Modflow model in RS22 Appen.B uses vertical conductivity values for wetland and glacial drift soils that are unrealistic to the extreme. Table 3-3 of RS22 Appen.B indicates that the hydraulic conductivity values used in the local-scale model are 0.0000033 ft/day (1.16X10-9 cm/s), for comparison, engineered clay liners in landfills typically aim for 1.0X10-7 cm/s hydraulic conductivity. I was unable to find any reference in the literature to wetland soil vertical conductivity as low as is used in the Modflow model. The lower end of the spectrum I found for wetland soil vertical conductivity was 1X10-6 cm/s. These low Kv values have effects on predicted recharge, mine pit inflow, groundwater drawdown, river baseflow impacts, and contaminant transport to the Partridge River.

2) No recharge to the Giant's Range or Biwabik Iron Formations is specified. These are material types in the Modflow layer one. Were they zero or just not reported?

3) The recharge for wetlands and drift (0.3 and 1.5 in/yr) are unusually low.
MODFLOW of Crandon project in an area of glacial drift and wetlands used 9 in/yr.
The Polymet MODFLOW mode for the plant/tailings site uses 8in/yr for wetland/drift areas.
The MODFLOW report supports the choice of 0.3 and 1.5 in/yr or recharge by citing the RS73A SWMM model "groundwater recharge coefficient". These are not equivalent parameters and the baseflow predicted by SWMM is most likely underestimated as explained below.

4) The 1.43 cfs of baseflow at SW-004 that the Modflow model is calibrated to (RS22 Appen.B, page 13) is a predicted value from the SWMM model which is calibrated to USGS gage 04015475 baseflow of 5.47 cfs, estimated from 1978-1988 flow data (RS73A). The USGS gage (near the inlet to Colby Lake) is 17 miles downstream of SW-004 and 26 miles downstream of the headwaters. Flow data collected in 2004 during 3 periods (see RS63) of low flow show significantly greater flows in the river at SW-004 and SW-003 than at the station (SW-005) 17 miles downstream near Colby Lake inlet (RS63). During these periods, SW-003 showed flows of 6 to 8.6 cfs while the downstream station (SW-005) showed flows of 2.7 to

7.6 cfs. In addition there was one measurement at SW-003 in 1978 that overlaps with the USGS gage 04015475. On 11/15/1978 flow at SW-003 was recorded as 25 cfs and at the USGS gage 23 cfs. The higher flows in the upper reaches of the Partridge River indicate that the river is gaining in its upper reaches and is loosing in its lower reaches. This is not at all surprising given the drop in elevation of 320 feet above SW-003. Below SW-003 there is only another 100 ft of drop over the 20 miles to the USGS gage.

The flow data from 2004 and 1978 appear to indicate that baseflow at SW-003 and SW-004 is approximately 1 to 2 times the baseflow in the Partridge River near the inlet to Colby Lake. Given the 1978 and 2004 data, it appears that the Modflow would more reasonably be calibrated to a baseflow of approximately 7-8 cfs at SW-003 and 4 cfs at SW-004. Calibration to higher baseflows in the Partridge River would likely produce a model with higher recharge, more flow to the pits, different contaminant transport results, and different drawdown and baseflow impact predictions.

Note: measurement stations in RS22, RS73, RS74 and RS63 have multiple names.

SW-001=PM1
SW-002=PM2=S-4
SW-003=PM3=CM126=S-1
SW-004=PM16
SW-005=PM4=CM123

Sub-section 2

The inability of the GoldSim model to accurately predict current water quality at the mine site or the plant site.

Subject:	Goldsim inaccurately predicts existing conditions, unlikely to accurately predict future project conditions
From:	"john.coleman" <jcoleman@glifwc.org>
Date:	7/2/2013 2:22 PM
Attachments:	Data_Pack_Plant_Site_Al_PM-13_Fig.I-05-02.2.pdf (271 KB)
CC:	"Sedlacek.Michael@epamail.epa.gov" <Sedlacek.Michael@epamail.epa.gov>, "Grimes.James@epamail.epa.gov" <Grimes.James@epamail.epa.gov>
To:	thomas.j.hingsberger@usace.army.mil, Ross.Vellacott@erm.com, safrank@fs.fed.us, "Bill.Johnson" <Bill.Johnson@state.mn.us>, lisa.fay@state.mn.us

To: Polymet EIS Co-leads 2013-07-02

From: John Coleman, GLIFWC

Re: Goldsim inaccurately predicts existing conditions, unlikely to accurately predict future project conditions

While we feel that modeling of the existing conditions is an inadequate substitute for a realistic No-Action Alternative model and does not follow CEQ guidelines, it appears that Goldsim does not even accurately model existing conditions. As we noted in our spreadsheet comments submitted June 25th, for many parameters at several water bodies the No-Action P50 model of annual average value is substantially different than the observed average existing conditions. Because of the inaccuracy of the Goldsim predictions of current conditions it is not clear that use of the Goldsim estimates of project impacts are adequate to ensure protection of water resources.

For example:

- -PSDEIS Table 4.2.2-18 reports Colby Lake as currently having an observed mean Arsenic of 0.78 to 1.4 ug/L (depending on the data set), whereas Figure 5.2.2-35, the No-Action (continuation of current conditions) P50 model for Colby Lake Arsenic shows annual maximum values of 0.5 ug/L.
- -PSDEIS Table 4.2.2-34 reports PM-10 (seep at the basin north toe) as having an observed mean Mn value of 100,192 ug/L, whereas Figure F-01-18.1 (Water Modeling Data Package Vol 2-Plant Site v9 MAR2013) shows the No-Action (continuation of existing conditions) P50 as an annual maximum Mn of 390 ug/L. at the north toe.
- -PSDEIS Table 4.2.2-34 reports PM-10 as having an observed mean Aluminum of 39.6 ug/L yet Figure F-01-02.1 (Water Modeling Data Package Vol 2-Plant Site v9 MAR2013) shows an annual maximum for No-Action (continuation of existing conditions) at the north toe as 11 ug/L.
- -PSDEIS Table 4.2.2-14 shows that observed average SO4 at SW-005 (9.11 mg/L) is nearly identical to the Goldsim P50 predicted current annual maximum for that site (PSDEIS Fig. 5.2.2-27, 9 mg/L). This suggests that Goldsim is under-predicting SO4 at SW-005. (The authors of the text on page 5.2.2-125 of the PSDEIS seem to misinterpret the P50 of the figure as a predicted annual average. This is not the case. The P50 of that figure is the "best" estimate of the annual maximum. The Goldsim model estimate of the annual average at SW-005 is shown as the P50 in Mine Site Data Package Attachment K Figure K-06-24.2, i.e. 6 mg/L) Again this suggests that Goldsim is underpredicting SO4 at SW-005.
- - PSDEIS Table 4.2.2-29 shows that observed average Al at PM-13 is 221 ug/L. This observed average is much higher than the modeled No-Action (continuation of existing conditions) P50 annual maximum (PSDEIS Table 5.2.2-47, 159-166 ug/L). The modeled No-Action P50 annual average for Al at PM-13 of 75 ug/L (attached Fig.I-05-02.2, Water Modeling Data Package Vol 2-Plant Site v9 MAR2013) is only 1/3 of the observed average.

The tables below compare the observed existing conditions values found in various PSDEIS tables to the P50 existing conditions predicted by Goldsim. While a very few of these model predictions are presented in the PSDEIS, many are not and therefor, the tables below refer back to the underlying data packages from which the PSDEIS was written.

Observed existing conditions in the Partridge River vs. annual average existing conditions predicted by Goldsim.

Parameter (ug/L)	Average existing water quality (PSDEIS Table 4.2.2-14)	Annual average P50 existing conditions predicted by Goldsim (Mine Site Data Package Attach.K)
Mn	SW-002 = 142	SW002 = 80 (Fig.K-01-18.2)
Tl	SW-002 = 0.6	SW002 = 0.11 (Fig.K-01-25.2)
Mn	SW-003 = 147	SW003 = 85 (Fig.K-02-18.2)
B	SW-004a = 126.5	SW004a = 30 (Fig.K-04-05.2)
K	SW-004a = 2,700	SW004a = 1,600 (Fig.K-04-16.2)
SO4	SW-004a = 15,900	SW004a = 8,000 (Fig.K-04-24.2)
Pb	SW-005 = 1.3	SW005 = 0.26 (Fig.K-06-21.2)
SO4	SW-005 = 9,110	SW005 = 6,000 (Fig.K-06-24.2)
Tl	SW-005 = 0.4	SW005 = 0.05 (Fig.K-06-25.2)

Observed mean existing conditions in Colby Lake vs. annual average existing conditions predicted by Goldsim.

Parameter (ug/L)	Colby Lake mean existing water quality (PSDEIS Table 4.2.2-18, Barr data)	Colby Lake Annual average P50 existing conditions predicted by Goldsim (Mine Site Data Package Attach.K)
Al	108	75 (Fig.K-08-02.2)
As	0.78	0.4 (Fig.K-08-04.2)
Cu	2.4	0.7 (Fig.K-08-13.2)
Ni	2.5	1.1 (Fig.K-08-20.2)
SO4	33,800	~10,000 (Fig.K-08-24.2)
Tl	0.1	0.025 (Fig.K-08-25.2)

Observed mean existing conditions at the tailings basin toe vs. annual maximum existing conditions predicted by Goldsim. (Goldsim predicted mean concentrations are not provided in Modeling Data Package Vol 2-Plant Site v9 MAR2013)

Parameter (ug/L)	Mean seep measured value at Basin Toe (Table 4.2.2-34)	Annual maximum P50 existing condition predicted by Goldsim (Plant Site Data Package Attach.F)
Al	PM-8 = 25.7	West toe = 14 (Fig.F-04-02.1)
AL	PM-9 = 29.9	NW toe = 13 (Fig.F-02-02.1)
AL	PM-10 = 39.6	North toe = 11 (Fig.F-01-02.1)
Mn	PM-8 = 3,039	West toe = 1,250 (Fig.F-04-18.1)
Mn	PM-10 = 100,192	North toe = 380 (Fig.F-01-18.1)
F	PM-8 = 2,900	West toe = 1,100 (Fig.F-04-14.1)
As	PM-8 = 3	West toe = 2 (Fig.F-04-04.1)
B	PM-10 = 379	North toe = 330 (Fig.F-01-05.1)

Pb	PM-10 = 1.3	North toe = 1 (Fig.F-01-21.1)

The above examples are not an exhaustive list of discrepancies between observed existing water quality data and the Goldsim P50 prediction of the No-Action alternative (continuation of existing conditions) but highlight some of the most notable discrepancies. What the discrepancies demonstrate is that the Goldsim model is a relatively poor predictor of current conditions. If a model is unable to accurately predict current conditions it is even less likely to accurately predict future Project conditions. The Goldsim models need to be better calibrated to existing conditions (the calibration effort reported in "Calibration of the Existing Natural Watershed at the Plant Site v4 MAR2012" only compared model output to upstream site PM-12 and apparently did a poor job of preparing the models to predict either the lower reaches of the Embarrass or the Partridge River.) and model results recalculated.

Thank you for considering this issue while revising the PSDEIS.

--

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Madison, WI 53706
608-263-2873 or 265-5639
jcoleman@glifwc.org

221 ug/L

average existing Al at PM-13 (PSDEIS Table 4.2.2-29)

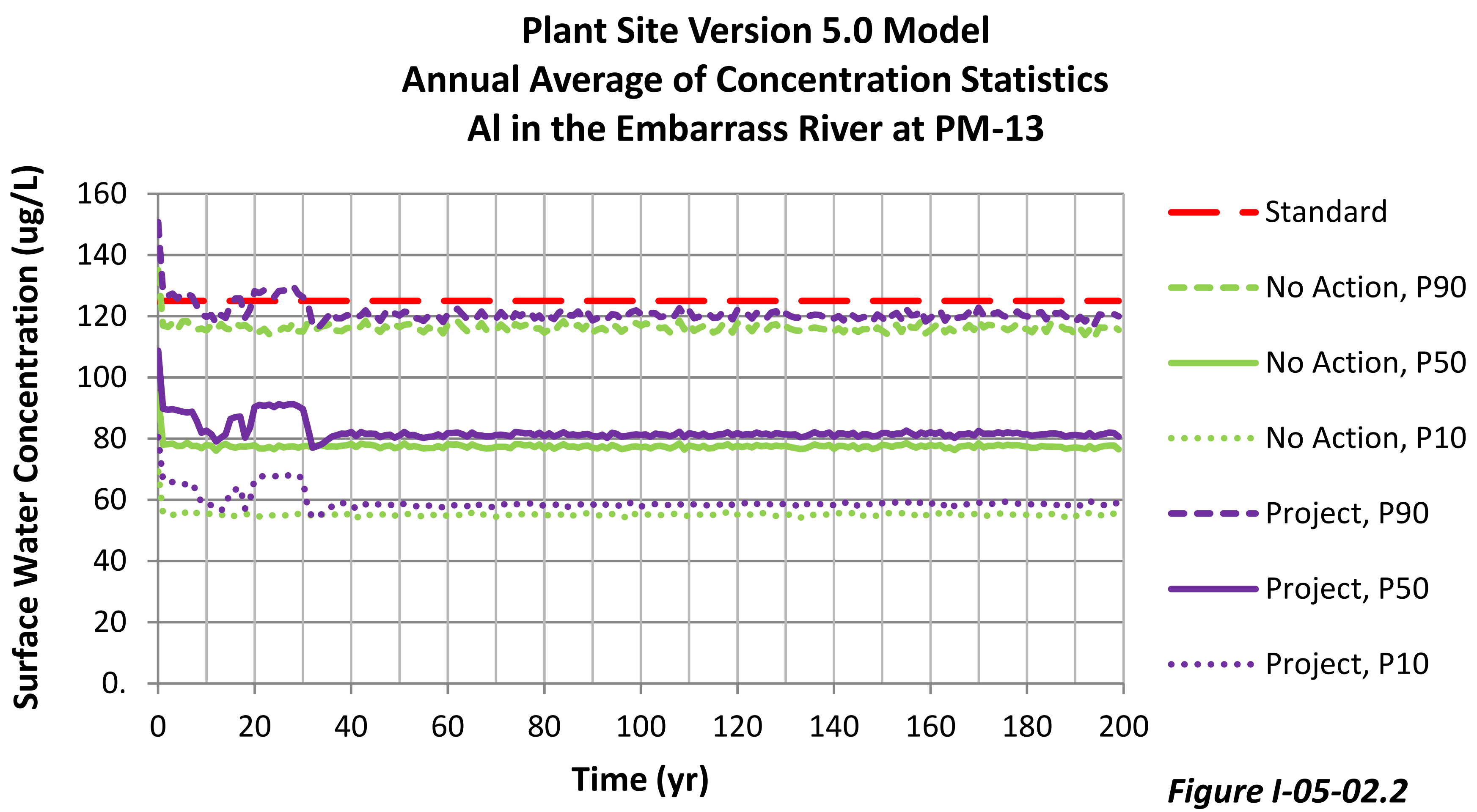

Figure I-05-02.2

Sub-section 3

The lack of inclusion of reasonably foreseeable events in the SDEIS No-Action Alternative modeling.

Subject:	Continuation of Existing Conditions an inappropriate No-Action alternative
From:	"john.coleman" <jcoleman@glifwc.org>
Date:	7/2/2013 3:15 PM
Attachments:	G-CEQ-40Questions.pdf (416 KB), Water Modeling Data Package Vol 2-Plant Site v9 MAR2013_F-01.10.1.pdf (47.5 KB)
CC:	"Sedlacek.Michael@epamail.epa.gov" <Sedlacek.Michael@epamail.epa.gov>, "Grimes.James@epamail.epa.gov" <Grimes.James@epamail.epa.gov>
To:	thomas.j.hingsberger@usace.army.mil, Ross.Vellacott@erm.com, safrank@fs.fed.us, "Bill.Johnson" <Bill.Johnson@state.mn.us>, lisa.fay@state.mn.us

To: Polymet EIS Co-leads 2013-07-02

From: John Coleman, GLIFWC

Re: Continuation of Existing Conditions an inappropriate No-Action alternative

According to CEQ guidelines (attached):

> "No action" in such cases would mean the proposed activity would not take place, and the resulting environmental effects from taking no action would be compared with the effects of permitting the proposed activity or an alternative activity to go forward.
>
> Where a choice of "no action" by the agency would result in predictable actions by others, this consequence of the "no action" alternative should be included in the analysis. For example, if denial of permission to build a railroad to a facility would lead to construction of a road and increased truck traffic, the EIS should analyze this consequence of the "no action" alternative.

Based on the above CEQ guidlines, it is clear that activities that will occur under the Cliffs Consent Decree should be included in modeling of a No Action alternative. Unfortunately not only are the consent decree activities not included, but the fact that it will be precipitating on the tailings basins for the foreseeable future has not been included in the No Action modeling. This is evident by the model results that show stable levels of Chloride coming from the basins for the next 200 years (Figure attached) when there is no ongoing source for Chloride. With no source for new Chloride, rainwater will gradually dilute the residual Chloride in the basin and levels will drop. The PSDEIS claims that the basins water quality has stabilized and that the current conditions will not change over time. The claim of chemical stability is based on basin pond water sampling for only 4 years (2001 - 2004, PSDEIS Table 4.2.2-23).

Since there has been no water quality data collected in the basin pond for 9 years it is reasonable to assume that the past 9 years of precipitation has diluted the water chemistry in the basin pond and that eventually the more dilute water will work its way though the basins and be discharged at the toe. If chemical stability is to be assumed, more recent data on basin pool water chemistry is needed. While the CEQ makes it clear that a blind "continuation of existing conditions" model is inappropriate as a No Action alternative, a "continuation of existing conditions" model that ignores simple environmental processes such as precipitation is even less appropriate.

Thank you for considering this issue.

46 Fed. Reg. 18026 (March 23, 1981)
As amended

COUNCIL ON ENVIRONMENTAL QUALITY

Executive Office of the President

Memorandum to Agencies:

Forty Most Asked Questions Concerning CEQ's National Environmental Policy Act Regulations

SUMMARY: The Council on Environmental Quality, as part of its oversight of implementation of the National Environmental Policy Act, held meetings in the ten Federal regions with Federal, State, and local officials to discuss administration of the implementing regulations. The forty most asked questions were compiled in a memorandum to agencies for the information of relevant officials. In order efficiently to respond to public inquiries this memorandum is reprinted in this issue of the Federal Register.

Ref: 40 CFR Parts 1500 - 1508 (1987).

FOR FURTHER INFORMATION CONTACT:

General Counsel,
Council on Environmental Quality,
722 Jackson Place NW,
Washington, D.C. 20006;
(202)-395-5754.

March 16, 1981

MEMORANDUM FOR FEDERAL NEPA LIAISONS, FEDERAL, STATE, AND LOCAL OFFICIALS AND OTHER PERSONS INVOLVED IN THE NEPA PROCESS

Subject: Questions and Answers About the NEPA Regulations

During June and July of 1980 the Council on Environmental Quality, with the assistance and cooperation of EPA's EIS Coordinators from the ten EPA regions, held one-day meetings with federal, state and local officials in the ten EPA regional offices around the country. In addition, on July 10, 1980, CEQ conducted a similar meeting for the Washington, D.C. NEPA liaisons and persons involved in the NEPA process. At these meetings CEQ discussed (a) the results of its 1980 review of Draft EISs issued since the July 30, 1979 effective date of the NEPA regulations, (b) agency compliance with the Record of Decision requirements in Section 1505 of the NEPA regulations, and (c) CEQ's preliminary findings on how the scoping process is working. Participants at these meetings received copies of materials prepared by CEQ summarizing its oversight and findings.

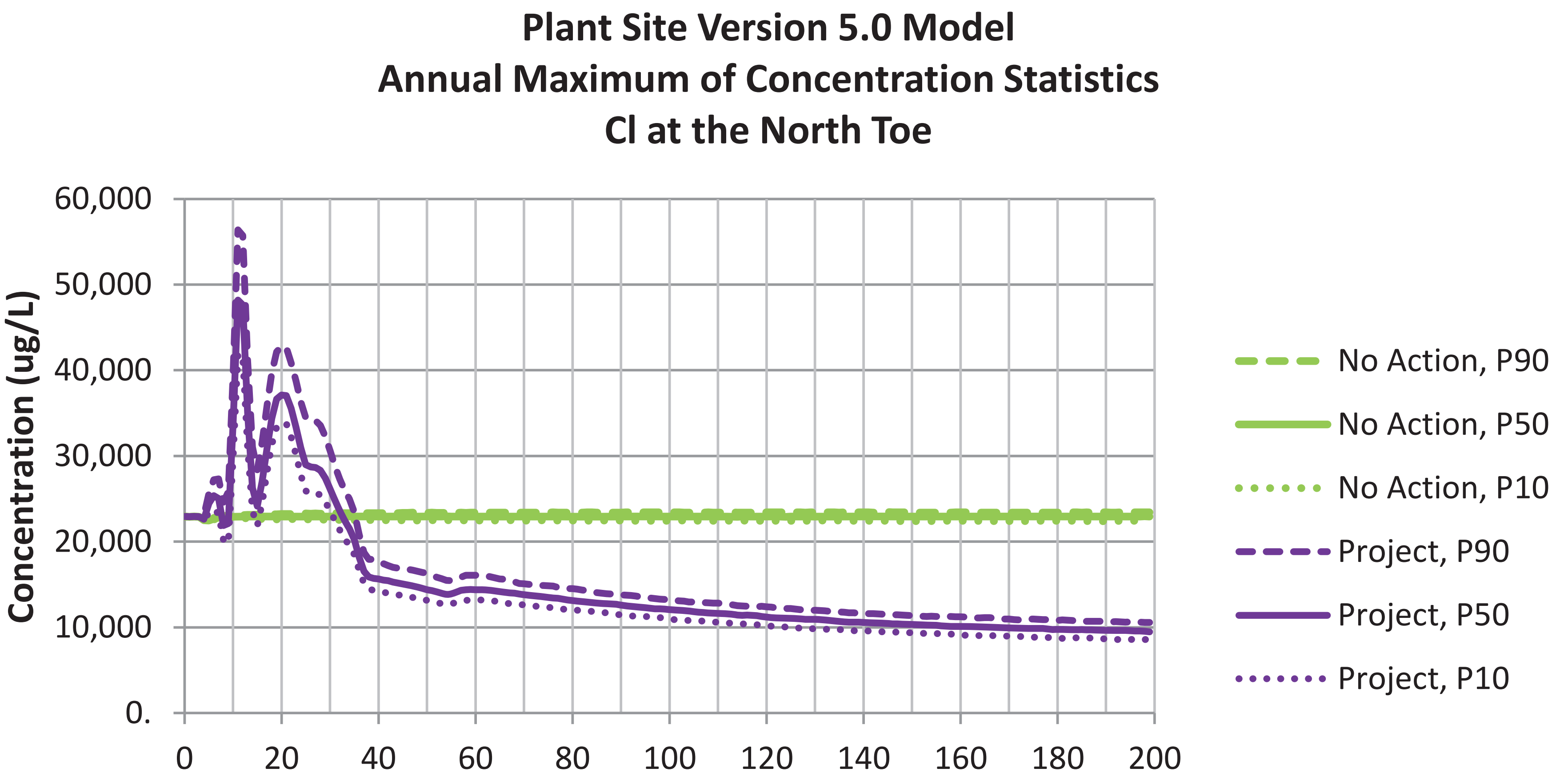

Figure F-01-10.1

Great Lakes Indian Fish and Wildlife Commission (GLIFWC) Mercury Section

Below are comments from the Great Lakes Indian Fish and Wildlife Commission (GLIFWC) related to mercury issues in the "NorthMet Mining Project and Land Exchange: Preliminary Supplemental Draft Environmental Impact Statement" (PSDEIS). Detailed rationale and comments follow the summary.

Summary

The understanding of mercury dynamics in the St. Louis River watershed is very limited and is insufficient to lead to the conclusion reached in the PSDEIS that "the NorthMet Project Proposed Action would not exceed applicable environmental evaluation criteria." This lack of scientific information is explicitly stated throughout the PSDEIS and is what led the Minnesota Pollution Control Agency (MPCA) early this year to delay the establishment of a St. Louis River TMDL until further mercury cycling data could be collected.

Further, the conclusion that "the NorthMet Project Proposed Action would not exceed applicable environmental evaluation criteria" is based on a number of flawed assumptions. Specifically, we do not agree with the following assumption in the PSDEIS (rationale provided below):

- The tailings basin will function as a mercury sink.
- Mercury methylation will not increase because the amount of sulfate being released to the environment will actually be reduced by the project.
- the NorthMet project would have minor effects on flows in the Partridge and Embarrass Rivers or their tributaries and is thus not expected to result in increases in flow fluctuations that promote mercury methylation.

Many lakes and rivers in the area are already classified as "impaired waters" by the MPCA due to elevated fish mercury. All additional increases in mercury contributions to the environment therefore constitute a risk to human and ecosystem health. The proposed project will result in increased mercury releases to the environment both via air and water, increasing human and ecosystem risk. All increases in mercury releases into the Lake Superior watershed are contrary to the goals of the 1991 "Binational Program to Restore and Protect the Lake Superior Basin" to establish a Zero Discharge Demonstration Program for nine critical pollutants, including mercury. These increased emissions are expected to have a measureable effect on mercury levels in fish and the subsequent health risk to recreational and subsistence fishers. Any additional mercury releases to the environment are exacerbating an already unacceptable risk situation in the area. Increased fish mercury levels fish will also have direct impacts on both the cultural and recreational resources of the region.

In addition, there are a several concerns related to mercury that are not addressed in the PSDEIS. These concerns are summarized here, with more detailed comments and rationale provided in the comments below. There is no discussion of the potential for the constructed wetlands over the East Pit and at the perimeter of the tailings basin to serve as a significant source of mercury methylation or as a route of mercury exposure to waterfowl and water birds that may utilize this habitat. The potential for the West Pit overflow to exceed the Great Lakes Initiative standard of 1.3 ng/L mercury is ignored. There is no consideration of the likely mercury pulse to the Partridge River resulting from placement of the stripped peat and unsaturated overburden into the unlined Overburden Storage and Laydown Area. It is not apparent whether mercury monitoring is included within the water quality monitoring of the Mine Site or Plant Site. The estimate of air emissions of mercury as a result of the project does not take into account emissions from electricity generation for the site or from the burning of fuel by mining vehicles or other equipment. Wetland monitoring following restoration is only vegetative and hydrologic in nature, but should include total and methyl mercury to collect information on mercury levels and methylation rates and identify any necessary remedial actions. The Wildlife Section does not discuss mercury contamination despite the fact that there are a number of fish- or aquatic invertebrate-eating species [such as the bald eagle (state listed and protected by federal law), otter, and wood turtle (state listed), and various amphibians] that may be impacted by increased methyl mercury in the food web. Flow to the Partridge River, Embarrass River, or their tributaries may be sufficient to impact habitat leading to alterations of species composition, food web structure, and ultimately mercury bioaccumulation.

<u>Comment 1</u>

The PSDEIS concludes that "Based on the results of the modeling and impacts analysis, the NorthMet Project Proposed Action would not exceed applicable environmental evaluation criteria." Due to a general lack of understanding of mercury dynamics, particularly in the St. Louis River (SLR) watershed, this conclusion is not defensible with regard to mercury. The PSDEIS explicitly points out this knowledge gap in a number of sections. For example:

- Section 5.2.2.1.2: indicates that even though mercury in fish tissue is relevant to water resources evaluation criteria considerations, the modeling did not attempt a numeric analysis of NorthMet Project Proposed Action-specific effects on mercury in fish tissue. In addition, the ability of numeric models to predict concentrations of mercury in fish tissue in response to changes in mercury-loading is currently inadequate due to gaps in scientific knowledge. Finally, the relationship of inorganic mercury-loading to uptake of methylmercury in fish is inherently complex and subject to numerous chemical, physical, and biological parameters, which vary geographically and are only partially understood.

- Sections 6.2.3.3.4 and 5.2.2.3.4: indicate that mercury was not included in the GoldSim model as insufficient data and a general lack of definitive understanding of mercury dynamics prevented modeling mercury like the other solutes.
- Section 5.2.2.3.4: indicates that current scientific understanding of the factors and mechanisms affecting mercury methylation and bioaccumulation is limited.

Further, the Minnesota Pollution Control Agency (MPCA) has concluded that a SLR mercury Total Maximum Daily Load (TMDL) is not feasible at this time due to a lack of understanding of mercury dynamics in the watershed. They have delayed completing the mercury TMDL process pending the collection of additional mercury data in the watershed. This brings into doubt the possibility that the PSDEIS could adequately assess mercury impacts from the proposed action to conclude there will be no exceedances of applicable environmental criteria related to mercury.

<u>Comment 2</u>

The conclusion that mercury will not increase in the environment or exceed applicable environmental evaluation criteria is based on several assumptions. One such assumption is that the tailings basin will function as a mercury sink (Section 5.2.2). This assumption is not justified for a number of reasons.

The assumption that the tailings basin will serve as a mercury sink is based only on a small-scale bench top study of tailings from the site of the NorthMet project, providing minimal information. Details of the study are not provided. Further, field conditions were not accurately simulated in the study. For example, the experiment used process water that was 3.3 ng/L to test the adsorption capacity of the tailings. But, the PSDEIS states that a pilot study found the process water from the project would contain an estimated 11.2 ng/L of mercury (3.4 times higher than the experimental concentration). Thus, the concentrations used in the experiment were not environmentally relevant to the anticipated conditions at the mine site. Process water with a much higher mercury concentration might not experience mercury reductions to the same degree as was seen in the small-scale bench top study.

In addition, the conclusions drawn from the bench top study are backed up in the PSDEIS by earlier Minnesota Department of Natural Resources (MDNR) research on taconite tailings. There are inherent differences in composition between taconite tailings and the tailings that would come from the NorthMet PGM type project. These differences are likely to affect metallic binding potential. Therefore it is not appropriate to apply conclusions from this research to the current project.

Also lacking from the discussion of the potential for mercury to be adsorbed by the mine tailings is a discussion of potential saturation of the tailings with mercury (or other metals) and whether the tailings could shift from a mercury sink to a source in the future. This information is not presented for the NorthMet tailings or for the taconite tailings already present on site. The time scale on which the experiments were conducted are not adequate for predicting the long-term behavior of mercury and its interactions with tailings materials. Questions that should be addressed include:

- Are there conditions under which the tailings would shift from a sink to a source (e.g., temperature or pH alterations as a result of mining activities or global climate change, oversaturation after a significant time period)?
- Is the mercury permanently and irreversibly adsorbed to the tailings?
- The PSDEIS indicates in section 5.2.7.2.5 that about 95 percent of the mercury originating in the ore is expected to remain within—or be adsorbed to—the tailings and the hydrometallurgical residue, where it would remain isolated from further transport to the environment. Has this been proven with regards to potential tailings saturation and changing environmental conditions?

<u>Comment 3</u>

The conclusion that mercury will not increase in the environment or exceed applicable environmental evaluation criteria is based on several assumptions. One such assumption is that mercury methylation will not increase because the amount of sulfate being released to the environment will actually be reduced by the project. This assumption is not justified. The MPCA 2006 strategy to address effects of sulfate on MeHg production focuses on avoiding discharges to "high risk" situations such as wetlands, low (<40 mg/L) sulfate waters where sulfate may be a limiting factor in the activity of sulfur-reducing bacteria, and waters that flow downstream to a lake that may stratify. As indicated in the PSDEIS (Section 5.2.2.3.4), most or all of these conditions apply to the area downstream of the tailings basin and waste water treatment facility (WWTF). As a result, sulfate releases from the mine site and subsequent impacts on mercury methylation are a critical consideration.

The assumption that mercury methylation will not increase because the amount of sulfate being released to the environment will actually be reduced by the project only holds true if water is captured and treated in perpetuity. The assumption no longer holds if this onsite water treatment ceases or is reduced. Further, there are concerns regarding the conclusion that sulfate releases will be decreased by the project. This may not be true in all instances (see GLIFWC hydrology attachment for comments related to sulfate releases). Finally, as the PSDEIS indicates (5.2.2.3.4), the current scientific understanding of the factors and mechanisms affecting mercury methylation and bioaccumulation is limited. It is known that the response of mercury methylation to sulfate concentrations is non-linear and complex. It is not defensible to state that the mercury/sulfate cycle is not well understood and then conclude that the projected levels of sulfate releases are expected to result in a decrease on mercury methylation in the watershed. It is apparent that there is not sufficient scientific knowledge to assess the impact of any change in sulfate concentration, positive or negative, on mercury methylation and the subsequent impact on mercury levels in fish and throughout the aquatic food web.

Comment 4

The conclusion that mercury will not increase in the environment or exceed applicable environmental evaluation criteria is based on several assumptions. One such assumption is that the NorthMet project would have minor effects on flows in the Partridge and Embarrass Rivers or their tributaries and is thus not expected to result in increases in flow fluctuations that promote mercury methylation. As indicated in the PSDEIS, The methylation of environmental mercury by sulfate-reducing bacteria is also stimulated by drying and rewetting associated with hydrologic changes and water level fluctuations (Gilmour et al. 2004; Selch et al. 2007). Drying (and subsequent increase in exposure to oxygen) of substrate containing reduced sulfur species (sulfides and organic sulfur) oxidizes those species into sulfate, which is remobilized and available to sulfate-reducing bacteria upon rewetting of the substrate. The PSDEIS also indicates that this mechanism stimulates production of methylmercury in sediments exposed to wetting and drying cycles (Gilmour et al. 2004) and is likely to account for some of the elevated methylmercury concentrations seen in discharge from wetlands during high flow events (Balogh et al. 2006). Thus, hydrologic changes and water level fluctuations are known to stimulate mercury methylation and enhance its bioaccumulation.

We do not accept the conclusion that the project will not significantly impact flow and water level fluctuations. Therefore, it is possible, if not likely, that the project will lead to increased mercury methylation and bioaccumulation. GLIFWC comments regarding hydrology effects (e.g. perched vs. connected wetlands, old and inaccurate hydrology data for the Partridge River, water level fluctuations exposing riparian wetlands, and groundwater drawdown are provided in the wetlands attachment).

Comment 5

In year 21, the East Pit backfill will be completed and a mitigation wetland will be constructed over the back filled material and another wetland will be constructed at the perimeter of the tailings pond (Section 5.2.2.3.1). There is no discussion of the impact that these constructed wetlands could have on mercury methylation and bioaccumulation. Wetlands are known to promote enhanced mercury methylation. The methylation process is dependent on many factors, including the concentrations of mercury and sulfate present in the water and sediment of the wetland. The East Pit and the tailings basin are regions of potentially elevated mercury and sulfate. Therefore, there is a reasonable potential for the constructed wetlands to be significant sources of methylmercury to the aquatic foodweb. This has not been accounted for in the assessment of mercury related impacts by the mining project.

Comment 6

There is a potential for the overflow from the West Pit (after year 40) to exceed the Great Lakes Initiative (GLI) standard for mercury of 1.3 ng/L (Section 5.2.2.3.4). This has not been considered when concluding the Proposed Action would not exceed applicable environmental evaluation criteria. The mercury concentration in the West Pit was estimated based on concentrations in other natural and mine pit lakes as well as by a mass balance approach.

Of the 16 mine pit lakes examined, two (12.5%) had average mercury concentrations >1.3 ng/L (1.61ng/L in Pit 2W and 1.87 ng/L in Pit 9S). Individual samples were as high as 2.55 ng/L, double the acceptable level. It is not stated how many of the 16 lakes had individual samples that exceeded the GLI standard. This result shows that there is a significant possibility that, based on comparisons with other similar mine pit lakes, the West Pit of the project may exceed the GLI standard for mercury of 1.3 ng/L.

The mass balance approach included an estimate that 3% of the mercury is lost via volatilization. Air emissions of mercury are known to be the primary source of mercury deposition to surface waters. This volatilized mercury then needs to be accounted for in the air emissions inventory since it will presumably primarily redeposit within the watershed.

Comment 7

There is no consideration of the likely mercury pulse to the Partridge River resulting from placement of the stripped peat and unsaturated overburden into the unlined Overburden Storage and Laydown Area. While the surface runoff will be collected, monitored and potentially routed to the WWTF, any potential water seepage into the ground below the Overburden Storage and Laydown Area will flow directly into the Partridge River. The result is a potentially unaccounted for and unquantified mercury pulse into the Partridge River.

Comment 8

It is not apparent whether mercury monitoring is included within the water quality monitoring of the Mine Site or Plant Site (Tables 5.2.2-52 and 5.2.2-53). If it is, this should be specified. If it is not, it should be added to the monitoring activities.

Comment 9

Air emissions of mercury are known to be the primary source of mercury deposition to surface waters. The estimate of air emissions of mercury as a result of the project (4.6 lbs/yr) does not take into account emissions from electricity generation for the site or from the burning of fuel by mining vehicles or other equipment (Section 5.2.7.2.5). This should be quantified and included in the analysis.

Comment 10

It appears that wetland monitoring following restoration is only vegetative and hydrologic in nature. Total and methyl mercury should be monitored pre-project through post-reclamation to collect information on mercury levels and methylation rates and identify any necessary remedial actions.

Comment 11

The Wildlife Section (5.2.5) does not discuss mercury contamination. There are a number of fish- or aquatic invertebrate-eating species [such as the bald eagle (state listed and protected by federal law), otter, and wood turtle (state listed), and various amphibians] that may be impacted by increased methyl mercury in the food web. The only fish-eating non-fish species considered in the PSDEIS is humans. Similarly the Aquatic Species Section (5.2.6) does not discuss direct health impacts to aquatic species due to mercury contamination. Presumably, these omissions are due to the fact that the PSDEIS concludes that mercury methylation in the watershed will actually be reduced due to reduced sulfate releases, mercury adsorption to tailings, and minimal resulting water level fluctuations. But, we do not accept these conclusions (see Comments 2, 3 and 4 in this document).

Comment 12

The PSDEIS dismisses the possibility of waterfowl and waterbirds utilizing the tailings basin despite the fact that common waterfowl and waterbirds have been observed at the LTVSMC tailings basin during migration (Section 5.2.5.2.3). We believe that this is a possibility and that it represents a significant potential pathway of mercury exposure to these individuals. The rationale given for the conclusion in the PSDEIS is that states this is not an issue because the tailings basin is <0.01% of the available open water in the area and because it does not contain any high quality foraging habitat. One aspect of this issue not considered is that wetlands will be constructed over the East Pit and adjacent to the tailings basin. If these wetlands are properly constructed they will represent potential waterfowl and/or waterbird habitat that is likely to result in increased mercury exposure and bioaccumulation (see Comment 5 of this document).

Comment 13

PSDEIS states there will be effects on flow in the Partridge R. and Embarrass R. tributaries, but that they are not expected to influence habitat (Section 5.2.6). We feel that the water level fluctuations may be sufficient to impact habitat (see GLIFWC hydrology attachment for comments on water fluctuations). Habitat alteration is likely to lead to changes in species composition or relative abundance. This in turn has an impact on food availability and the structure of the food web. Mercury bioaccumulation is highly influenced by the structure and length of the food web. Therefore, the project has a reasonable potential to impact mercury food web dynamics with the possibility of ultimately causing increased mercury levels in fish and exposure to fish-eating humans and wildlife.

Comment 14

Many lakes and rivers in the area are classified as "impaired waters" by the MPCA due to elevated fish mercury. All additional increases in mercury contributions to the environment therefore constitute a risk to human and ecosystem health. There are a number of aspects of the proposed action cited in the PSDEIS that will lead to increased mercury releases to the environment, increasing human and ecosystem risk. For example:

- There will be a predicted net increase in mercury loading to Embarrass River (22.3 to 22.9 g/year) due to redirection of flow and construction of east dam (Section 5.2.6.22). The PSDEIS concludes that despite this increase in mercury loading, mercury in fish would decrease because of reduced sulfate inputs. We do not agree with the conclusion that sulfate inputs would be reduced by the project in all instances (see Comment 3 of this document).
- There will be estimated air emissions of mercury of 4.6 lbs/yr from plant site (Section 5.2.7.2.5).

These increased emissions are expected to have a measureable effect on mercury levels in fish and the subsequent health risk to recreational and subsistence fishers. This will compound the facts that (1) many sport and subsistence fish species already have mercury concentrations exceeding acceptable threshold criteria, (2) background risk quotients (RQ) for all human populations analyzed already exceed 1, and (3) the mercury levels in the St. Louis River watershed have been deemed high enough that the statewide mercury TMDL will not be sufficient to remove fish consumption restrictions in this region. Therefore, any additional mercury releases to the environment are exacerbating an already unacceptable risk situation in the area.

All increases in mercury releases are contrary to the goals of the 1991 “Binational Program to Restore and Protect the Lake Superior Basin” to establish a Zero Discharge Demonstration Program for nine critical pollutants, including mercury.

<u>Comment 15</u>

According the PSDEIS, the MPCA conducted a review of the NorthMet Project Proposed Action mercury emissions and determined that it will not impede the reduction goals (Section 5.2.7.2.5). The mercury TMDL for the St. Louis River has not yet been established due to insufficient understanding of mercury dynamics in the watershed. It is known that the statewide TMDL is insufficient for reducing mercury to acceptable levels in fish of the SLR. Since there is no SLR mercury TMDL available, the impact of the project’s mercury emissions on reduction goals in the area cannot be adequately assessed.

<u>Comment 16</u>

Increased mercury, especially in fish, could negatively impact cultural resources, especially for local Native American tribes who rely on fish as a major source of subsistence food and who view fishing and fish consumption as vitally important cultural and spiritual activities. This is not acknowledge in the PSDEIS. Further, fish harvest is a treaty reserved right of these tribes. The presence of mercury in fish at levels that restrict consumption threaten the ability of the tribes to exercise this treaty right.

Wild Rice Section

Wild Rice Sulfate Standard

The State of Minnesota has promulgated a 10 mg/l sulfate standard for Wild Rice waters. There is extensive scientific support for the fact that sulfate negatively affects wild rice. Tribal cooperating agencies, the 1854 Treaty Authority, and GLIFWC have commented numerous times on this issue and provided extensive background information to support the need to protect wild rice from sulfate. Additional scientific support is available through the MPCA document *The Sulfate Standard to Protect Wild Rice Study Protocol* (MPCA 2011).

Yet, the PSDEIS, like the 2009 DEIS, continues to prevaricate on the issue of sulfate impacts to wild rice. It is puzzling that this error remains after all the information and perspectives provided to the lead agencies and their contractor.

The point is simply this. A 10 mg/l sulfate standard applies in wild rice waters. All extraneous discussion that attempt to minimize the validity or applicability of that standard should be removed from the PSDEIS.

Seasonal Application of the Sulfate Standard

The MPCA has determined that the 10 mg/l standard can be applied seasonally; essentially during winter months when the plant is not growing. We fundamentally disagree with this interpretation because there is no scientific basis for stating that seed is not affected by high sulfate levels while it lays dormant over the winter or that the effects of high sulfate water would not remain into the summer. It is GLIFWC staff position that the sulfate standard should apply all year.

The PSDEIS states the NorthMet is not seeking a seasonal application of the wild rice sulfate standard. This position is supported by an email from Bill Johnson of the MNDNR dated 6-19-2013 that states “Finally please note that PolyMet is not seeking the application of the seasonal wild rice standard at this time. They intend to meet the 10 mg/l standard year round.” We believe this statement is misleading. The PSDEIS indicates in several sections that the goal is to transition from mechanical water treatment to passive water treatment systems. These passive water treatment systems are described in the Adaptive Water Management Plan v5 (March 2013). Descriptions in the AWMP as well as page 5.5.2-200 of the PSDEIS state:

“The West Pit overflow non-mechanical treatment system would be designed to discharge only during September and October in order to comply with the seasonal sulfate discharge criterion for wild rice downstream of the Mine Site. The 2-month discharge period would result in a higher flow rate and larger treatment system than would be required for continuous discharge.”

The above statement is in contradiction of other sections of the PSDEIS and the MNDNR statements that the applicant is not seeking a seasonal application of the standard. This contradiction should be addressed.

Embarrass River Watershed

Historic Data and Information

We are aware of the MPCA determination on waters that are defined as supporting the production of wild rice. We believe that the process used to inform this determination must incorporate historic information of wild rice presence, abundance and habitat. The following section provides historic information on wild rice that, when viewed in combination with other more recent information, suggests that the Embarrass River produces or has produced wild rice in several areas upstream of the current point of compliance. Therefore, we suggest that the compliance point for the wild rice sulfate standard should be upstream of the current location at all areas where rice is growing.

Manoomin or Wild Rice can be found throughout the Great Lakes but the areas of greatest concentration are in Minnesota and Wisconsin (Figure 1) (Peter David, GLIFWC wild rice biologist, personal communication, Jenks 1901, Moyle 1944, MRC 1969). The areas of greatest concentration, which are defined as wild rice districts by Jenks, encompass lakes and streams within the region covered by glacial outwash. Jenks' description of the wild rice district is often cited in other publications that describe the range of wild rice (GLIFWC, 1999). Jenks provides additional information on wild rice distribution by stating that within the wild rice district, rice is found wherever there is suitable habitat. Specifically:

"Farther south the St. Louis River system tells the same tale – the streams all bear abundant stores of wild rice" (Jenks, 1901, page 1035)

This publication supports the accounts of tribal members from the tribes acting as cooperating agencies for this project. The draft Cultural Landscape Report prepared as part of the Polymet SDEIS dated September 15, 2011 states, "With the potential for wild rice in the shallow margins of lakes and streams, and abundant wild plant, fishing and hunting habitats, portions of the Preliminary Project APE may have been very attractive to the Ojibwe" (pg. 48). That report also includes an account from a Bois Forte tribal member indicating that harvest occurred on the Embarrass River. Another tribal member stated that she knows of a family that harvested wild rice in the vicinity of the LTV tailings dam on the Embarrass River. These specific descriptions would indicate harvest occurring upstream of Embarrass Lake and upstream of Wynne and Sabin Lakes. This supports the notion of abundant wild rice stands in areas where only smaller stands now remain.

Another corroborating piece of information is the presence of a wild rice farm straddling the Embarrass River. This wild rice farm operated from 1957 until 1993 when the operation went bankrupt (Barr, 1995). Aerial Photos taken in the spring of 1991 and 1992 show the flooded rice paddies and some ditches connecting the farm to the Embarrass River (Figure 2). The use of water from the river in the farm operation clearly defines the Embarrass River as used for the production of wild rice. Figure 2 also shows that Unnamed Creek (Labeled Rice Farm Creek in Figure 2) was likely a source of water for the farm. This creek currently originates at the northwest corner of the LTV tailings basin (Figure 3). According to the Clean Water Act (CWA) this use of water for production of wild rice is a designated use. As such, the sulfate standard applies for the Embarrass River.

Wild Rice Habitat

Field data collected by Barr Engineering (Barr, 2011) indicates that mine related sulfate effluent has already impacted the river to the point of exceeding the wild rice standard. The Draft Staff Recommendation does not provide information on how the MPCA considered the existing water quality in its recommendation and to what extent the high sulfate values have already impacted wild rice on the Embarrass River. This basic analysis should be part of describing existing conditions in the PSDEIS. A description of how the issues of wild rice habitat protection and existing elevated sulfate levels in the Embarrass River water were treated in the development of the recommendation is needed. Wild rice in this area is a degraded resource. As such, all remnant populations are in need of protection. This need is further emphasized by the designation of the Embarrass River as impaired in the 2012 draft 303d list (Figure 4)

The current wild rice standard language clearly states that wildlife use of wild rice is an important factor in protecting the plant. It is not clear how MPCA staff determined that the number of wild rice plants upstream of the current point of compliance is not enough to be used as a food source by wildlife. GLIFWC staff is not aware of research that defines the number of plants or the density of a rice bed that would make it usable to blackbirds, muskrat, geese, or other wildlife. A single plant can provide nutrition to wildlife. Furthermore, browsing by wildlife is one of the reasons that wild rice fluctuates in abundance and density from year to year (Peter David, GLIFWC wild rice biologist, personal communication). The variability that is observed in the wild rice survey data on the Embarrass River may well be the result of wildlife use. Finally, Barr Engineering field notes indicate wildlife is using the wild rice stands in the area. These observations of browsing include small stands that are classified in the lowest density and lowest abundance categories (Barr, 2013). This supports the tribal position that all locations where rice is growing should be points of compliance for the 10 mg/l sulfate standard.

Summary and Conclusion.

Based on available information the GLIFWC staff believes that productive wild rice waters on the Embarrass River are where wild rice is currently growing and is confirmed to have been present in the past. The basis for this view is:

- Wild Rice has been present at these locations during at least one of the four survey years (2009 – 2012).
- The wild rice sulfate standard is 10 mg/l. Language attempting to cast doubt of the current applicability of this standard should be removed. Further, there is no scientific support for the seasonal application of the standard.
- Wild Rice is food for wildlife regardless of its density and the observed inter annual fluctuation in abundance of wild rice in the Embarrass River is consistent with the ecology of wild rice. Barr field notes support this position.
- Historic information from tribal sources indicates past harvest in this area and non-tribal sources support the assertion that this is an area where wild rice was found.
- The existence of a rice farm in this area is consistent with the assertion that the Embarrass River water quality was supportive to wild rice prior to mining impacts.
- Wild rice in the Embarrass River endures despite degraded water quality. It is likely that the degraded water quality has decreased the abundance of wild rice in this river.

It is important to note that this view is based on current information and field data. Should new information be developed or field data be collected, this view may change.

Sources Cited

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- GLIFWC, Proceedings of the Wild Rice Research and Management Conference, Carlton, Minnesota, 1999.
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- Moyle, John T., Wild Rice in Minnesota, Journal of Wildlife Management, Vol. 8 No. 3, 1944.
- Minnesota Resources Commission (MRC), A Study of Wild Rice in Minnesota, Staff report by F. Robert Erdman, 1969.

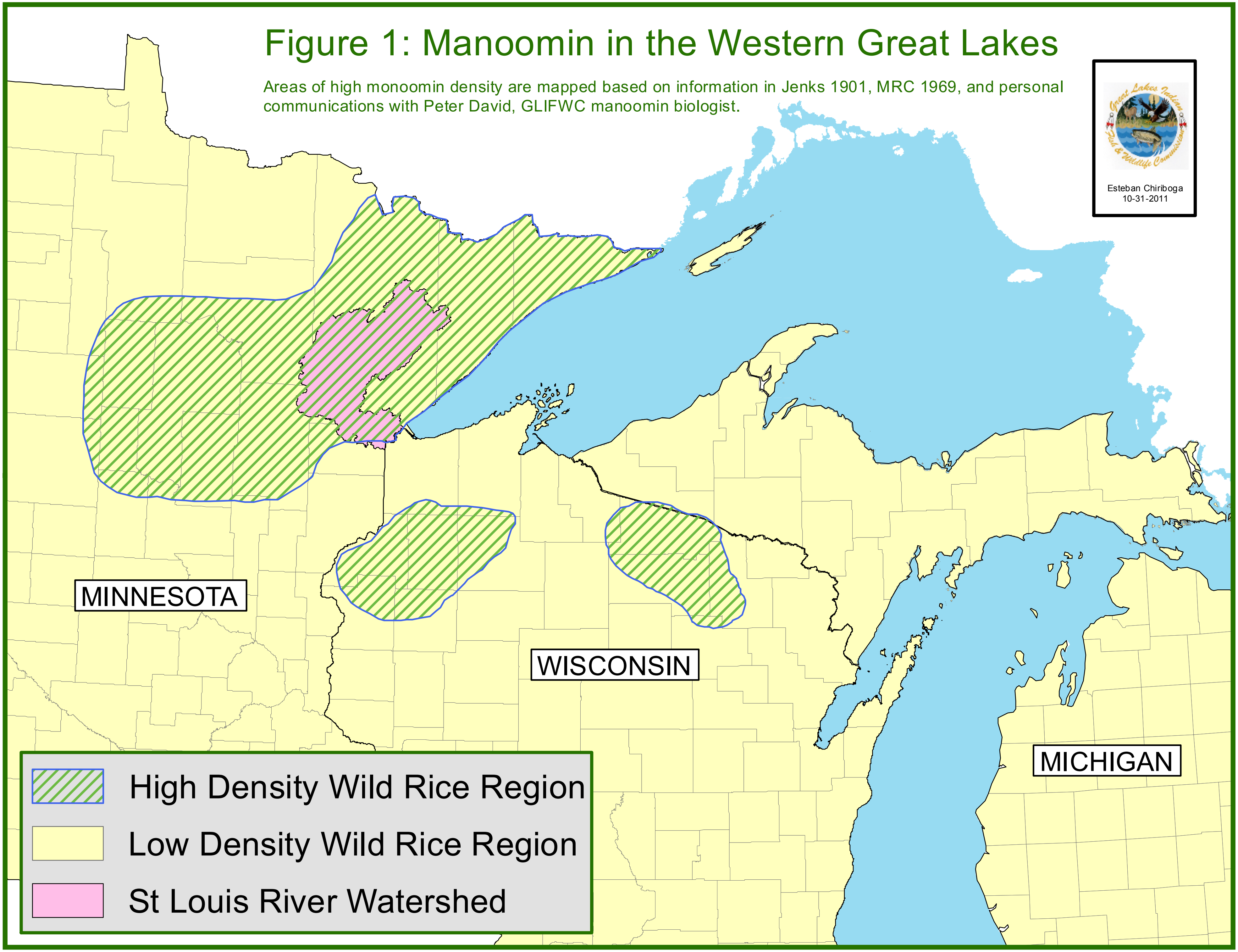


Figure 1: Manoomin in the Western Great Lakes

Areas of high monoomin density are mapped based on information in Jenks 1901, MRC 1969, and personal communications with Peter David, GLIFWC manoomin biologist.

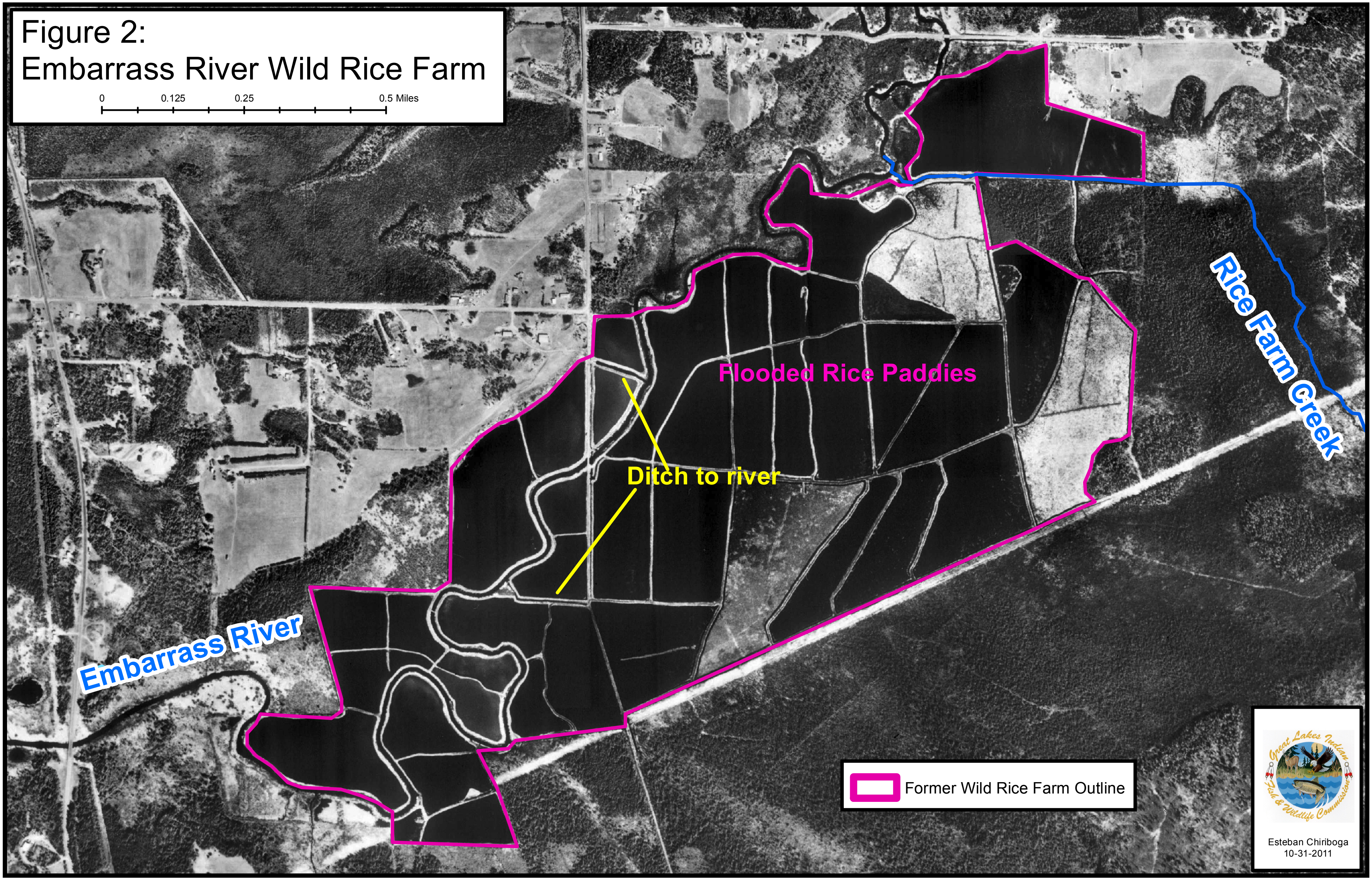


Figure 2:
Embarrass River Wild Rice Farm

Fig 3: Proposed Polymet Mine: Upper Embarrass River Wild Rice

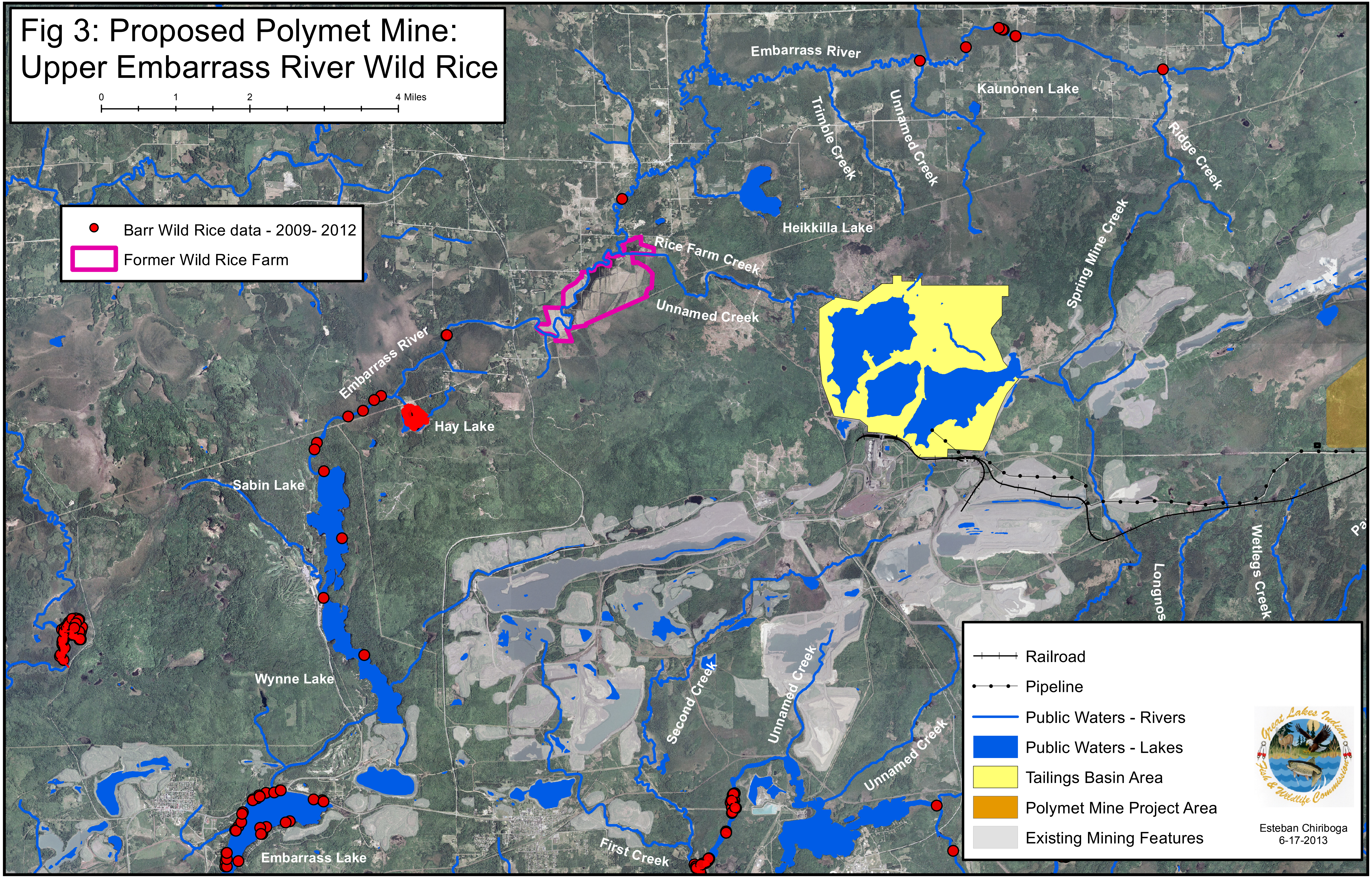
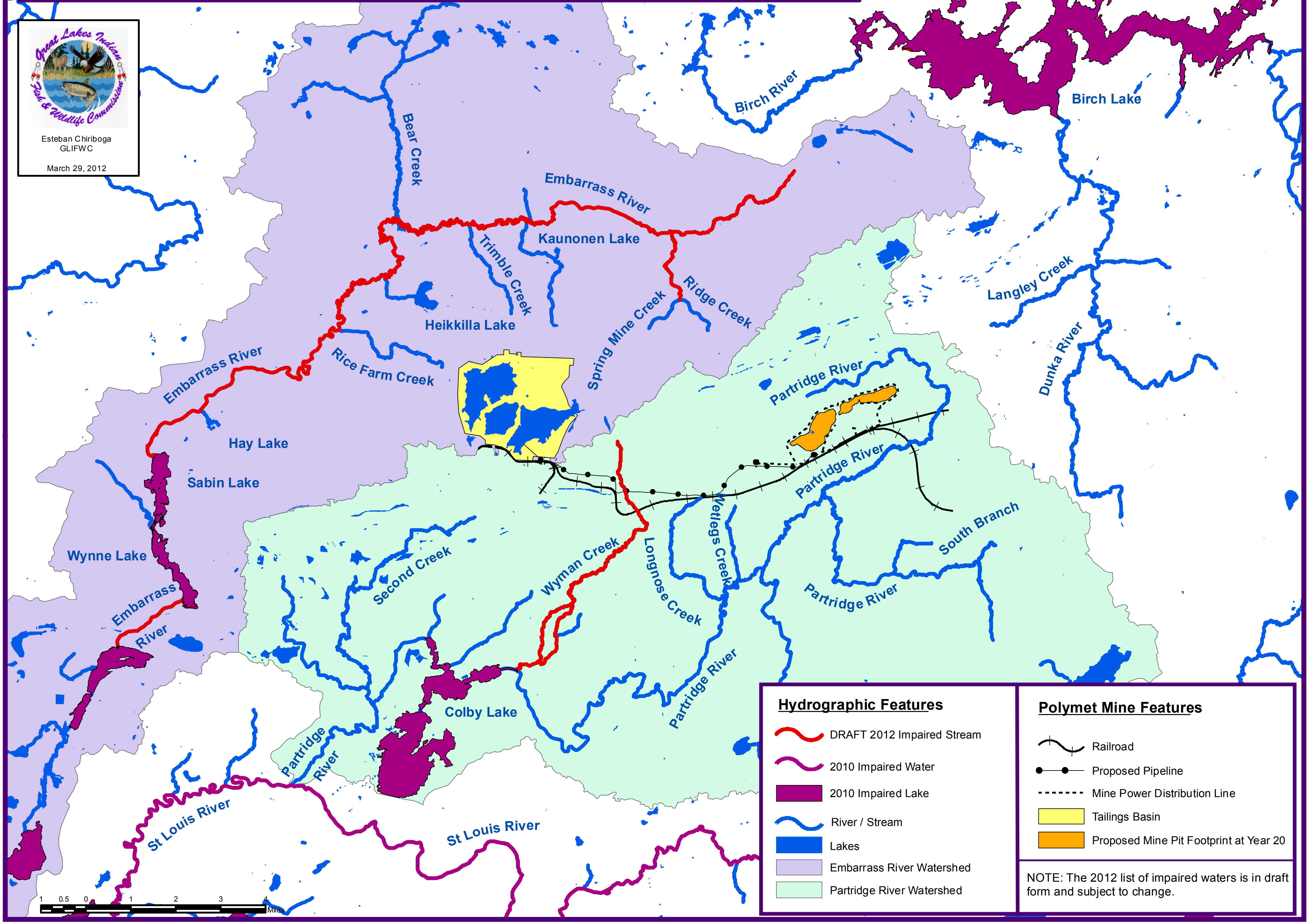


Fig 4. 303d Impaired Waters Surrounding the Proposed Polymet Mine



Underground Mine and West Pit Backfill Alternatives

GLIFWC staff believes that the underground mine and west pit backfill alternatives have been prematurely eliminated from consideration in the PSDEIS for the NorthMet project. We believe that there is potential for significant environmental benefits to these alternatives when compared to the proposed action. This document will provide questions and discussion on each of these alternatives. However, we believe that these alternatives are related to one another in terms of the issue of inferred ore deposits at depth and foreseeable future actions at this site. This issue impacts the accuracy of information in the PSDEIS and is discussed below.

Underground Mine Alternative

The Underground Mining Alternative Assessment for the NorthMet Mining Project and Land Exchange Environmental Impact Statement document dated February 5th 2013 provides the lead agency rationale for eliminating the alternative from further analysis in the SDEIS. The document states that for an alternative to be evaluated it must meet 5 screening criteria:

1. be technically feasible
2. be available
3. offer significant environmental benefits over the proposed project
4. meet the purpose and need
5. be economically feasible

The lead agency position paper correctly states that the underground alternative would offer significant environmental benefits over the proposed action. In some areas these benefits would be substantial. The roughly 1000 acre wetland fill could be almost completely eliminated and the amount of tailings and waste rock generated by the project would be significantly reduced. The water quality and quantity impacts on surface and groundwater would be mitigated. This is particularly important given the probability that the NorthMet project will violate water quality standards and the certainty that the project would require perpetual water treatment. In addition to the environmental benefits the document correctly states that underground mining is technically feasible and available at the site. It is important to note that with underground mining the land exchange with the Superior National Forest would not be needed therefore environmentally sensitive areas like the 100 mile swamp and essential Lynx habitat would remain in the federal estate.

The only rationale that is used to eliminate the alternative is economic feasibility. All other objectives of the purpose and need statements in section 1.3.2.1 of the PSDEIS are met. Therefore, the question on further analysis is determined by the applicants' assessment of the economics of the alternative. This leads to several questions.

Section 1.2 of the Underground Mining Alternative Assessment describes the assessment as a semi-quantitative screening analysis. Section 1.2.2 of the Underground Mine Alternative Assessment states "The information provided by PolyMet was reviewed by technical staff at the MNDNR and was determined to be sufficient for a screening level review of the feasibility of underground mining at the NorthMet Deposit". What is the accuracy of a screening level review? The determination that a project is economic or not necessarily relies on rather detailed analysis. The following are some descriptions of the accuracy that can be expected for different types of analysis:

- **Conceptual Studies - Desktop/Order of Magnitude:** Conceptual/Strategic studies are conducted early in the project life cycle to assist exploration strategy and to identify fatal flaws and development opportunities. These studies are typically used to support the decision to progress to Preliminary Economic Assessment. **Order of Magnitude (+/-50%) estimating accuracy** is typical for this level of study.

- **Preliminary Economic Estimates:** The Preliminary Economic Assessment (PEA) is a scooping-level study which relies on information from disciplines such as geotechnical, environmental, infrastructure and markets in addition to the core inputs from mining, geology and metallurgy. Capital and operating cost **estimates for the project will typically be estimated to +/-30%.**

- **Preliminary Feasibility Studies:** The Preliminary Feasibility Study (PFS) develops the concepts and work completed in scooping-level studies, examines necessary trade-offs or optimizations, and may progress resources into reserves. Multi-disciplinary technical teams will improve the accuracy of capital estimates through the completion of additional engineering. Disciplines such as geotechnical, environmental, infrastructure and markets are utilized in addition to the core inputs from mining, geology and metallurgy. Capital and operating cost estimates for the project **will typically be estimated to 20-25% overall accuracy.** Engineers and geologists have experience in the completion of Pre-Feasibility Studies and can manage the resources required for such work.

A description of the error term in the economic assessment needs to be developed and clearly explained in the SDEIS.

Section 2.0 of the Underground Mining Alternative Assessment states that the project should "(provide sufficient income to cover: operating capital and other costs with an adequate return to investors). If an adequate rate of return is to be included in the economic feasibility it should be defined. What do the authors ascertain is an adequate return to investors? Is the underground mine alterative excluded because of a net negative return to investors or a positive return that is not deemed adequate? The November 2012 PolyMet power point presented by Douglas Newby projects an after tax Internal Rate of Return (IRR) of 30.6% for the open pit mine. Is the same assumption made for an underground mine?

Section 2.1 discusses the significant environmental and/or socioeconomic benefits. However, no economic data was presented related to the environmental benefits related to the underground mining alternative. For example:

- There is no mention that an underground mine would not require a $4 million land exchange with the United States Forest Service.
- No mention of the economic benefits (environmental goods and services) provided by wetlands
- No mention of the economic impact of perpetual maintenance and water treatment at the site. Of note, there is no discussion on the cost of wetland mitigation activities that are needed with an open pit mine. An underground mine would not require extensive wetlands mitigation costs for wooded swamp and bog sites that could reach between

$35,460,000-$110,205,000 (i.e. 1200 acres x 1.5 rate x $19,700/acre ACOE source and 1200 acres x 1.5 rate x $61,225/acre MN Department of Transportation – (i.e. - Mitigation of Impacts to Fish and Wildlife Habitat: Estimating Costs and Identifying Opportunities, Environmental Law Institute, October 2007, Corps District, St. Paul, Corps District Data Average $19,700 and Wetland Mitigation in Abandoned Gravel Pits, Minnesota Department of Transportation, Research Services, Office of Policy Analysis, Research & Innovation, March 2010, Final Report#2010-11, Executive Summary page 3)

The Underground Mining Alternative Assessment relied heavily on an InfoMine model to determine economic feasibility. However there is no detail on the model itself, the model assumptions or how the model calculates its results. For a complete evaluation of the alternative, a review of this model should have been done by the lead agencies.

Finally, it appears likely that the project as proposed will violate applicable water quality standards. This means that the current proposal is not likely to be permitted. Because of this, it seems reasonable that an underground alternative be considered as an additional mitigation measure.

West Pit Backfill Alternative

Based on the lead agency memorandum titled Co-lead Agencies' Consideration of a West Pit Backfill Alternative dated April 11, 2013 it is clear that this alternative meets the purpose and need, is available, is technically feasible and is economically feasible. The document argues that environmental benefits are unclear. However, because of the screening level analysis used by the lead agencies the full effect of the alternative on the environment is not known. Page 3 indicates that there is no information to determine water quality projections under this alternative. Therefore the primary potential benefit of this alternative is not addressed. Until this information is developed, GLIFWC staff maintain that backfill of the west pit may provide long term water quality benefits. Given that the current project is expected to violate water quality standards, additional mitigation is needed and this alternative should be more fully analyzed.

Inferred Ore Deposits at Depth and Reasonably Foreseeable Future Actions

The proposed NorthMet project proposes to mine a relatively small portion of the ore body. Figure 3.2-10 of the PSDEIS indicates that an upper mineralization zone and a portion of the Unit 1 mineralization are the targets. This mine plan appears to leave behind a substantial portion of ore. GLIFWC staff has argued that the remaining ore could be accessed through underground mining methods. According to the Co-lead Agencies' document "Consideration of a West Pit Backfill Alternative" dated April 11, 2013, a major reason for the development of an open pit mine plan is that there is a lease agreement between PolyMet and the owners of mineral rights immediately southwest of the toe of NorthMet's west pit. These private lease agreements apparently include using the west pit as a portal for future mining activities. In addition, tribal cooperating agencies have provided the lead agencies with power point presentations from PolyMet staff to their investors that tout the potential for future mining of these mineral resources southwest of the west pit.

If the west pit is to be used as a portal for this future mining, then that should be described in the PSDEIS and the environmental consequences assessed. The Evaluation of Backfilling the NorthMet West Pit (December 2012) states on page 2 “mineralization on the western end is much more flat laying, dipping at about 15 degrees and could be developed in the future via expansion of the proposed open pit mining operation and/or underground mining from the base of the west pit.” It appears that the PSDEIS is describing a project that is not complete in that future mining is not included. What are the implications of developing an underground mine that extends from the west pit to surface and groundwater resources of the Partridge River watershed?

Another stated reason for avoiding backfill for the west pit is the lease requirement of not encumbering the mineral resources to the southwest. The lead agencies have also noted this goal in the PSDEIS. The assertion that backfilling the west pit would encumber minerals is ludicrous. We disagree with the notion that the only way to access minerals at depth is through the bottom of the west pit. These minerals could be accessed through other standard underground mining techniques from other locations. In fact, these minerals are accessible now and would continue to be accessible even if the NorthMet project is never built. Taking advantage of an existing pit may provide economic benefits to a mining company but it is unclear why a regulatory agency would prefer this method without first conducting an analysis. If the lead agencies are taking the position that the preferred alternative of a future underground project includes a portal through the west pit, then they need to provide a scientifically defensible reason for that decision.

Finally, the titled Co-lead Agencies’ Consideration of a West Pit Backfill Alternative dated April 11, 2013 provides several reasons for the conclusion that backfill would not provide significant environmental and socioeconomic improvements over the proposed action. Page 3 of the document clearly states that there has been no analysis done to support these conclusions.

It appears that economic considerations of a future mine expansion are the only concrete reasons for not conducting an analysis of the environmental and socioeconomic benefits of backfilling the west pit. The NorthMet project as proposed is a perpetual maintenance and water treatment facility. It seems logical that every available option that might improve the long term impacts of the project should be explored regardless of the commitments that applicant may have made on their mineral lease. GLIFWC staff suggests that this alternative has been eliminated prematurely and that a full analysis is needed.

GLIFWC Wetlands Attachment

Analysis of Indirect Wetland Impacts from Groundwater Drawdown

Enclosed please find an analysis of indirect impacts to wetlands due to drawdown at the NorthMet mine site developed by the Great Lakes Indian Fish and Wildlife Commission (GLIFWC). GLIFWC is an intertribal agency exercising delegated authority from 11 federally recognized Ojibwe (or Chippewa) tribes in Wisconsin, Michigan and Minnesota.[1] Those tribes have reserved hunting, fishing and gathering rights in territories ceded in various treaties with the United States. GLIFWC's mission is to assist its member tribes in the conservation and management of natural resources and to protect habitats and ecosystems that support those resources.

As you know, the proposed Polymet mine is located within the territory ceded in the Treaty of 1854. GLIFWC member tribes have expressed concern about the potential impacts of sulfide mining, whether those impacts occur within the 1854 ceded territory, in the 1842 ceded territory, which includes portions of Lake Superior, or the 1837 ceded territory. The following analysis is submitted by GLIFWC staff with the explicit understanding that each GLIFWC member tribe or any other tribe may choose to submit analysis and information from its own perspective.

Potential impacts to wetlands due to groundwater drawdown at the NorthMet mine site are described in the NorthMet Project Wetland Data Package Version 7 dated March 1, 2013 and summarized in the 2013 PSDEIS. Potential impacts due to drawdown are assessed using an analog method where information from another site is used to provide a best guess as to how wetlands surrounding NorthMet might be affected. The data package states that this method came out of the Wetlands IAP process however it does not state that GLIFWC and other cooperating and reviewing agencies have objected to using this method. The objections are detailed in the comments that GLIFWC provided within the IAP process (Attachment A).

GLIFWC continues to believe that the analog method can be informative in the process. We also reiterate that the lead agencies' reliance on analogs as the only source of information to gauge impacts from pit dewatering is not a rigorous approach to impact estimation. However, because of the lead agencies insistence that this method be used in the SDEIS, GLIFWC is providing an independent analysis using information from other mine pits located on the Mesabi Range.

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1 GLIFWC member tribes are: in Wisconsin -- the Bad River Band of the Lake Superior Tribe of Chippewa Indians, Lac du Flambeau Band of Lake Superior Chippewa Indians, Lac Courte Oreilles Band of Lake Superior Chippewa Indians, St. Croix Chippewa Indians of Wisconsin, Sokaogon Chippewa Community of the Mole Lake Band, and Red Cliff Band of Lake Superior Chippewa Indians; in Minnesota -- Fond du Lac Chippewa Tribe, and Mille Lacs Band of Chippewa Indians; and in Michigan -- Bay Mills Indian Community, Keweenaw Bay Indian Community, and Lac Vieux Desert Band of Lake Superior Chippewa Indians.

Analog Data Used

- Randal Property Wells T3 and T4 (Source: Crotteau, 2013), Rhino and Highway 7 wells in the vicinity of the Canisteo pit. (Source: Adams and Liljegren 2011)
- MNDNR observation well, in the vicinity of Hibtac pits (Source: Crotteau, 2013).
- Dom-ex and Pinto wells north of Hibbing in the vicinity of Hibtac (Source: Crotteau, 2013).
- Keewatin City wells #1 and #2 in the vicinity of the Keetac pit (Source: Liesh and Associates Technical Memorandum, 2009).

Contour lines showing the analog well information in relation to the proposed NorthMet mine site are provided in Figure 1.

Wetland Analog Impact Zones and Significance Criteria

GLIFWC objections to the impact zones developed by the lead agencies are presented in Attachment A. We believe these distance zones are somewhat arbitrary and continue to have concerns regarding their use. Despite these concerns, we are using similar impact zones so that the results we present can be compared to the analysis that in presented in the NorthMet Project Wetland Data Package Version 7.

GLIFWC impact zones (Figure 2) are:

- Zone 1 – 0 to 1000 feet from the mine pit edge.
- Zone 2 – 1000 to 2000 feet from the mine pit edge.
- Zone 3 – 2000 to 5000 feet from the mine pit edge.
- Zone 4 – 5000 to 10000 feet from the mine pit edge.

For impact assessment, this analysis applies the significance criteria outlined in large table 8 of the NorthMet Project Wetland Data Package Version 7. However, GLIFWC does not automatically exclude wetlands that have been classified as ombotrophic in the data package from being considered impacted by drawdown. Literature indicates that ombotrophic wetlands can and are impacted by drawdown. Several studies document vegetation changes at ombotrophic bogs in Finland (Murphy et al, 2009, Grootjans et al 2009, Jaatinen et al 2006, Vassander 1995). In general, groundwater drawdown beneath these ombotrophic bogs leads to increases in the root mass of woody vegetation species as well as greater dominance of woody species at the surface. The functions and values changes resulting from the drawdown induced change in vegetation in ombotrophic bogs are not characterized in the PSDEIS.

The analysis in the NorthMet Project Wetland Data Package Version 7 relies on surface observations of plant communities to classify bog wetlands as ombotrophic or minerotrophic. GLIFWC agrees that this is useful information but we maintain that it is not a substitute for detailed understanding of the relationship of the water table and wetlands at the site. NorthMet Project Wetland Data Package Version 7 states that hydraulic conductivity in the unconsolidated deposits around the mine site can range between 0.012 to 31 feet per day. This range of values indicates that substantial water movement within the aquifer can occur. Therefore unless there is information on whether the unconsolidated deposits that underlie wetlands are saturated or not it is not possible to know the degree to which groundwater supports wetland hydrology. Despite the assumption in the wetlands section of perched conditions for over 50% of wetlands at the mine site, Section 4.2.2-5 of the PSDEIS states that saturated conditions exist within the unconsolidated deposits and the underlying bedrock. It also states that recharge to the bedrock comes from leakage from the overlying surficial aquifer. Given these statements describing vertical movement of water in the mine site area, it does seem reasonable to also assume a vertical hydrologic connection between ombotrophic wetlands and the surficial aquifer.

The data package and PSDEIS assume that wetlands deemed to be ombotrophic are not connected to groundwater and therefore are not impacted by drawdown. This assumption is based mostly on plant lists and surface observations. We believe that this assumption is not supportable. Instead, GLIFWC assumes that there is at least a partial connection between ombotrophic wetlands and groundwater. Therefore, if groundwater under these "perched" wetlands is drawn down by several feet, this new head pressure would lead to impacts to the wetlands because of a "bathtub effect". In other words, water would seep out of ombotrophic wetlands in areas where there is a hydrologic connection to the saturated layer. This assumption is the support for assigning significance criteria for Deep Mersh/Shallow Marsh and Open bog wetlands for the Crandon project. It is this project that is the basis for the significance criteria used in the PSDEIS (large table 8 of the NorthMet Project Wetland Data Package Version 7).

Finally, the data package ignores the fact that the proposed NorthMet pits would be over twice the depth of a typical pit located up on the Mesabi Range and double the depth of the Canisteo pit analog. Thus the hydrologic effects on the surrounding aquifer will likely be greater for the NorthMet project.

Zone 1 Impacts (0 – 1000 Feet)

Wetlands within Zone 1 are depicted in Figure 3. Information provided by MNDNR Mining Hydrologist Michael Crotteau indicates that 2 wells at the Randall property (Wells T3 and T4) were artesian before a drain tile was installed to reduce groundwater levels in the area. This indicates a strong hydrologic connection between these wells and the Canisteo pit approximately 700 feet from the edge of the pit (Figure 4). The basement of the Randall residence was built when the Canisteo pit was dewatered is at an elevation of 1300 feet above sea level. The surface elevation at the site is 1310.73 feet above sea level. This indicates at least an 8 to 10 foot increase in the elevation of the water table 792 feet away from a reflooded Canisteo pit.

Based on these analog wells, a drawdown of up to 10 feet could affect wetlands in zone 1. We believe it is reasonable to assume that 5 to 10 feet of drawdown would occur throughout zone 1. In addition, these wetlands are often remnants of wetlands directly impacted by the pits and stockpiles, are surrounded by roads and ditches, and directly border the pits. Therefore, all wetlands in zone 1 are assessed as severely impacted (Table 1).

UNIQUE ID	EGGERS & REED CLASS	ACRES	IMPACT	IMPACT DESCRIPTION
24	Alder thicket	5.920	Severe	Conversion of wetland type
33A	Alder thicket	142.927	Severe	Conversion of wetland type
43	Alder thicket	7.456	Severe	Conversion of wetland type
44	Alder thicket	14.704	Severe	Conversion of wetland type
45	Alder thicket	159.903	Severe	Conversion of wetland type
51	Alder thicket	5.542	Severe	Conversion of wetland type
52	Alder thicket	18.113	Severe	Conversion of wetland type
53D	Alder thicket	39.376	Severe	Conversion of wetland type
100	Coniferous bog	981.692	Severe	Possible conversion of wetland type
101	Coniferous bog	60.631	Severe	Possible conversion of wetland type
103	Coniferous bog	174.579	Severe	Possible conversion of wetland type
107	Coniferous bog	126.238	Severe	Possible conversion of wetland type
25	Coniferous bog	20.965	Severe	Possible conversion of wetland type
32	Coniferous bog	73.745	Severe	Possible conversion of wetland type
48	Coniferous bog	190.986	Severe	Possible conversion of wetland type
62	Coniferous bog	1.782	Severe	Possible conversion of wetland type
76	Coniferous bog	22.181	Severe	Possible conversion of wetland type
77	Coniferous bog	118.315	Severe	Possible conversion of wetland type
79	Coniferous bog	25.709	Severe	Possible conversion of wetland type
82	Coniferous bog	44.293	Severe	Possible conversion of wetland type
888	Coniferous bog	12.481	Severe	Possible conversion of wetland type
90	Coniferous bog	499.822	Severe	Possible conversion of wetland type
96	Coniferous bog	52.276	Severe	Possible conversion of wetland type
97	Coniferous bog	32.904	Severe	Possible conversion of wetland type
99	Coniferous bog	14.536	Severe	Possible conversion of wetland type
107A	Coniferous swamp	3.090	Severe	Change in vegetation
33B	Coniferous swamp	47.690	Severe	Change in vegetation
68	Coniferous swamp	172.129	Severe	Change in vegetation
72	Coniferous swamp	14.910	Severe	Change in vegetation
13	Deep marsh	54.139	Severe	Conversion of wetland type
20	Sedge meadow	2.237	Severe	Conversion to upland
107B	Shallow marsh	27.922	Severe	Conversion of wetland type
9	Shallow marsh	19.424	Severe	Conversion of wetland type

Table 1. Zone 1 impact assessment.

Zone 2 Impacts (1000 – 2000 Feet)

Wetlands within zone 2 are depicted in Figure 5. The Dom-ex well is located on the north side of the city of Hibbing is 1320 feet from the nearest dewatered pit at Hibtac. According to Mr. Crotteau this well experienced a drop of 3.07 feet in response to pit dewatering. Because wells in zone 3 (discussed below) indicate drawdown values ranging between 1 and 3 feet, and wells in zone 1 indicate dewatering of up to 10 feet, this analysis assumes that drawdowns in zone 2 are on the order of 3 to 5 feet. In addition to drawdown, wetlands in zone 2 are remnants of wetlands directly impacted by the project are surrounded by roads, ditches and other mine features, or have sections in zone 1. These wetlands can also be impacted by aerial deposition of mine related contaminants. The impact assessment for wetlands in zone 2 is outlined in Table 2.

It is important to note that a section of the upper Partridge River is located within Zone 2. Drawdowns of 3 to 5 feet under a river could severely reduce baseflow leading to reductions in flow in the river channel. Reductions in flow could indirectly impact riparian wetlands downstream.

UNIQUE ID	EGGERS & REED CLASS	ACRES	IMPACT	IMPACT DESCRIPTION
100A	Alder thicket	8.275	Moderate to Severe	Change in vegetation to change in wetland type
53D	Alder thicket	802.660	Moderate to Severe	Change in vegetation to change in wetland type
43	Alder thicket	9.150	Moderate to Severe	Change in vegetation to change in wetland type
53	Alder thicket	15.967	Moderate to Severe	Change in vegetation to change in wetland type
100A	Alder thicket	8.210	Moderate to Severe	Change in vegetation to change in wetland type
22C	Alder thicket or Shrub-carr	30.447	Moderate to Severe	Change in vegetation to change in wetland type
315	Alder thicket or Shrub-carr	185.118	Moderate to Severe	Change in vegetation to change in wetland type
100	Coniferous bog	49.041	Severe	Possible conversion of wetland type
48	Coniferous bog	556.958	Severe	Possible conversion of wetland type
62	Coniferous bog	108.797	Severe	Possible conversion of wetland type
80	Coniferous bog	3.138	Severe	Possible conversion of wetland type
86	Coniferous bog	4.866	Severe	Possible conversion of wetland type
88	Coniferous bog	14.561	Severe	Possible conversion of wetland type
100	Coniferous bog	105.174	Severe	Possible conversion of wetland type
104	Coniferous bog	4.747	Severe	Possible conversion of wetland type
90	Coniferous bog	383.229	Severe	Possible conversion of wetland type
773	Coniferous bog	53.424	Severe	Possible conversion of wetland type
888	Coniferous bog	940.711	Severe	Possible conversion of wetland type
77	Coniferous bog	20.517	Severe	Possible conversion of wetland type
552	Coniferous bog	31.210	Severe	Possible conversion of wetland type
61	Coniferous swamp	3.727	Moderate to Severe	Possible changes in vegetation
701	Coniferous swamp	3.968	Moderate to Severe	Possible changes in vegetation
856	Coniferous swamp	74.335	Moderate to Severe	Possible changes in vegetation
22A	Coniferous swamp	9.564	Moderate to Severe	Possible changes in vegetation
53C	Coniferous swamp	28.741	Moderate to Severe	Possible changes in vegetation
48A	Coniferous swamp	7.821	Moderate to Severe	Possible changes in vegetation
57	Coniferous swamp	36.143	Moderate to Severe	Possible changes in vegetation
64	Hardwood swamp	3.290	Moderate to Severe	Change in vegetation to change in wetland type
47	Open bog	2.341	Severe	Change in vegetation to change in wetland type
90A	Open bog	78.350	Severe	Change in vegetation to change in wetland type
22B	Shallow marsh	29.190	Severe	Conversion of wetland type
16	Shallow marsh	3.317	Severe	Conversion of wetland type
22	Shallow marsh	15.372	Severe	Conversion of wetland type

Table 2. Zone 2 impact assessment.

Zone 3 Impacts (2000 – 5000 Feet)

GLIFWC has modified Zone 3 in response to available data (from 2000 to 3500 feet in data package to 2000 to 5000 feet). Wetlands within zone 3 are depicted in Figure 6. The Rhino and Highway 7 wells are 2150 and 2625 feet respectively from the Canisteo pit. In response to reflooding in the pit, the Rhino well responded with a greater than 1 foot increase and the Highway 7 well responded with a greater than 2 foot increase. Two additional wells provide analog information for this zone. First, the Pinto well north of Hibbing is 2112 feet from the nearest active pit shows a drop of at least 3.55 feet in response to pit dewatering. Second, a MNDNR observation well located 4224 feet from the nearest active pit at Hibtac shows a 3.5 foot drop in water level. Attachment B is a slide from a presentation given by Mr. Crotteau outlining the water level drop at this well.

In addition to these wells, the city of Keewatin has been greatly impacted by pit dewatering. Well #2 at approximately 4220 feet from the Mesabi Chief pit dropped 75 feet in response to a 150 foot drop in water levels in the pit. Water levels in Well #1 at approximately 4750 feet from the pit are also correlated with pit dewatering at the pit although the report indicates that the amount of water drop was less than at well #2. The correlations between pit dewatering and water level drop at the wells were also supported by chemical characterization of the water in the pit (Attachment C).

These two wells are drilled into the bedrock and therefore it is not clear how those large water level drops in bedrock wells are expressed in the surficial aqufer and in wetlands. However, as previously stated, the PSDEIS does document vertical movement of water between the surficial aquifer and the bedrock aquifer. Regardless, this information fits with the analog approach of the lead agencies for NorthMet and illustrates that pit induced groundwater drawdowns can be expected to extend well into zone 3. The analog information suggests that drawdowns of 1 to 3.5 feet can be expected throughout zone 3. The impact assessment for zone 3 wetlands is provided in Table 3.

Zone 3 wetlands on the north side of the mine pits are also subject to impacts related to the dewatering of the Northshore pit. Figure 8 illustrates the possible extent of drawdown impacts at the Northshore pit based on the Hibtac well data provided by the MNDNR Mining Hydrologist Michael Crotteau. This cumulative effect is not included in version 7 of the data package or the PSDEIS. This analysis should be conducted.

It should also be noted that there are wetlands that fall within Zone 3 that have not been delineated by PolyMet. These wetlands should be delineated and the impacts of the combined Northshore and NorthMet drawdown on these wetlands should be assessed by the applicant.

Most of the east west reach of the Partridge River on the north side of the mine pits is within zone 3. As previously suggested, 1 to 3.5 feet of drawdown could be a significant impact to the hydrology of the river. In addition, the City of Kewaatin wells indicate that groundwater drawdown of tens of feet in the bedrock aquifer below the Partridge River are likely. This potential hydrologic impact should be assessed as part of the NEPA process. Finally, reductions in flow to the Partridge River could indirectly impact riparian wetlands downstream.

UNIQUE ID	EGGERS & REED CLASS	ACRES	IMPACT	IMPACT DESCRIPTION
53	Alder thicket	184.092	Moderate	Change in vegetation
53D	Alder thicket	714.287	Moderate	Change in vegetation
54B	Alder thicket	6.040	Moderate	Change in vegetation
54C	Alder thicket	8.015	Moderate	Change in vegetation
58	Alder thicket	372.266	Moderate	Change in vegetation
53D	Alder thicket	1283.309	Moderate	Change in vegetation
55	Alder thicket	15.732	Moderate	Change in vegetation
678	Alder thicket	1.676	Moderate	Change in vegetation
743	Alder thicket	4.750	Moderate	Change in vegetation
744	Alder thicket	10.344	Moderate	Change in vegetation
746	Alder thicket	3.572	Moderate	Change in vegetation
747	Alder thicket	10.027	Moderate	Change in vegetation
749	Alder thicket	99.326	Moderate	Change in vegetation
752	Alder thicket	36.908	Moderate	Change in vegetation
315	Alder thicket or Shrub-carr	2907.52	Moderate	Change in vegetation
565	Alder thicket or Shrub-carr	20.622	Moderate	Change in vegetation
566	Alder thicket or Shrub-carr	63.204	Moderate	Change in vegetation
480	Alder thicket or Shrub-carr	47.863	Moderate	Change in vegetation
555	Alder thicket or Shrub-carr	61.723	Moderate	Change in vegetation
557	Alder thicket or Shrub-carr	31.464	Moderate	Change in vegetation
890	Alder thicket or Shrub-carr	157.349	Moderate	Change in vegetation
106	Coniferous bog	581.72	Moderate to Severe	Change in vegetation
114	Coniferous bog	7.911	Moderate to Severe	Change in vegetation
406	Coniferous bog	26.125	Moderate to Severe	Change in vegetation
48	Coniferous bog	14.142	Moderate to Severe	Change in vegetation
552	Coniferous bog	31.738	Moderate to Severe	Change in vegetation
559	Coniferous bog	229.834	Moderate to Severe	Change in vegetation
562	Coniferous bog	56.744	Moderate to Severe	Change in vegetation
564	Coniferous bog	38.575	Moderate to Severe	Change in vegetation
62	Coniferous bog	20.018	Moderate to Severe	Change in vegetation
714	Coniferous bog	1692.646	Moderate to Severe	Change in vegetation
773	Coniferous bog	33.980	Moderate to Severe	Change in vegetation
774	Coniferous bog	88.486	Moderate to Severe	Change in vegetation
84	Coniferous bog	14.276	Moderate to Severe	Change in vegetation
84A	Coniferous bog	55.627	Moderate to Severe	Change in vegetation
88	Coniferous bog	6.396	Moderate to Severe	Change in vegetation
887	Coniferous bog	1359.301	Moderate to Severe	Change in vegetation
888	Coniferous bog	1123.789	Moderate to Severe	Change in vegetation
90	Coniferous bog	685.002	Moderate to Severe	Change in vegetation
98	Coniferous bog	24.180	Moderate to Severe	Change in vegetation
984	Coniferous bog	162.094	Moderate to Severe	Change in vegetation
105	Coniferous bog	62.495	Moderate to Severe	Change in vegetation
11	Coniferous bog	95.587	Moderate to Severe	Change in vegetation
479	Coniferous bog	157.954	Moderate to Severe	Change in vegetation
558	Coniferous bog	50.111	Moderate to Severe	Change in vegetation
697	Coniferous bog	48.894	Moderate to Severe	Change in vegetation
699	Coniferous bog	23.740	Moderate to Severe	Change in vegetation
713	Coniferous bog	80.451	Moderate to Severe	Change in vegetation
782	Coniferous bog	10.815	Moderate to Severe	Change in vegetation
783	Coniferous bog	20.604	Moderate to Severe	Change in vegetation
949	Coniferous bog	19.484	Moderate to Severe	Change in vegetation
53B	Coniferous swamp	4.626	Moderate	Minor vegetation change
53C	Coniferous swamp	2.275	Moderate	Minor vegetation change
54	Coniferous swamp	44.113	Moderate	Minor vegetation change
54A	Coniferous swamp	34.455	Moderate	Minor vegetation change
54D	Coniferous swamp	17.547	Moderate	Minor vegetation change
553	Coniferous swamp	27.413	Moderate	Minor vegetation change
57	Coniferous swamp	293.943	Moderate	Minor vegetation change
701	Coniferous swamp	1642.996	Moderate	Minor vegetation change
745	Coniferous swamp	143.479	Moderate	Minor vegetation change
81	Coniferous swamp	13.507	Moderate	Minor vegetation change
856	Coniferous swamp	29.496	Moderate	Minor vegetation change
864	Coniferous swamp	1005.134	Moderate	Minor vegetation change
1145	Coniferous swamp	30.313	Moderate	Minor vegetation change
404	Coniferous swamp	137.651	Moderate	Minor vegetation change
53A	Coniferous swamp	25.257	Moderate	Minor vegetation change
53E	Coniferous swamp	20.088	Moderate	Minor vegetation change
554	Coniferous swamp	23.212	Moderate	Minor vegetation change
891	Coniferous swamp	74.816	Moderate	Minor vegetation change

Table 3. Zone 3 impact assessment.

Zone 4 Impacts (5000 – 10000)

Wetlands within zone 4 are depicted in Figure 7. There is no well data that can be used to draw conclusions about mine pit related drawdown in this zone. Based on Zone 3, it is reasonable to assume that 0 to 1 feet of drawdown would occur under wetlands within this zone.

As discussed above zone 4 wetlands on the north side of the proposed mine pits are also subject to impacts related to the dewatering of the Northshore pit (Figure 8).

UNIQUE ID	EGGERS & REED CLASS	ACRES	IMPACT	IMPACT DESCRIPTION
752	Alder thicket	36.908	None	None
53D	Alder thicket	1283.309	None	None
55	Alder thicket	15.732	None	None
58	Alder thicket	235.493	None	None
678	Alder thicket	1.676	None	None
743	Alder thicket	4.750	None	None
744	Alder thicket	10.344	None	None
746	Alder thicket	3.572	None	None
747	Alder thicket	10.027	None	None
749	Alder thicket	99.326	None	None
53	Alder thicket	130.786	None	None
480	Alder thicket or Shrub-carr	47.863	None to Moderate	None to vegetation change
555	Alder thicket or Shrub-carr	61.723	None to Moderate	None to vegetation change
557	Alder thicket or Shrub-carr	31.464	None to Moderate	None to vegetation change
566	Alder thicket or Shrub-carr	35.777	None to Moderate	None to vegetation change
890	Alder thicket or Shrub-carr	157.349	None to Moderate	None to vegetation change
315	Alder thicket or Shrub-carr	1256.836	None to Moderate	None to vegetation change
558	Coniferous bog	50.111	None	None
84A	Coniferous bog	41.351	None	None
11	Coniferous bog	95.587	None	None
105	Coniferous bog	62.495	None	None
90	Coniferous bog	230.686	None	None
479	Coniferous bog	157.954	None	None
559	Coniferous bog	228.822	None	None
564	Coniferous bog	33.827	None	None
697	Coniferous bog	48.894	None	None
699	Coniferous bog	23.740	None	None
713	Coniferous bog	80.451	None	None
714	Coniferous bog	1002.456	None	None
782	Coniferous bog	10.815	None	None
783	Coniferous bog	20.604	None	None
887	Coniferous bog	1128.525	None	None
888	Coniferous bog	90.125	None	None
949	Coniferous bog	19.484	None	None
106	Coniferous bog	451.616	None	None
54A	Coniferous swamp	16.573	None to Moderate	None to minor vegetation change
57	Coniferous swamp	20.917	None to Moderate	None to minor vegetation change
404	Coniferous swamp	137.651	None to Moderate	None to minor vegetation change
553	Coniferous swamp	18.531	None to Moderate	None to minor vegetation change
554	Coniferous swamp	23.212	None to Moderate	None to minor vegetation change
701	Coniferous swamp	852.230	None to Moderate	None to minor vegetation change
745	Coniferous swamp	82.463	None to Moderate	None to minor vegetation change
53A	Coniferous swamp	25.257	None to Moderate	None to minor vegetation change
891	Coniferous swamp	74.816	None to Moderate	None to minor vegetation change
864	Coniferous swamp	901.932	None to Moderate	None to minor vegetation change
1145	Coniferous swamp	30.313	None to Moderate	None to minor vegetation change
53E	Coniferous swamp	20.088	None to Moderate	None to minor vegetation change
899	Open bog	23.039	None	None
83	Open bog	16.555	None	None
83	Open bog	26.414	None	None
885	Open bog	950.076	None	None
889	Shallow marsh	3.279	None	None
17	Shallow marsh	12.072	None	None
1	Shallow marsh	4.560	None	None
3	Shallow marsh	3.808	None	None
6	Shallow marsh	6.654	None	None
29	Shallow marsh	126.876	None	None
708	Shallow marsh	42.189	None	None
709	Shallow marsh	18.496	None	None
NWI	Black Spruce Forest - Undelineated	778.140	Moderate	Change in vegetation

Table 4. Zone 4 impact assessment.

Impacts to Riparian Wetlands along the Partridge River

The applicant and lead agencies have ignored repeated requests by cooperating agencies to better characterize the hydrology of the mine site through a robust surface and groundwater data collection program. Therefore reliable data with which to assess the effects of drawdown in the surficial and bedrock aquifers to riparian wetlands along the Partridge River are not available. Based on pit dewatering induced drawdowns at other sites described in this report, it is reasonable to assume that flow in the Partridge River would be significantly reduced if the NorthMet project proceeds as currently designed. This would have an effect on riparian wetlands far downstream. These effects are highly important because of the potential for increased methylation of mercury that is released by the project. To date, these potential impacts have not been characterized.

Summary

GLIFWC disagrees with the use of the Canisteo pit analog as the only method for estimating drawdown impacts for the NorthMet project. Repeated requests for a robust approach have not been successful. Therefore, this analysis uses the lead agencies own analog approach with data that is not included in the PSDEIS analysis. It is important to note that this analysis also uses the impact criteria developed for the Crandon project in Wisconsin which is the basis for impact criteria in the PSDEIS.

The assumption that ombotrophic bogs are completely separated from the surficial aquifer is not supportable. The extent of the hydrologic connection should be investigated.

Based on GLIFWCs analysis, wetlands severely impacted by drawdown total 3188.62 acres in zone 1; 2458.12 acres in zone 2; and 273.01 acres in zone 3. Severe indirect impacts to wetlands from mine pit drawdown total 5719.75 acres. All wetlands potentially impacted by drawdown are depicted in Figure 9. The Corps should require up front mitigation for all severely impacted wetlands. At a minimum, up front mitigation for all wetlands in zone 1 should be required. Additional up front mitigation should be considered for wetlands that are classified in the moderate to severe category. Robust monitoring is required for wetlands in the moderate category.

Impacts for wetlands suffering the cumulative effect of NorthMet and Northshore projects should be assessed and mitigation required. Un-delineated wetlands south of the Northshore pits should be delineated and included in the analysis. Impacts to riparian wetlands cannot be discounted given the shortcomings of the analog method and the inadequate characterization of surface and groundwater hydrology for the mine site area.

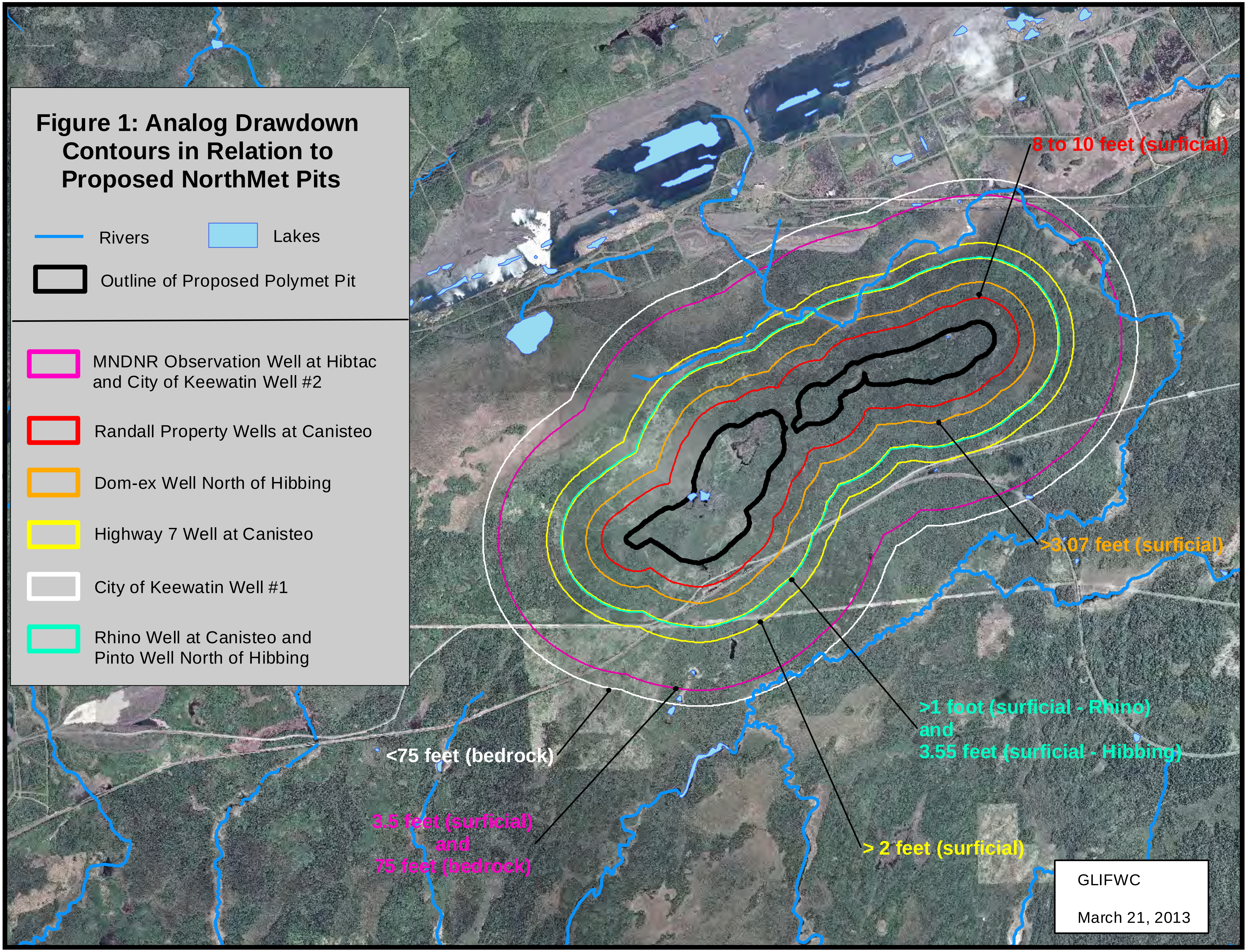


Figure 1: Analog Drawdown Contours in Relation to Proposed NorthMet Pits
Rivers
Lakes
Outline of Proposed Polymet Pit
MNDNR Observation Well at Hibtac and City of Keewatin Well #2
Randall Property Wells at Canisteo
Dom-ex Well North of Hibbing
Highway 7 Well at Canisteo
City of Keewatin Well #1
Rhino Well at Canisteo and Pinto Well North of Hibbing
8 to 10 feet (surficial)
>3.07 feet (surficial)
>1 foot (surficial - Rhino) and 3.55 feet (surficial - Hibbing)
> 2 feet (surficial)
<75 feet (bedrock)
3.5 feet (surficial) and 75 feet (bedrock)
GLIFWC
March 21, 2013

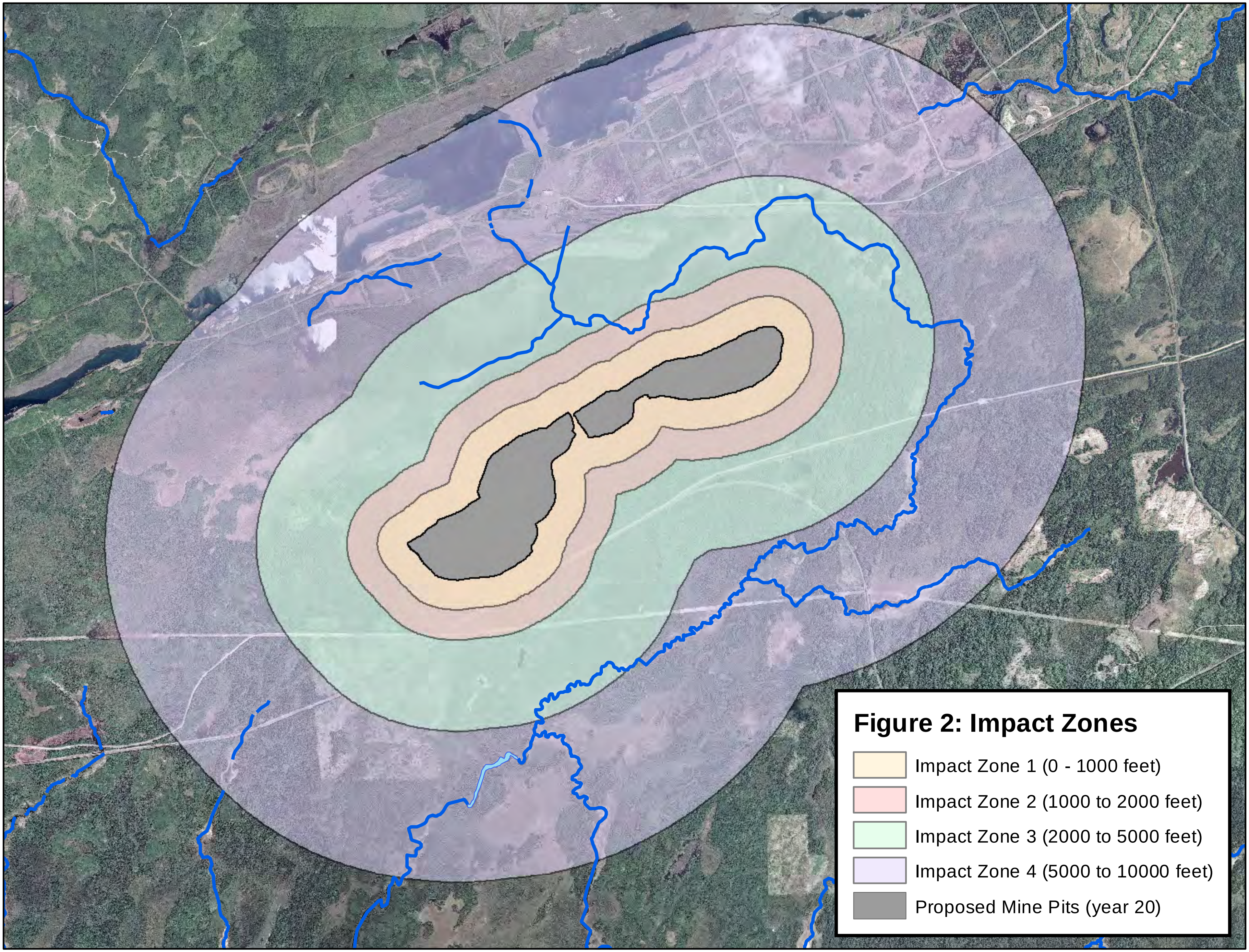


Figure 2: Impact Zones
Impact Zone 1 (0 - 1000 feet)
Impact Zone 2 (1000 to 2000 feet)
Impact Zone 3 (2000 to 5000 feet)
Impact Zone 4 (5000 to 10000 feet)
Proposed Mine Pits (year 20)

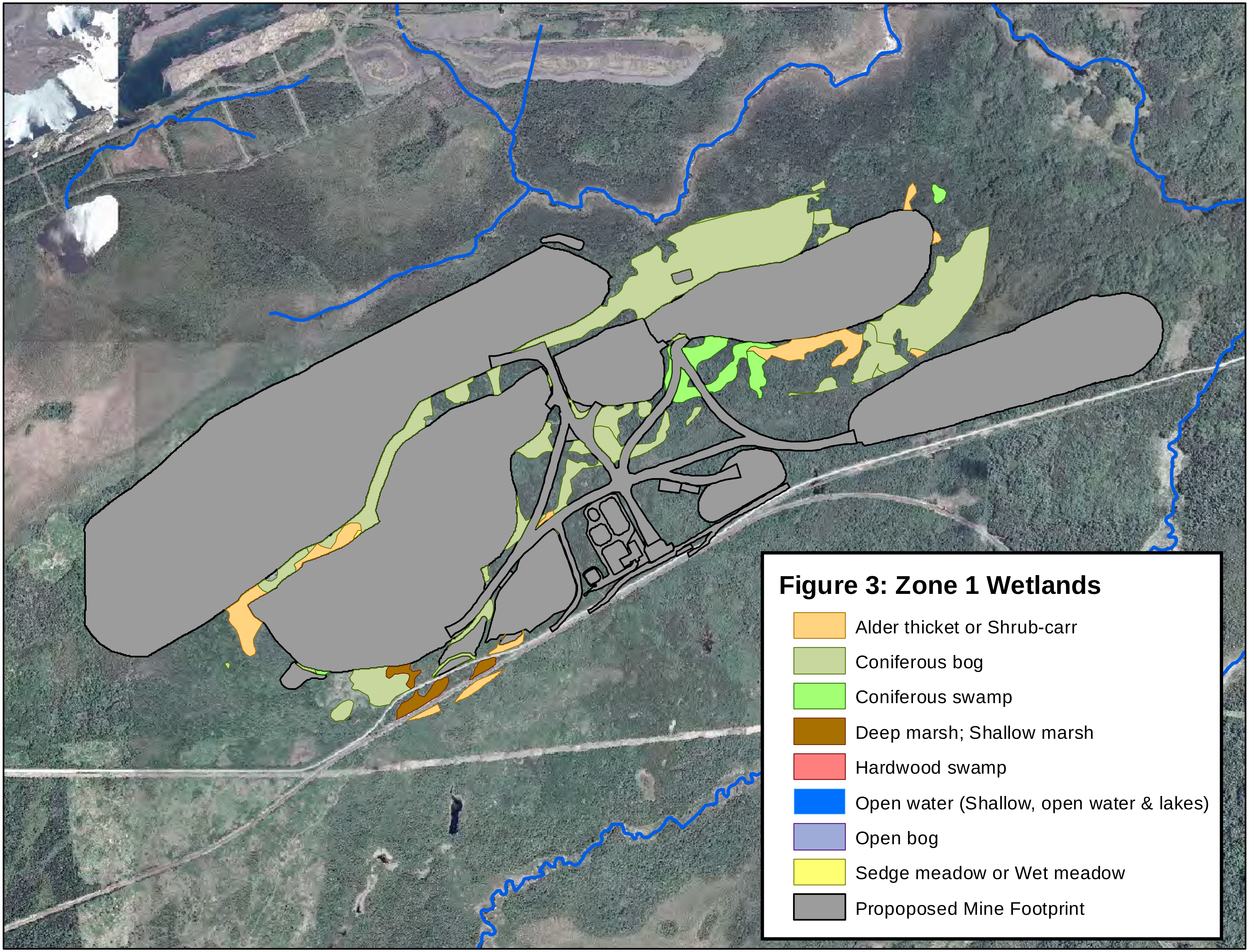
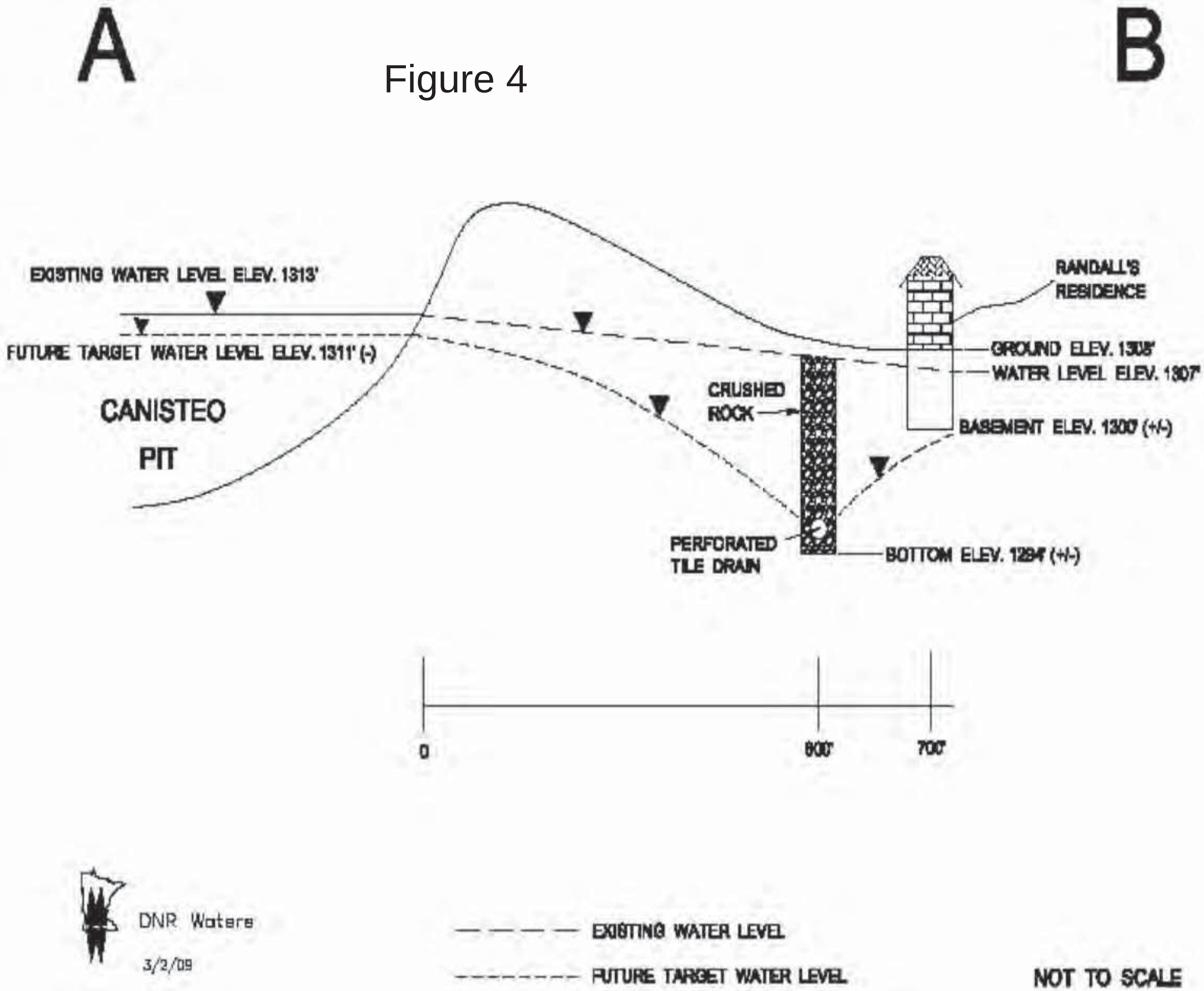


Figure 3: Zone 1 Wetlands
Alder thicket or Shrub-carr
Coniferous bog
Coniferous swamp
Deep marsh; Shallow marsh
Hardwood swamp
Open water (Shallow, open water & lakes)
Open bog
Sedge meadow or Wet meadow
Propoposed Mine Footprint

Figure 4


A
B
EXISTING WATER LEVEL ELEV. 1313'
FUTURE TARGET WATER LEVEL ELEV. 1311' (-)
CANISTEO PIT
CRUSHED ROCK
PERFORATED TILE DRAIN
RANDALL'S RESIDENCE
GROUND ELEV. 1308'
WATER LEVEL ELEV. 1307'
BASEMENT ELEV. 1300' (+/-)
BOTTOM ELEV. 1294' (+/-)
0
600'
700'
DNR Waters
3/2/09
EXISTING WATER LEVEL
FUTURE TARGET WATER LEVEL
NOT TO SCALE

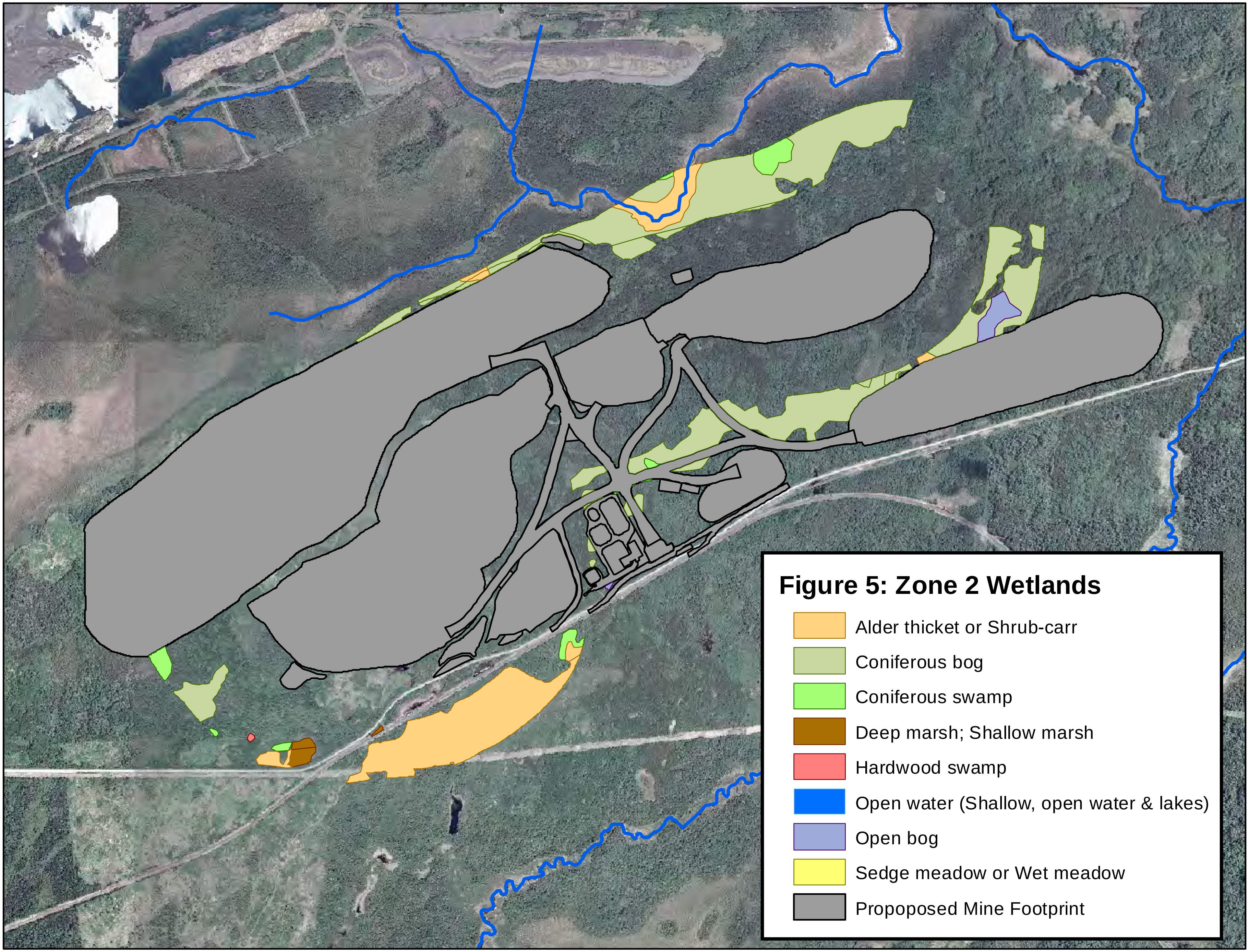


Figure 5: Zone 2 Wetlands
Alder thicket or Shrub-carr
Coniferous bog
Coniferous swamp
Deep marsh; Shallow marsh
Hardwood swamp
Open water (Shallow, open water & lakes)
Open bog
Sedge meadow or Wet meadow
Propoposed Mine Footprint

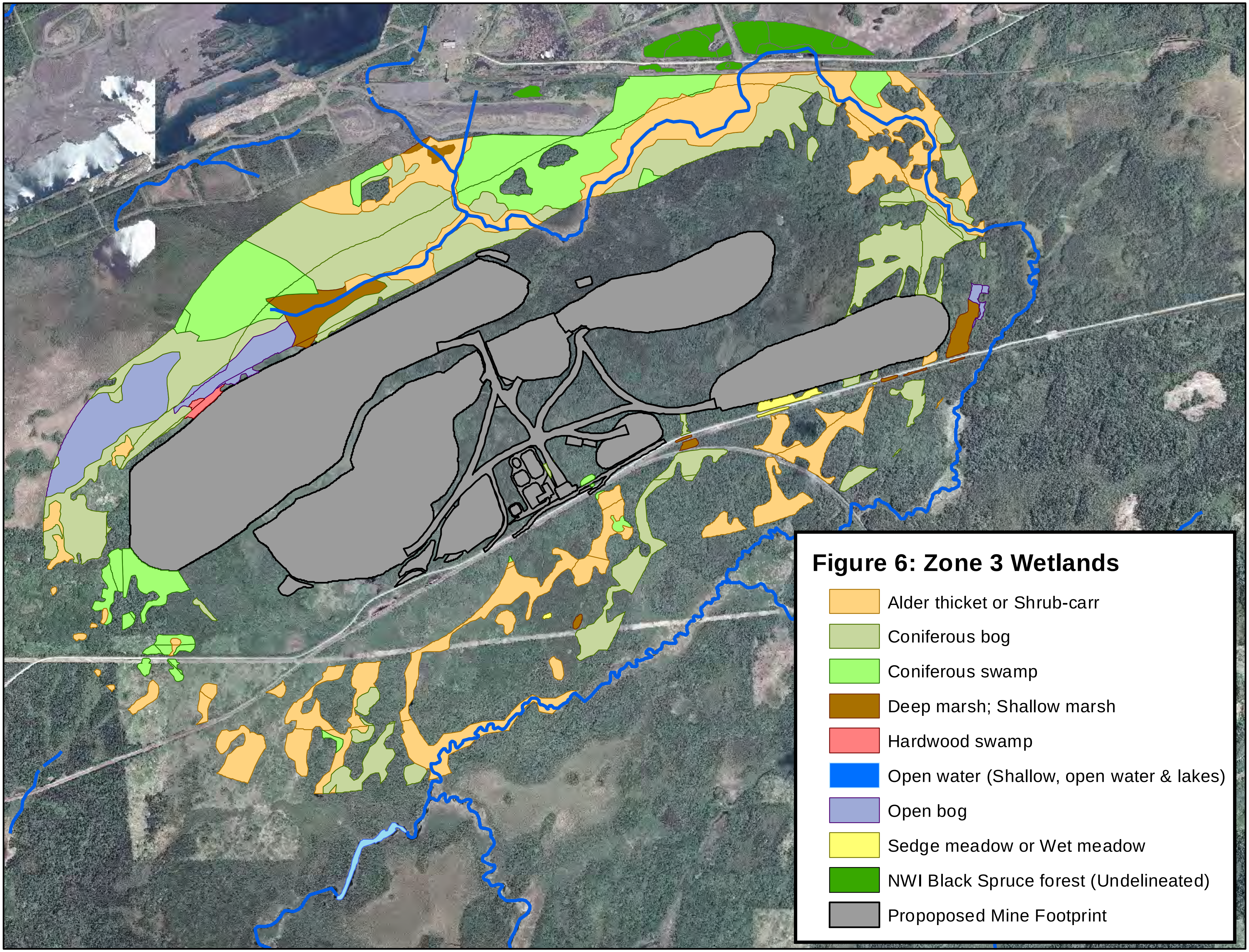


Figure 6: Zone 3 Wetlands
Alder thicket or Shrub-carr
Coniferous bog
Coniferous swamp
Deep marsh; Shallow marsh
Hardwood swamp
Open water (Shallow, open water & lakes)
Open bog
Sedge meadow or Wet meadow
NWI Black Spruce forest (Undelineated)
Propoposed Mine Footprint

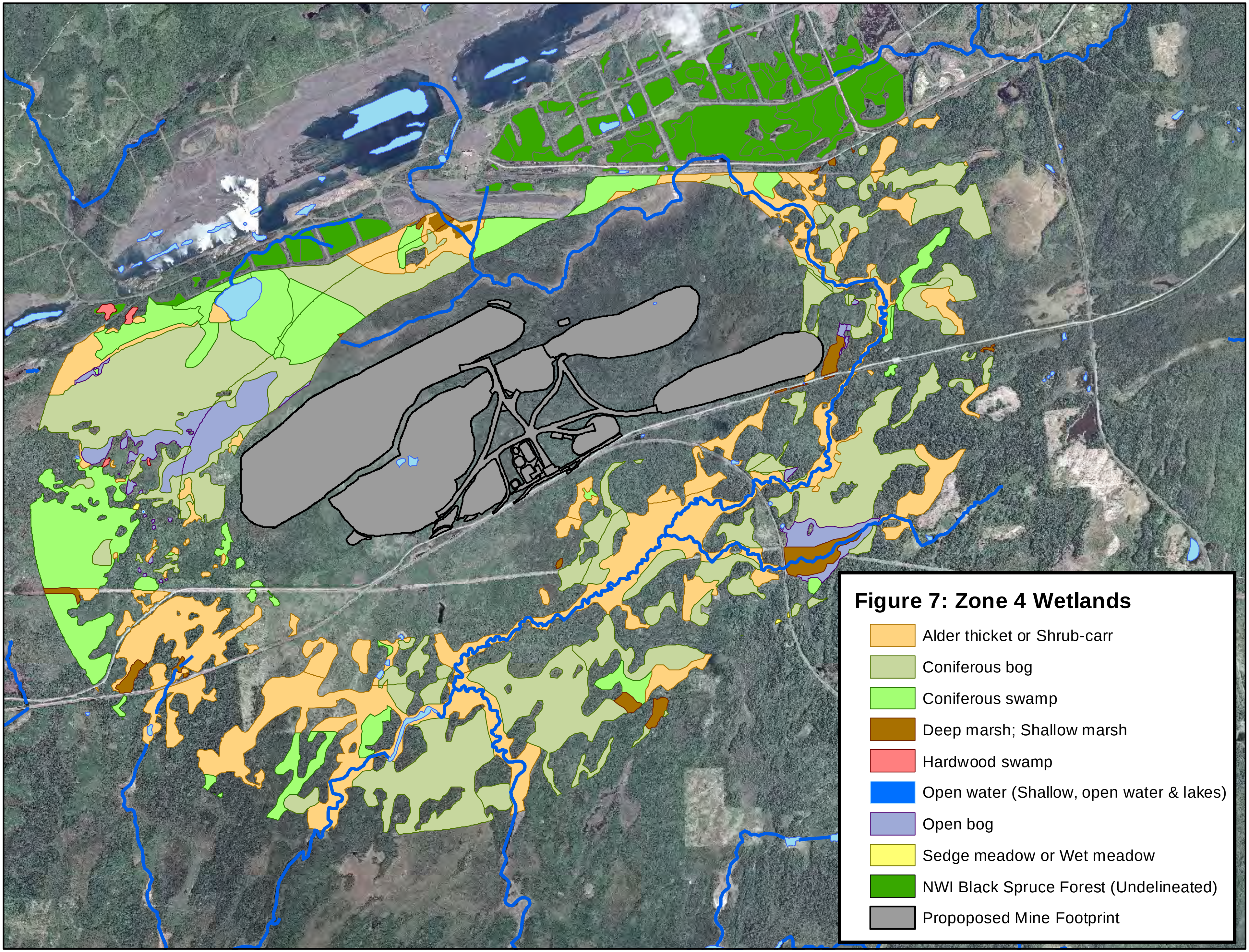
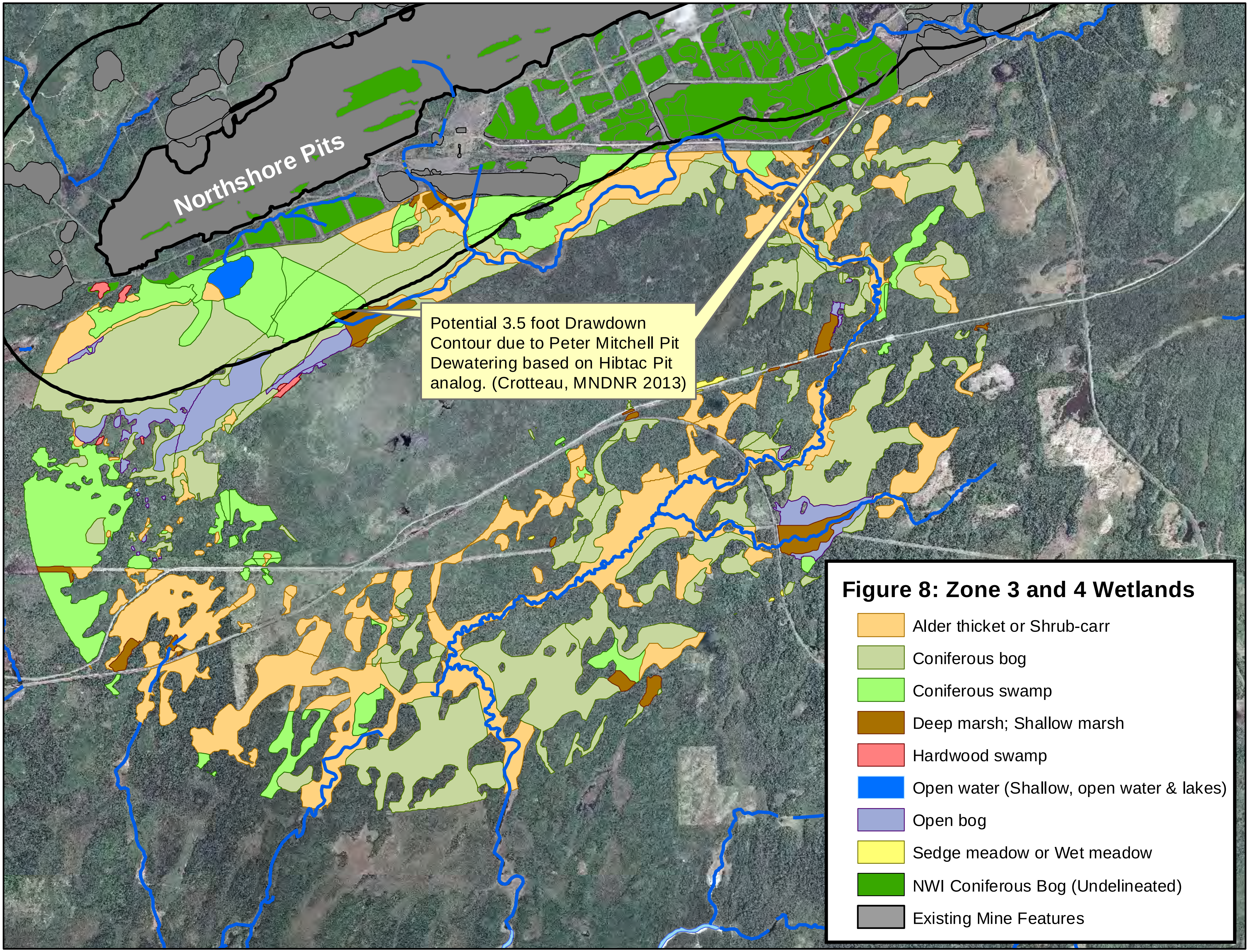


Figure 7: Zone 4 Wetlands
Alder thicket or Shrub-carr
Coniferous bog
Coniferous swamp
Deep marsh; Shallow marsh
Hardwood swamp
Open water (Shallow, open water & lakes)
Open bog
Sedge meadow or Wet meadow
NWI Black Spruce Forest (Undelineated)
Propoposed Mine Footprint


Northshore Pits
Potential 3.5 foot Drawdown Contour due to Peter Mitchell Pit Dewatering based on Hibtac Pit analog. (Crotteau, MNDNR 2013)
Figure 8: Zone 3 and 4 Wetlands
Alder thicket or Shrub-carr
Coniferous bog
Coniferous swamp
Deep marsh; Shallow marsh
Hardwood swamp
Open water (Shallow, open water & lakes)
Open bog
Sedge meadow or Wet meadow
NWI Coniferous Bog (Undelineated)
Existing Mine Features

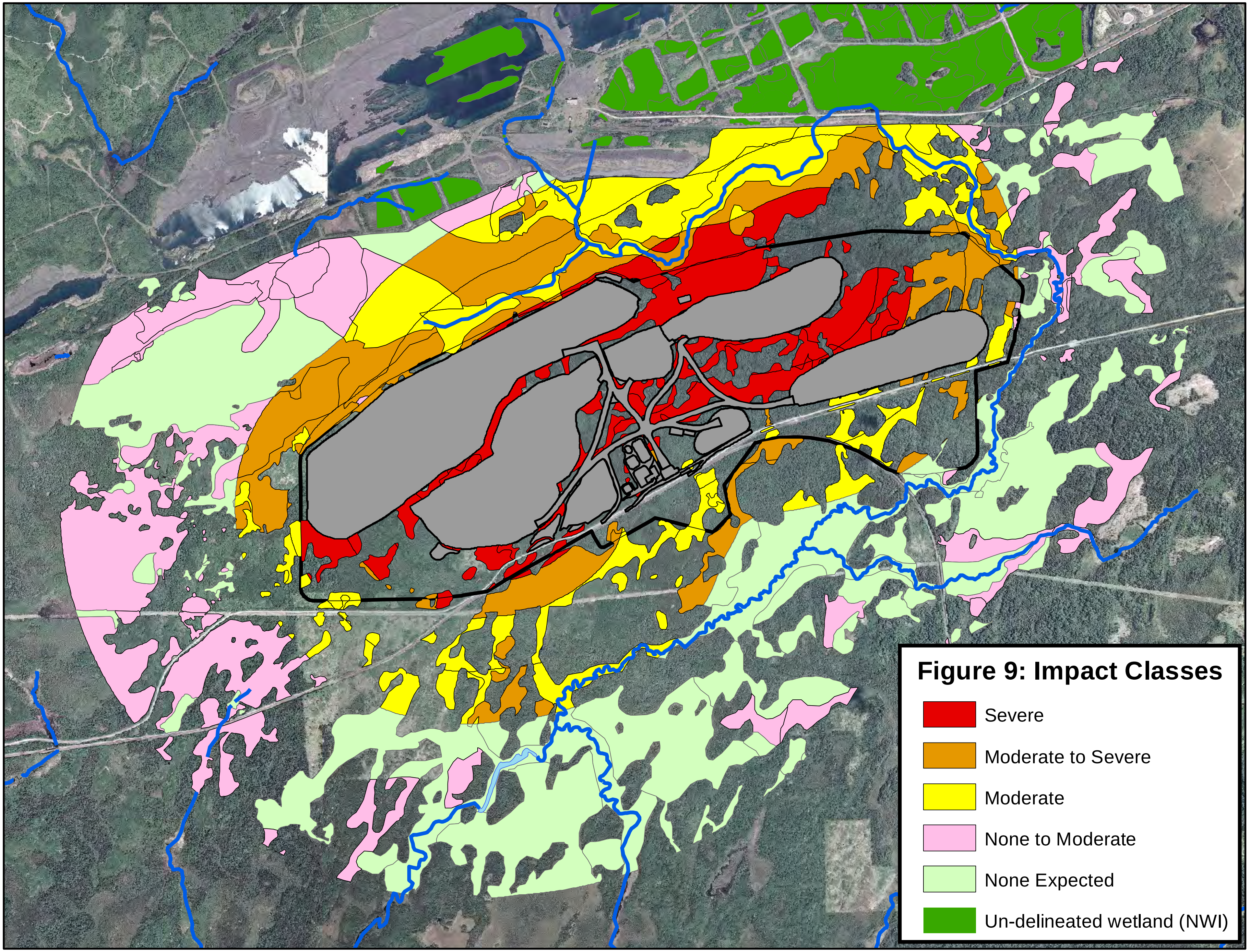


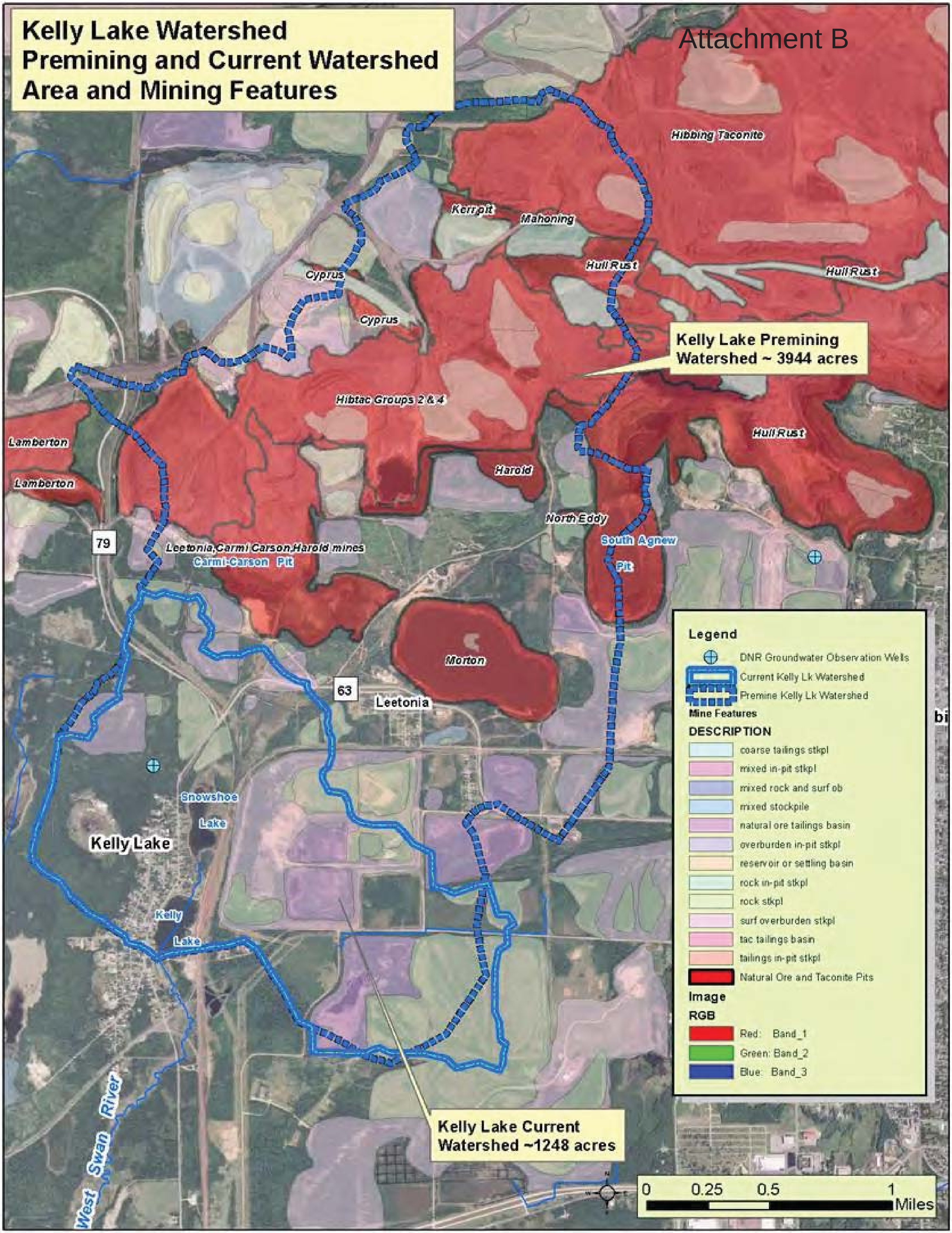
Figure 9: Impact Classes
Severe
Moderate to Severe
Moderate
None to Moderate
None Expected
Un-delineated wetland (NWI)

Attachment A

Wetland Resources IAP Draft Summary Memo

Line Number	Comments
	[insert your name]
General Comments (per line number)	
105	The Co-lead position described here is unchanged from the 2009 DEIS. This position is contrary to standard analysis that mining companies have to conduct as part of sulfide mine EIS processes across the country.
118	This characterization requires further detail. According to our meeting notes, the need for a quantitative assessment of drawdown at the mine site was a unanimous position among the tribal cooperating agencies, the EPA, and the Fish and Wildlife Service. This position also received strong support from the PCA. This is why the original request by the wetland workgroup for a quantitative method of assessing drawdown impacts at the mine site was described as a "consensus". This should be clarified in the summary memo. See attached comment letter for additional detail on the groundwater modeling issue.
143	GLIFWC staff concur with Margaret Watkins that the cumulative impact assessment should be conducted for the same area that is used in the cultural resource assessment (Wetland area of potential effect).
148	As discussed during the Wetland IAP call of May 13th 2011, baseline data for water quality in wetlands are essential to this analysis. We support the Corps request that the applicant provide a list of available baseline data that will be assessed for adequacy in describing the existing condition and no action alternative. We request that this be specifically included in the workplan.
PolyMet NorthMet Project Co-Lead Agency Workplan Preparation Guidance for Wetland Assessment General Comments	
032	GLIFWC staff maintains that the analogue method proposed by the Army Corps does not provide sufficient information to base the indirect wetland impact analysis for the entire project.
078	GLIFWC staff believe that the analysis area for cumulative impacts is not adequate. See comment on line 143 of the summary memo. In addition, the cumulative impact assessment should cover topics that were not part of the 2009 DEIS. Climate change in the region is a stressor for wetlands. This additional factor should be assessed. Cumulative impacts of Iron Range mine projects on water quality of wetlands should be described.
085	GLIFWC staff do not agree with the Corps' definition of "reasonably foreseeable project". Several mine projects to the east and northeast of Polymet are likely to be proposed, some as early as this summer. A mining company interested in the Dunka deposit will be installing a stream gauge on the upper Partridge River this spring. Because this project will likely impact some of the same areas as Polymet (Partridge River watershed), this project should be included in the analysis.

090	GLIFWC staff agree that the analogue data prepared by John Adams can be used as part of the indirect impact analysis. We remain concerned that this analysis is being used as the sole data source for the discussion of indirect wetland impacts at the Polymet mine site. As discussed during the wetland IAP call of May 13th 2011, a detailed report that includes all data and assumptions used by John Adams to assess the Canisteo Pit data should be developed and reviewed by the wetlands IAP group. After that review, a determination on the adequacy of the analysis as an analogue to Polymet can be made.
102	GLIFWC staff believe that these distances are open to a great deal of interpretation. We do not believe that the distance categories listed in this document are conservative interpretations of the Canisteo pit data.
118	The Canisteo Pit data indicated that water levels at a well 2300 feet from the pit were correlated with water fluctuations in the pit. Therefore it is inappropriate to exclude the "high likelihood" category from this distance category.
123	For the same reason stated in the comment on line 118, it is not appropriate to exclude the "high likelihood" or "moderate likelihood" of impact from this distance category.



Kelly Lake Watershed
Premining and Current Watershed
Area and Mining Features
Attachment B
Hibbing Taconite
Kerr pit
Mahoning
Hull Rust
Hull Rust
Cyprus
Cyprus
Kelly Lake Premining
Watershed ~ 3944 acres
Hibtac Groups 2 & 4
Hull Rust
Lamberton
Lamberton
Harold
North Eddy
South Agnew
Pit
79
Leetonia,Carmi Carson,Harold mines
Carmi-Carson Pit
Morton
63
Leetonia
Snowshoe
Lake
Kelly Lake
Kelly
Lake
West Swan River
Kelly Lake Current
Watershed ~1248 acres
Legend
DNR Groundwater Observation Wells
Current Kelly Lk Watershed
Premine Kelly Lk Watershed
Mine Features
DESCRIPTION
coarse tailings stkpl
mixed in-pit stkpl
mixed rock and surf ob
mixed stockpile
natural ore tailings basin
overburden in-pit stkpl
reservoir or settling basin
rock in-pit stkpl
rock stkpl
surf overburden stkpl
tac tailings basin
tailings in-pit stkpl
Natural Ore and Taconite Pits
Image
RGB
Red: Band_1
Green: Band_2
Blue: Band_3
0 0.25 0.5 1
Miles

Liesch Associates, Inc. ■ 13400 15th Avenue North ■ Minneapolis, MN 55441
Phone: (763) 489-3100 ■ Toll Free: (800) 338-7914 ■ Fax: (763) 489-3101

TECHNICAL MEMORANDUM

TO: **Mike Johnson, PE - Liesch Associates, Inc.**

FROM: **Jim de Lambert, PG - Liesch Associates, Inc.**

DATE: **February 18, 2009**

RE: **Water Supply Contingency Plans for Keewatin and Nashwauk**

U.S. Steel – Minnesota Ore Operations (US Steel) is proposing to increase production at the US Steel Corporation Keewatin Taconite Facility under a project known the Keetac Expansion Project (the "Project"). The Project involves continuous dewatering operations that are ongoing and will continue in current and future mining areas. These planned activities are expected to generate drawdown in the aquifer locally and potentially at the water supply wells for the Cities of Keewatin and Nashwauk.

This memorandum is intended to provide background on the City water supplies and the Biwabik Iron Formation and to outline a plan to monitor the effects of mine pit dewatering on the aquifer so that appropriate steps can be taken to maintain the water supplies.

Relatively little information exists concerning the hydrogeology of the Biwabik Iron Formation (BIF) and the City water supplies. The Minnesota Department of Health (MDH) has assisted both Cities with Wellhead Protection activities and the results of this work probably represent the most comprehensive source of information concerning the source of water discharging at the City wells. In conducting this work it was apparent that traditional groundwater flow models would not be appropriate tools to estimate capture zones in the fractured BIF Aquifer. Instead, MDH utilized isotopic and chemical characteristics of water from the wells and nearby surface water bodies to estimate the source of water discharging at the wells. This work is summarized in separate reports titled Wellhead Protection Plan for the City of Keewatin - Part I (Walsh 2003) and Wellhead Protection Plan for the City of Nashwauk - Part I (Walsh 2007). Each report includes a delineation of the Wellhead Protection Area (WHPA), determination of the Drinking Water Supply Management Area (DWSMA) and assessments of Well and DWSMA Vulnerability. In addition, the reports include a summary of the hydrogeologic conditions concerning the city water supplies. Additional information used in preparing this memorandum includes various published maps and reports and personal communication with representatives from MDH, Department of Natural Resources and the Cities.

Keetac Mine Hydrogeology

The Keetac Mine extracts iron ore from the Biwabik Iron Formation (BIF) of the Mesabi Iron Range. The BIF is Precambrian in age, was deposited under marine conditions and is composed primarily of chert and iron minerals. Its subcrop area extends along strike for a distance of at least 100 miles generally from Grand Rapids to Babbitt and varies in width from one to three miles. The BIF has an overall thickness 350 to 750 feet and dips generally to the south at three to twelve degrees (Grout 1951). Information provided by the MDH from a deep test hole drilled near Keewatin suggests a BIF thickness of 590 feet in this area.

According to a suggestion by J. F. Wolf in 1917, and elaboration by J. W. Gruner in 1946 (Grout 1951), the BIF is generally divided into four members. From top to bottom, these are Upper Slaty, Upper Cherty, Lower Slaty, and Lower Cherty. The low grade magnetic iron ores, known as taconite, are mined from the Upper Cherty and Lower Cherty members. The Upper Cherty Member has a thickness ranging from 80 to 250 feet. The Lower Cherty ores are typically 120 to 425 feet thick. The slaty units can alter to form a sticky, clayey rock that generally exhibits low permeability including the Intermediate Slate which is a thin bedded silicate taconite, also known as paint rock that occurs at the base of the Lower Slaty Member. This is an important marker horizon for water supply purposes as it marks the contact with the Lower Cherty Member. Borehole logs suggest that the more productive zones for water supply wells may occur below this contact in the Lower Cherty Member.

In addition to being an important source of iron ore the BIF is also an important aquifer locally. Both Nashwauk and Keewatin, and numerous other range Cities and water users, utilize the BIF Aquifer. Depending on the amount of water desired and other factors, BIF aquifer wells are typically constructed by drilling a casing to solid rock, usually the top of the BIF Formation, and then drilling an open hole to a sufficient depth to obtain the required quantity of water. Yields in the 300 to 600 gallon per minute (gpm) range have been reported from existing wells. For Nashwauk and Keewatin, geochemical work conducted by MDH has indicated that a significant percentage of the water discharging at some of the wells originates from nearby mine pits.

The BIF Aquifer consists primarily of fine grained chert and iron minerals, exhibiting very little primary porosity. Groundwater movement appears to be restricted to zones of secondary permeability controlled by fractures and joints particularly in the cherty portions of the BIF. The MDH has conducted a suite of borehole logs at available wells constructed in the BIF Aquifer in an attempt indentify preferred flow paths and to further characterize the hydrogeology of the formation. This information suggests the occurrence of preferred flow zones in both of the cherty members.

The Virginia Formation immediately overlies the BIF while the Pokegama Formation and the Giants Range Batholith underlay the BIF. These bedrock formations generally do not yield significant volumes of water to wells and are generally not considered important aquifers. Up to 200 feet of glacial drift lies above the consolidated bedrock near the Mesabi Range. Where these deposits include saturated granular outwash they may provide a potential source for significant volumes of water.

Little information is available regarding groundwater flow fields in the BIF due to a lack of available wells and detailed water level measurements over time. Mining operations conducted to date have undoubtedly altered natural flow patterns and planned mine dewatering activities in the Mesabi Range will continue to influence flow patterns.

Keewatin Water Supply

In recent years the City of Keewatin has obtained its water supply from two wells, designated Well 1 and Well 2. The City has indicated that it drilled an additional well in 2007, designated Well 3, in response to increasing manganese concentrations at Well 2. All wells are shown on the attached **Figure 1** (Attachment 1). Keewatin Well 3 has been added to the City's water supply system and Well 2 has been removed from service.

Basic information concerning Keewatin's wells is summarized on **Table 1** below and logs for each well are included in Attachment 2.

Table 1

Well	Well	Casing		Open Hole, Elevation (ft msl)			
Name	Number	Diameter	Depth (ft)	Top	Bottom	Status	Notes
1	192359	8-inch	249	1224	867	Active	Drilled in 1952/1982
2	228828	10-inch	344	1113	984	Observation	Drilled in 1951
3	751520	12-inch	198	1274	857	Active	Drilled in 2007

Water level information contained in Keewatin's Part 1 WHP plan shows a direct correlation between the dewatering of the Mesabi Chief Pit which was initiated in 1995 and Keewatin Well 2. As of 2002, the water level was lowered approximately 150 feet at the Mesabi Chief Mine while the static water level fell approximately 75 feet at Keewatin Well 2. Water levels were not collected at Keewatin Well 1 after 1998, however, the earlier measurements at Keewatin Well 1 also showed water level declines but somewhat less than those observed at Well 2. The WHP plan shows a correlation between water levels at select existing mine pits within the footprint of the proposed Project during dewatering and the water level at Well 2. The correlation was also supported by chemical characterization of water from the mine pits and well.

Details of the connection between mine dewatering, water levels and water chemistry at the City Wells are not clear. Long term monitoring is recommended to obtain additional information concerning the connection and to provide a mechanism to determine whether additional steps are needed to maintain the City's source of water supply.

Keewatin Water Use

The City of Keewatin is currently operating under Minnesota Department of Natural Resources (DNR) Appropriations Permit number 1972-2192. This permit allows Keewatin to pump up to 75 million gallons of water per year (mgy) at a permitted rate not to exceed 350 gallons per minute. The yearly reported pumping volumes submitted to the DNR are provided on **Table 2**. The reported values illustrate that the City's annual water use has increased from 45 to approximately 65 mgy in recent years.

Table 2

Permit	Well	Unique Well No.	Permit Vol (mgy)	Permit Rate (gpm)	2007	2006	2005	2004	2003	2002	2001	2000	1999	1998
1979-2192	1	192359	75.0	350.0	54.6	49.5	44.0	43.7	24.3	29.2	28.8	23.8	18.3	26.2
	2	228828			8.8	14.5	16.2	16.9	29.2	15.8	17.1	22.8	25.8	18.2
	3	751520			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ten Year Average = 52.8 mgy				Total:	63.4	64.1	60.2	60.5	53.5	45.0	45.9	46.6	44.1	44.4

Nashwauk Water Supply

The water supply for the City of Nashwauk is obtained from two bedrock wells located within the City limits of Nashwauk as shown on **Figure 1**. Like Keewatin, both of Nashwauk's wells tap portions of the BIF Aquifer. Basic information concerning Nashwauk's wells is summarized on **Table 3** below and logs for each well are included in Attachment 2. Less information is available concerning Nashwauk's wells and some discrepancies exist regarding well numbering and depths. The well names and unique numbers used here are as presented in the MDH Wellhead Protection Plan Part 1, prepared for the City. The log for Well 3 indicates a casing depth of 40 feet in combination with a depth to bedrock of 110 feet. This is an unlikely scenario as the casing would typically extend at least to the top of the rock.

Table 3

Well Name	Well Number	Casing Diameter	Casing Depth (ft)	Open Hole, Elevation (ft msl) Top	Open Hole, Elevation (ft msl) Bottom	Status	Notes
3	241017	8-inch	40	1449	1075	Active	Drilled in 1930
4	228819	16-inch	150	1289	899	Active	Drilled in 1947

The northern portion of the City of Nashwauk and the City's Well 3 are situated directly between two former natural ore pits, the Larue to the northeast and the Hawkins to the southwest. Well 4 is situated in the southern portion of the City approximately 3200 feet south of Well 3. Geochemical information provided in the MDH WHP report suggests that a significant percentage of water discharging at the wells originates at the Larue Pit. It is also likely that a connection exists between the levels in nearby mine pits and the

City wells. To the northeast, the nearest mining proposed under the Keetac Project is more than two miles away. The effects of mine pit dewatering under this Project on the City wells will likely depend on the effects at the former natural ore pits between the Project and the City. Anecdotal evidence suggests that the former natural ore pits are separated by "land bridges" that may serve to reduce the effects of dewatering at the City wells.

To the southwest of Nashwauk, Minnesota Steel also has plans for taconite extraction, including mine pit dewatering and water supply pumping that could also affect water levels in nearby natural ore pits and the City wells.

Nashwauk Water Use

Nashwauk is currently operating under Minnesota Department of Natural Resources (DNR) Appropriations Permit number 1975-2151. This permit allows the City of Nashwauk to pump up to 70 million gallons of water per year (MGY) at a permitted rate not to exceed 1,100 gallons per minute. The yearly reported pumping volumes submitted to the DNR are provided on **Table 4**. Pumping in recent years has ranged from approximately 45 to 65 mgy.

Table 4

Permit	Well	Unique Well No.	Permit Vol (mgy)	Permit Rate (gpm)	2007	2006	2005	2004	2003	2002	2001	2000	1999	1998
1975-2151	4	228819	70.0	1,100.0	25.1	25.9	27.7	34.0	33.3	32.9	25.5	23.6	22.1	23.7
	3	241017			27.2	20.1	29.3	29.5	30.6	23.1	26.4	21.6	21.4	22.1
Ten Year Average = 52.5 mgy				**Total:**	52.3	46.0	57.1	63.6	63.9	55.9	52.0	45.2	43.4	45.8

Proposed Monitoring Plan

Monitoring is proposed to establish baseline conditions, to monitor changes in the BIF Aquifer that could impact the existing water supply wells for the Cities of Keewatin and Nashwauk and to assess potential measures to mitigate impacts, if necessary. Development and implementation of the Keetac Project will take place in stages over a period of several years. Sufficient time exists to monitor the resources in question and to develop a mitigation plan, if required. Impacts could include interference drawdown from dewatering activities or water supply pumping and/or changes in water quality that make use of the water undesirable. Therefore, the monitoring program should include both water quantity and quality components.

Water Quality

Existing water quality from both Cities supply wells should be obtained from the City and MDH. Additional baseline samples should be taken from existing wells for dissolved mineral constituents and general chemistry. Annual sampling of the wells should continue for select parameters to detect changes over time. Wells to be sampled include Nashwauk Wells 3 and 4 and Keewatin Wells 1 and 3. Parameter lists for baseline and annual sampling are included in Attachment 3.

The MDH has recommended that the Cities sample for stable isotopes of water, chloride and sulfate as part of their ongoing WHP efforts. MDH has indicated that they will conduct the analysis but the City would be responsible for obtaining the samples. US Steel representatives responsible for sample collection will contact MDH prior to sampling to coordinate collection of MDH samples with the sampling recommended here. The results could assist the Cities in their WHP efforts and provide useful information concerning the hydrogeology of the BIF Aquifer and the source of water discharging at the City wells.

Water Quantity

Long term water level monitoring points are required to assess drawdown in the aquifer. A search should be conducted to identify potential monitoring points including wells and surface water locations. MDH and DNR staff have expressed an interest in long term monitoring and noted a lack of available points in the BIF aquifer.

We understand that not all of the City wells involved are accessible for water level measurements. Arrangements should be made for the wells to be accessible and for City utility personnel to make regular measurements of static levels, pumping levels, pumping rates and volume.

Former Well 2 at Keewatin is now out of service and could serve as a useful monitoring point. We understand that the DNR has recently conducted logging procedures at the well and that both the DNR and MDH are interested in data from this location. The City has indicated that this well is available for long term monitoring by US Steel. A data logger and transducer will be installed and maintained by US Steel for well water level measurement at this location.

At present we are not aware of a suitable BIF Aquifer well for long term monitoring near Nashwauk. A new observation well is proposed for use as a dedicated monitoring point generally between the City and the Keetac project. This well should also be equipped with a transducer and data logger. Transducers and data loggers will be visited quarterly to verify operation, collect data and to reset the instruments to correct for drift.

Measurements of water levels from select mine pits, should also be collected as part of the Monitoring Plan. This includes water levels from pits within the Keetac Project, the LaRue pit complex and data collected by Minnesota steel for their operations southwest of Nashwauk. This information will be useful for correlating mine pit water levels with the City wells and the BIF Aquifer water levels in general.

Reporting

All data should be collected and summarized in a report format annually. The report should include a summary of the data collected during the previous year, a description of any changes to the monitoring network, recommended changes to the monitoring network and a determination as to any effects of the dewatering activities on the Cities well water supplies. If the results of the planned monitoring suggest significant changes in well water quality or level that may be related to Keetac mining activities, additional monitoring activities may be recommended. The annual report will be prepared by US Steel no later than February 15th for the previous calendar year and distributed to the Cities, DNR and MDH for review.

Potential Mitigation Measures

In the event that mine dewatering activities have an adverse impact on the production or quality of the City water supply additional monitoring, treatment, augmentation or replacement of the impacted supply may become necessary. The hydrogeology of the Keewatin/Nashwauk area limits the available options to the following:

- Increased monitoring or changes to the monitoring plan if suspected impacts do not immediately threaten the City's ability to supply water.
- Modification of existing facilities including lowering, or replacing, existing pumps and deepening wells.
- New wells drilled in the BIF Aquifer in areas where interference effects are not as great.
- New wells drilled in the glacial outwash if areas of sufficient saturated thickness and favorable water quality can be identified.
- A new water treatment system to treat surface water, mine water or affected well water.

The extent of potential interference effects associated with the Project cannot be predicted with certainty at this time. The BIF Aquifer is utilized throughout the area and has the potential to supply adequate amounts of water to satisfy municipal needs. However, a better understanding of the effects of pumping on the BIF Aquifer is required to assess the potential for ongoing use and locations for additional BIF wells.

Glacial outwash deposits are utilized as municipal water sources throughout Minnesota. Although historical publications suggest that glacial outwash deposits are present between Keewatin and Nashwauk, glacial outwash deposits can change significantly over very short distances and specific investigations would be required to identify and assess the suitability for use as sources of water supply.

There are surface water resources in the area that could potentially provide a source of water including lakes that fill old mine pits and underground workings. It is anticipated that such a system would require construction of a surface water treatment plant.

Select References

Grout, F. F., Gruner J. W., Schwartz G. M., and Thiel G. A. (1951) Precambrian Stratigraphy of Minnesota, Bulletin of the Geological Society of America, Volume 62, pages 1017-1078

Walsh, J. F. (2003) Wellhead Protection Plan for the City of Keewatin, Part 1 Delineation of the Wellhead Protection Area (WHPA), Drinking Water Supply Management Area (DWSMA) and Assessments of Well and DWSMA Vulnerability, Minnesota Department of Health, St. Paul, MN, 30 p.

Walsh, J. F. (2007) Wellhead Protection Plan, Part 1, Wellhead Protection Area Delineation, Drinking Water Supply Management Area Delineation, Well and Aquifer Vulnerability Assessments for the City of Nashwauk, Minnesota Department of Health, St. Paul, MN, 43 p.

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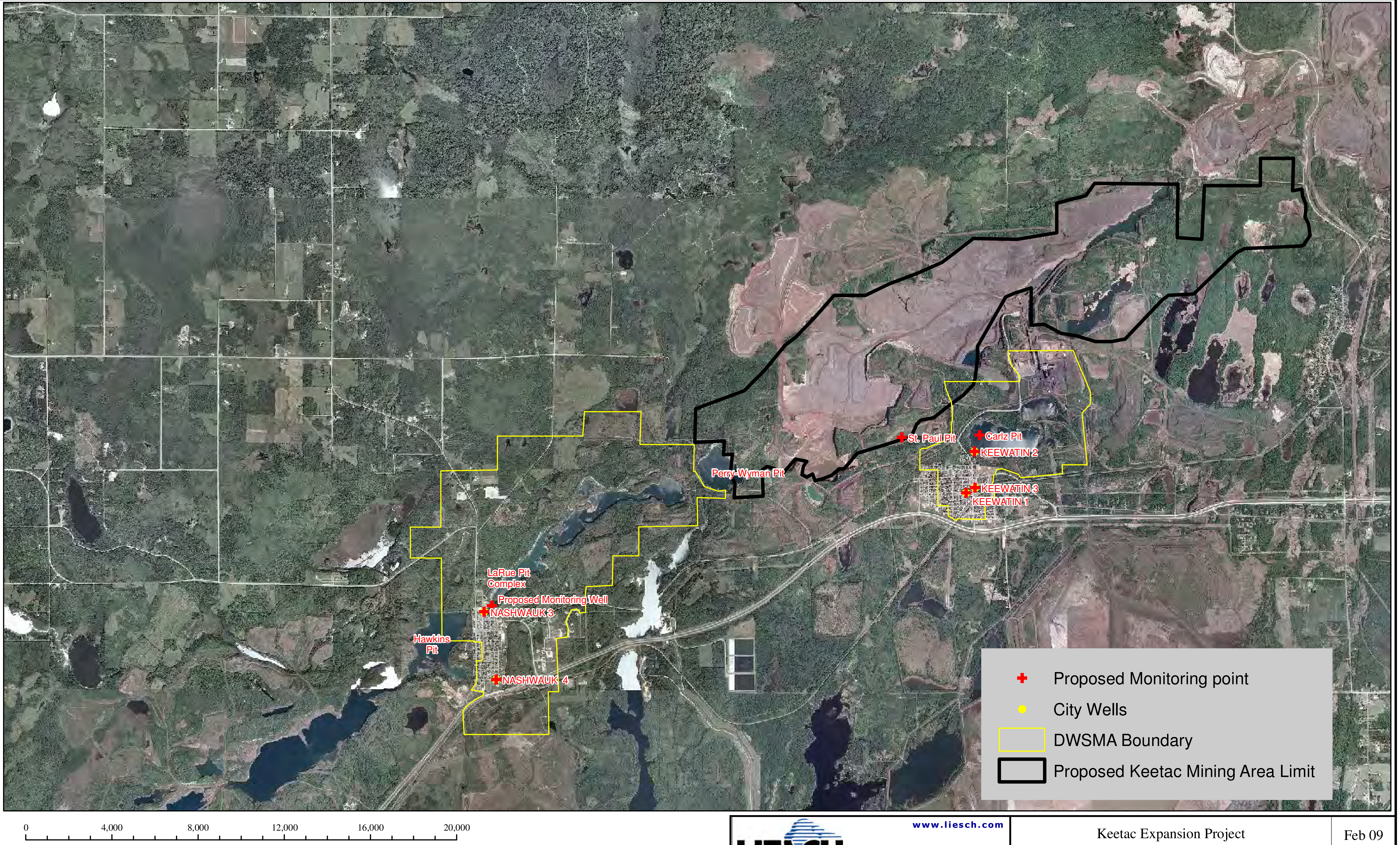
Attachment 1



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Keetac Expansion Project	Feb 09
Location Map Nashwauk and Keewatin Water Supplies	Figure 1

Attachment 2

Unique No. 00192359

County Name Itasca

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

Minnesota Statutes Chapter 1031

Update Date 2002/01/29

Entry Date 1992/08/03

Township Name	Township	Range	Dir	Section	Subsection
	57	22	W	25	ABDC

Well Depth 606 ft. Depth Completed 606 ft. Date Well Completed 1982/11/03

Well Name KEEWATIN 1

Drilling Method Cable Tool

Contact's Name KEEWATIN 1

KEEWATIN MN 55753

Drilling Fluid

Well Hydrofractured? ☐ Yes ☐ No

From ft. to ft.

Use Community Supply (municipal)

Casing Drive Shoe? ☐ Yes ☑ N

Hole Diameter

0 in. to 249 ft

in. to 606 ft

Casing Diameter Weight(lbs/ft)

8 in. to 249 ft 28

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO
CLAY			0	40
QUICKSAND			40	50
CLAY			50	80
QUICKSAND			80	90
CLAY			90	180
SLATE			180	211
DISSEMINATED TACONITE			211	216
DISSEM. CHERTY & SLATY			216	281
DISSEM. CHERTY & SLATY			281	471
DISSEM. CHERTY TAC. & P			471	481
PAINT ROCK NON-MAG.			481	491
DISSEM. CHERTY TAC. & P			491	496
PORUS DISSEM. CHERTY T			496	526
POURS DISSEM. CHERTY T			526	606

Screen N

Open Hole From 249 ft. to 606 ft.

Make Type

Static Water Level 86 ft. from Land surface Date 1982/10/13

PUMPING LEVEL (below land surface)

ft. after hrs. pumping g.p.m.

Well Head Completion

Pitless adapter mfr Model

Casing Protection ☑ 12 in. above grade

☐ At-grade(Environmental Wells and Borings ONLY)

Grouting Information Well grouted? ☑ Yes ☐ No

Material	From	To (ft.)	Amount(yds/bags)	
G	0	185	239	Y
G	185	223	22	Y
G	223	249	0.3	Y

Nearest Known Source of Contamination

50 ft. direction type

Well disinfected upon completion? ☑ Yes ☐ No

Pump ☐ Not Installed Date Installed Y

Mfr name RED JACKET

Model HP 60 Volts 460

Drop Pipe Length 441 ft. Capacity 375 g.p.m

Type S

Any not in use and not sealed well(s) on property? ☐ Yes ☐ No

Was a variance granted from the MDH for this Well? ☐ Yes ☐ No

REMARKS, ELEVATION, SOURCE OF DATA, etc.

ORIGIN CASING 12 INCH DIAMETER TO 217 FEET.

WELL ORIGINALLY DRILLED BY MCCARTHY WELL CO. APRIL 1952.

USGS Quad: Keewatin Elevation: 1473

Aquifer: PEBI Alt Id: 79-2192

Well CONTRACTOR CERTIFICATION Lic. Or Reg. No. 69183

License Business Name

Name of Driller PETERSON, D.

Report Copy

Unique No. 00228828

County Name Itasca

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

Minnesota Statutes Chapter 1031

Update Date 2004/03/10

Entry Date 1992/08/03

Township Name	Township	Range	Dir	Section	Subsection
	57	22	W	24	DCDABB

Well Depth 473 ft. **Depth Completed** 473 ft. **Date Well Completed** 1951/00/00

Well Name KEEWATIN 2

Drilling Method Cable Tool

Contact's Name KEEWATIN 2

KEEWATIN MN 55753

Drilling Fluid

Well Hydrofractured? ☐ Yes ☐ No

From ft. to ft.

Use Community Supply (municipal)

Casing **Drive Shoe?** ☐ Yes ☐ N

Hole Diameter

Casing Diameter **Weight(lbs/ft)**

10 in. to 344 ft

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO
CLAY	BLUE		0	6
CLAY & BIG STONES	BLUE		6	10
CLAY & BIG STONES, SAND	RED		10	24
CLAY & BIG BOULDERS	BLUE		24	29
CLAY	BLUE		29	58
SANDY CLAY, SOME GRAV			58	73
MUDDY SAND & BIG STONE			73	82
SANDY CLAY	BLUE	HARD	82	90
CLAY	BLUE	HARD	90	115
SLATE			115	124
DECOMPOSED TANCONITE			124	130
SOLID TACONITE			130	133
DECOMPOSED TACONITE			133	143
PAINTY DECOMPOSED TAC			143	165
DECOMPOSED TACONITE			165	170
PAINTY DECOMPOSED TAC			170	201
DECOMPOSED TACONITE			201	205
TACONITE		V.HARD	205	208
DECOMPOSED PAINTY CUT			208	212
SANDY DECOMPOSED TAC			212	220
SOLID TACONITE LITTLE SL			220	224
DECOMPOSED TACONITE L			224	230
SLATY TACONITE			230	345
DECOMPOSED TACONITE			345	350
DEC. TACONITE & PAINT R			350	355
PAINT ROCK			355	365
SAND & ORE (WATER)			365	369
CHERTY TACONITE			369	374

Screen N

Open Hole From 344 ft. to 473 ft.

Make Type

Static Water Level 279 ft. from Land surface Date 1951/00/00

PUMPING LEVEL (below land surface)

324 ft. after hrs. pumping 280 g.p.m.

Well Head Completion

Pitless adapter mfr Model

Casing Protection ☐ 12 in. above grade

☐ At-grade(Environmental Wells and Borings ONLY)

Grouting Information Well grouted? ☐ Yes ☐ No

Nearest Known Source of Contamination

ft. direction type

Well disinfected upon completion? ☐ Yes ☐ No

Pump ☐ Not Installed Date Installed Y

Mfr name

Model HP 60 Volts

Drop Pipe Length ft. Capacity g.p.m

Type

Any not in use and not sealed well(s) on property? ☐ Yes ☐ No

REMARKS, ELEVATION, SOURCE OF DATA, etc.

WELL DEEPENED FROM 374 TO APPROX.473 AROUND 1960,
CASING IS SLOTTED FROM 344-374

USGS Quad:	Keewatin	Elevation:	1457
Aquifer:	PEBI	Alt Id:	79-2192

Was a variance granted from the MDH for this Well? ☐ Yes ☐ No

Well CONTRACTOR CERTIFICATION Lic. Or Reg. No. 27022

License Business Name

Name of Driller MCCARTHY

Report Copy

HE-01205-06 (Rev. 9/96)

Unique No. 00751520

County Name Itasca

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

Minnesota Statutes Chapter 1031

Update Date 2007/10/01

Entry Date 2007/08/23

Township Name	Township	Range	Dir	Section	Subsection
	57	22	W	25	ABDADB

Well Depth 615 ft. **Depth Completed** 615 ft. **Date Well Completed** 2007/08/16

Well Name KEEWATIN 3

Drilling Method Multiple methods used

Contact's Name CITY OF KEEWATIN
P. O. BOX 190
KEEWATIN MN 55753

Drilling Fluid Water

Well Hydrofractured? ☐ Yes ☑ No
From ft. to ft.

Use Community Supply (municipal)

Well Owner's Name KEEWATIN 3
2ND E AV
KEEWATIN MN 55753

Casing **Drive Shoe?** ☐ Yes ☐ N

Hole Diameter

in. to	80 ft
in. to	198 ft
in. to	615 ft

Casing Diameter **Weight(lbs/ft)**

18 in. to	80 ft	70.59
12 in. to	198 ft	49.56

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO
FILL	BROW	SOFT	0	3
CLAY	BROW	SOFT	3	7
SAND, GRAVEL, ROCKS	BROW	SOFT	7	20
SANDY CLAY	BROW	SOFT	20	22
SAND & GRAVEL	BROW	SOFT	22	32
GRAVEL & CLAY LAYERS	BROW	SOFT	32	35
CLAY & GRAVEL	GRAY	SOFT	35	163
SLATE & CLAY LAYERS	BLACK	V.SOFT	163	164
SLATE & CLAY LAYERS	BLACK	V.SOFT	164	168
SLATE & CLAY LAYERS (SO	BLK/G	V.SOFT	168	190
SLATE & QUARTZ	BLACK	SFT-MED	190	195
SLATE & QUARTZ	BLACK	SFT-MED	195	245
SLATE	GRN/G	SFT-MED	245	265
SLATE & TACONITE (MAGN	GRN/B	MED-HRD	265	315
TACONITE (MAGNETIC) GR	VARIE	HARD	315	450
TACONITE (MAGNETIC) RU	VARIE	MED-HRD	450	470
TACONITE (MAGNETIC)	VARIE	HARD	470	585
TACONITE (MAGNETIC)	GRN/G	HARD	585	615

Screen N **Open Hole** From 198 ft. to 615 ft.
Make Type

Static Water Level 186 ft. from Land surface Date 2007/08/16

PUMPING LEVEL (below land surface)
370 ft. after 6 hrs. pumping 450 g.p.m.

Well Head Completion
Pitless adapter mfr Model
Casing Protection ☑ 12 in. above grade
☐ At-grade(Environmental Wells and Borings ONLY)

Grouting Information Well grouted? ☑ Yes ☐ No

Material	From	To (ft.)	Amount(yds/bags)	
G		80	3	Y

Nearest Known Source of Contamination
100 ft. direction E type SEW
Well disinfected upon completion? ☐ Yes ☐ No

Pump ☑ Not Installed Date Installed N
Mfr name
Model HP Volts
Drop Pipe Length ft. Capacity g.p.m
Type

Any not in use and not sealed well(s) on property? ☐ Yes ☑ No

Was a variance granted from the MDH for this Well? ☐ Yes ☑ No

REMARKS, ELEVATION, SOURCE OF DATA, etc.

CALIPER, MULTI TOOL, & FLOW METERED 9-12-2007. LOGGED FOR MDH.

GAMMA LOGGED 8-31-2007. M.G.S. NO. 4741. LOGGED BY JIM TRAEN.

USGS Quad: Keewatin Elevation: 1472
Aquifer: PEBI Alt Id: 4741

Well CONTRACTOR CERTIFICATION Lic. Or Reg. No. 1404
License Business Name
Name of Driller TONY/DAN

Report Copy

Unique No. 00241017
County Name Itasca

MINNESOTA DEPARTMENT OF HEALTH
WELL AND BORING RECORD
Minnesota Statutes Chapter 1031

Update Date 2005/06/23
Entry Date 1992/08/03

Township Name	Township	Range	Dir	Section	Subsection
	57	22	W	32	BACD

Well Depth 414 ft. Depth Completed 414 ft. Date Well Completed 1930/00/00

Well Name NASHWAUK 3

Drilling Method

Drilling Fluid

Well Hydrofractured? ☐ Yes ☐ No
From ft. to ft.

Use Community Supply (municipal)

Casing Drive Shoe? ☐ Yes ☐ N

Hole Diameter

Casing Diameter Weight(lbs/ft)
8 in. to 40 ft

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO
DRIFT			0	110
BIWABIK OXIDES OF IRON			110	210
BIWABIK, MASSIVE IRON F			210	414

Screen
Make Type

Open Hole From ft. to ft.

Static Water Level ft. from Date

PUMPING LEVEL (below land surface)
ft. after hrs. pumping g.p.m.

Well Head Completion
Pitless adapter mfr Model
Casing Protection ☐ 12 in. above grade
☐ At-grade(Environmental Wells and Borings ONLY)

Grouting Information Well grouted? ☐ Yes ☐ No

Nearest Known Source of Contamination
ft. direction type
Well disinfected upon completion? ☐ Yes ☐ No

Pump ☐ Not Installed Date Installed
Mfr name
Model HP Volts
Drop Pipe Length ft. Capacity 450 g.p.m
Type T

Any not in use and not sealed well(s) on property? ☐ Yes ☐ No

Was a variance granted from the MDH for this Well? ☐ Yes ☐ No

Well CONTRACTOR CERTIFICATION Lic. Or Reg. No.
License Business Name
Name of Driller

REMARKS, ELEVATION, SOURCE OF DATA, etc.
DATE OF SAMPLE 11/73
INFO FROM CITY CLERK

USGS Quad: Nashwauk Elevation: 1489
Aquifer: PEBI Alt Id: 75-2151

Report Copy

Unique No. 00228819

County Name Itasca

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

Minnesota Statutes Chapter 1031

Update Date 2005/06/23

Entry Date 1992/08/03

Township Name	Township	Range	Dir	Section	Subsection
	57	22	W	32	CDAD

Well Depth 540 ft. **Depth Completed** 540 ft. **Date Well Completed** 1947/00/00

Well Name NASHWAUK 4

Drilling Method

Drilling Fluid

Well Hydrofractured? ☐ Yes ☐ No
From ft. to ft.

Use Community Supply (municipal)

Casing **Drive Shoe?** ☐ Yes ☐ N

Hole Diameter

Casing Diameter **Weight(lbs/ft)**

16 in. to 150 ft

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO
UPPER SLATEY ABSENT			0	144
UPPER CHERTY			144	335
LOWER SLATE			330	345
LOWER CHERTY MEMBER			345	540

Screen

Open Hole From ft. to ft.

Make Type

Static Water Level 150 ft. from Land surface Date

PUMPING LEVEL (below land surface)

ft. after hrs. pumping g.p.m.

Well Head Completion

Pitless adapter mfr Model

Casing Protection ☐ 12 in. above grade

☐ At-grade(Environmental Wells and Borings ONLY)

Grouting Information Well grouted? ☐ Yes ☐ No

Nearest Known Source of Contamination

ft. direction type

Well disinfected upon completion? ☐ Yes ☐ No

Pump ☐ Not Installed Date Installed

Mfr name

Model HP Volts

Drop Pipe Length ft. Capacity 450 g.p.m

Type T

Any not in use and not sealed well(s) on property? ☐ Yes ☐ No

Was a variance granted from the MDH for this Well? ☐ Yes ☐ No

REMARKS, ELEVATION, SOURCE OF DATA, etc.

LOCATED BY CITY CLERK

USGS Quad: Pengilly

Elevation: 1439

Aquifer: PEBI

Alt Id: 1310024S02

Well CONTRACTOR CERTIFICATION Lic. Or Reg. No.

License Business Name

Name of Driller

Report Copy

Attachment 3

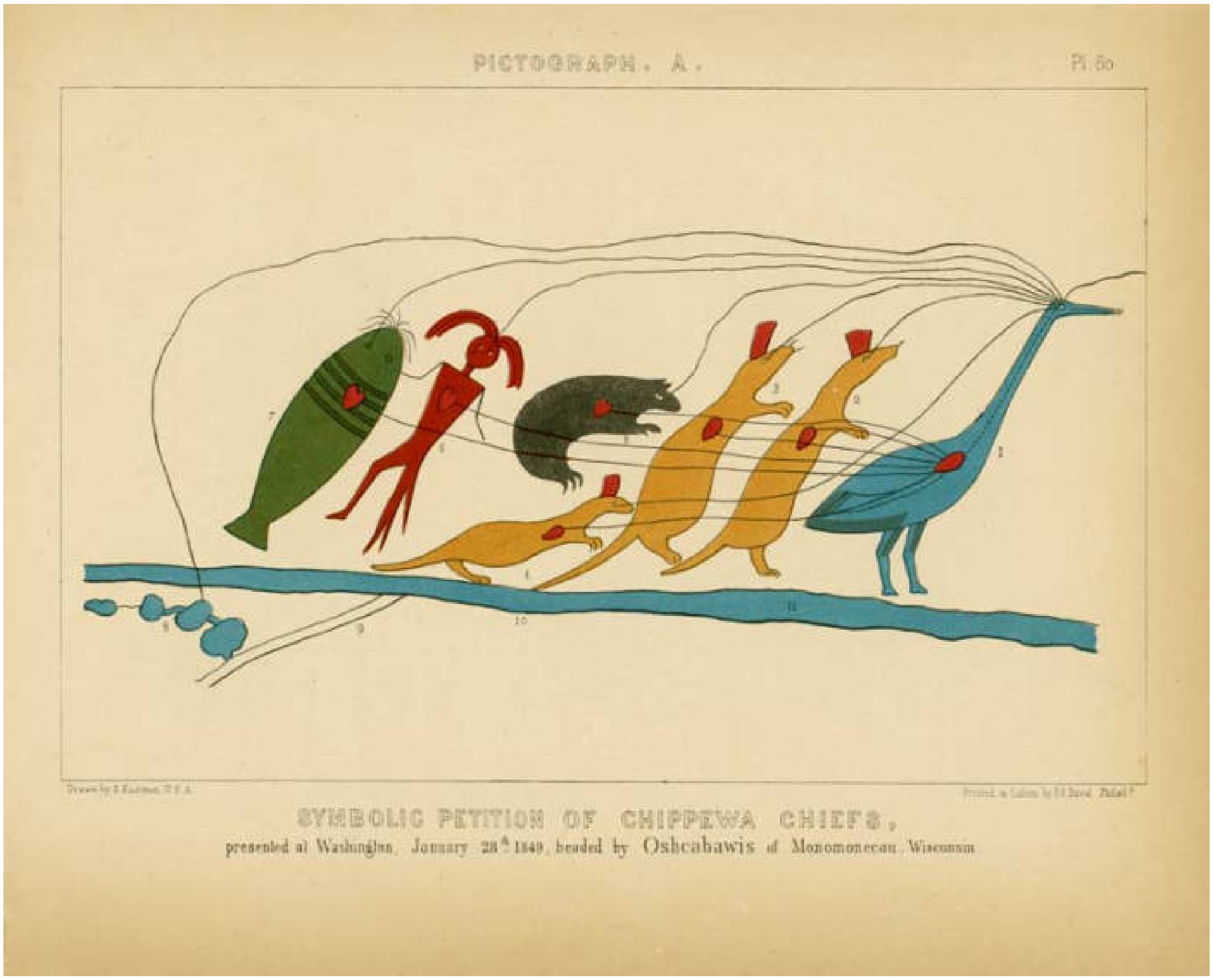
Table 5 - Baseline and Annual Sampling Lists

Baseline List

Analyte	Units
Gross Alpha	pCI/L
Gross Beta	pCI/L
Uranium	ug/L
Radium 226	pCI/L
Radium 228	pCI/L
Radon 222	pCI/L
Alkalinity, Total	mg/L
Arsenic	mg/L
Barium	mg/L
Cadmium	mg/L
Calcium	mg/L
Carbonate/Bicarbonate	mg/L
Chloride	mg/L
Chromium	mg/L
Fluoride	mg/L
Hardness, Total	mg/L
Iron	mg/L
pH, Lab	units
Lead	mg/L
Magnesium	mg/L
Manganese	mg/L
Mercury	mg/L
Nitrogen, Nitrate +Nitrite	mg/L
Potassium	mg/L
Selenium	mg/L
Silver	mg/L
Sodium	mg/L
Sulfate	mg/L
Thallium	mg/L
Dissolved Solids, Total	mg/L
Cation/Anion Ballance	--
Volatile Organic Compounds 465 F	ug/l

Annual List

Analyte	Units
Alkalinity, Total	mg/L
Arsenic	mg/L
Barium	mg/L
Cadmium	mg/L
Calcium	mg/L
Carbonate/Bicarbonate	mg/L
Chloride	mg/L
Chromium	mg/L
Fluoride	mg/L
Hardness, Total	mg/L
Iron	mg/L
pH, Lab	units
Lead	mg/L
Magnesium	mg/L
Manganese	mg/L
Mercury	mg/L
Nitrogen, Nitrate +Nitrite	mg/L
Potassium	mg/L
Selenium	mg/L
Silver	mg/L
Sodium	mg/L
Sulfate	mg/L
Thallium	mg/L
Dissolved Solids, Total	mg/L
Cation/Anion Ballance	--



Tribal Cooperating Agencies Cumulative Effects Analysis

NorthMet Mining Project and Land Exchange

Prepared by staff from the Bois Forte Band of Chippewa, the Fond du Lac Band of Lake Superior Chippewa, the Grand Portage Band of Lake Superior Chippewa, the Great Lakes Indian Fish and Wildlife Commission, and the 1854 Treaty Authority

September 2013

Tribal Cooperating Agencies Cumulative Effects Analysis

NorthMet Mining Project and Land Exchange

In Chapter 6 of the *Preliminary Supplemental Draft Environmental Impact Statement (PSDEIS) for the NorthMet Mining Project and Land Exchange*, the co-lead agencies present a resource-specific cumulative effects analysis (CEA) for the NorthMet Project Proposed Action and Land Exchange Proposed Action that may result when combined with effects from other activities. It acknowledges that in addition to additive effects, cumulative effects may be further magnified by synergisms or cross-interactions in the environment. The analysis was developed by the co-lead agencies and their third-party contractor with consideration of the 1997 CEQ guidance *Considering Cumulative Effects under the National Environmental Policy Act* and EPA's 1999 NEPA review guidance *Consideration of Cumulative Impact in EPA Review of NEPA Documents.* However, despite specific and repeated requests from tribal cooperating agencies, the co-lead agencies did not elect to utilize a tool developed in 2011 by the EPA in cooperation with tribes, *Applying Cumulative Impact Analysis Tools to Tribes and Tribal Lands*, in order to discern potential cumulative effects to resources important to the tribes who retain usufructuary rights within the 1854 Ceded Territory. The NorthMet Project Proposed Action and Land Exchange Proposed Action are both located entirely within the boundaries of the 1854 Ceded Territory (Figure 1).

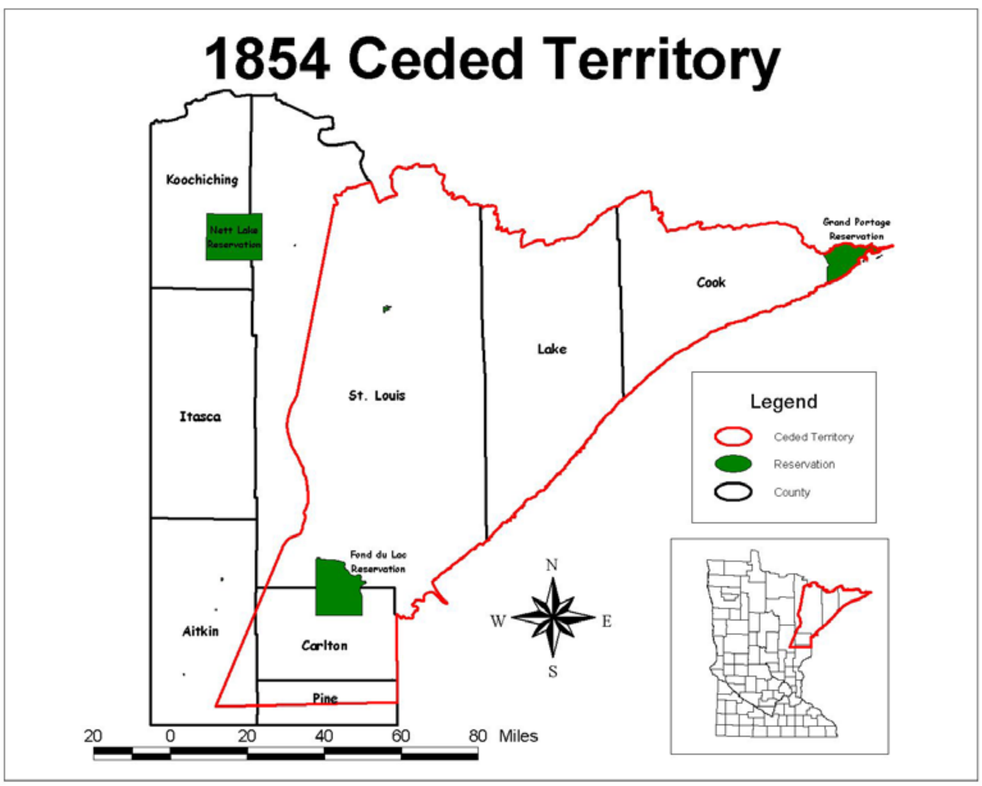


Figure 1.1854 Ceded Territory.

The Fond du Lac, Bois Forte, and Grand Portage Bands, as well as the 1854 Treaty Authority (1854) and the Great Lakes Indian Fish & Wildlife Commission (GLIFWC), have consistently advocated for a more robust, comprehensive CEA for the PolyMet NorthMet project and other mining projects. We have observed that current, historic, and 'reasonably foreseeable' mining activities have profoundly and, in many cases permanently, degraded vast areas of forests, wetlands, air and water resources, wildlife habitat, cultural sites and other critical treaty-protected resources within the 1854 Ceded Territory. As we have engaged with the lead federal and state agencies for the environmental review process under NEPA and the tribal consultation process under §106 of the National Historic Preservation Act (NHPA), we have clearly expressed our concerns for the incompleteness and inadequacy of their CEA.

In the 2008 CPDEIS section 2.2, Issues Identified During the EIS Scoping Process, it is stated that "The MnDNR and USACE determined that the following topics are not expected to present significant impacts, but would be addressed in the EIS using limited information beyond that provided in the Scoping EAW commensurate with the anticipated impacts: Cover Types; Vehicle Related Air Emissions; Air Emissions; Noise; Archeology; Visibility; Compatibility with Plans and Land Use Regulations; Infrastructure; Asbestiform Fibers; and 1854 Ceded Territory". Yet none of these resource categories or issues was fully evaluated from the standpoint of describing cumulative effects at spatial or temporal scales that the tribes find relevant, either in the earlier environmental impacts analysis or the current SDEIS process. The tribal cooperating agencies' perspectives on the resource-specific temporal and spatial boundaries for the CEA are significantly different from the co-lead agencies. Additionally, many of the tribal cooperating agencies' assumptions regarding predicted effects of the proposed actions (both the project and the land exchange) and the predicted success of proposed mitigations are significantly different from the co-lead agencies. Therefore, the tribal cooperating agencies have undertaken an alternative cumulative effects analysis, considering impacts to multiple resource categories to the extent we were able to do in the brief time within which we have been able review the draft PSDEIS, provide comments, and identify major differences of opinion.

In this CEA, we will be presenting major differences of opinion regarding cumulative effects to the 1854 Ceded Territory, Tribal Historic District (Figure 2) and the St. Louis River watershed. In addition, our analysis of the No-Action Alternative assumes current legal and regulatory requirements to remediate pollution from previous mining activities will, if implemented and enforced, lead to resource conditions that are substantially improved from their current degraded condition.

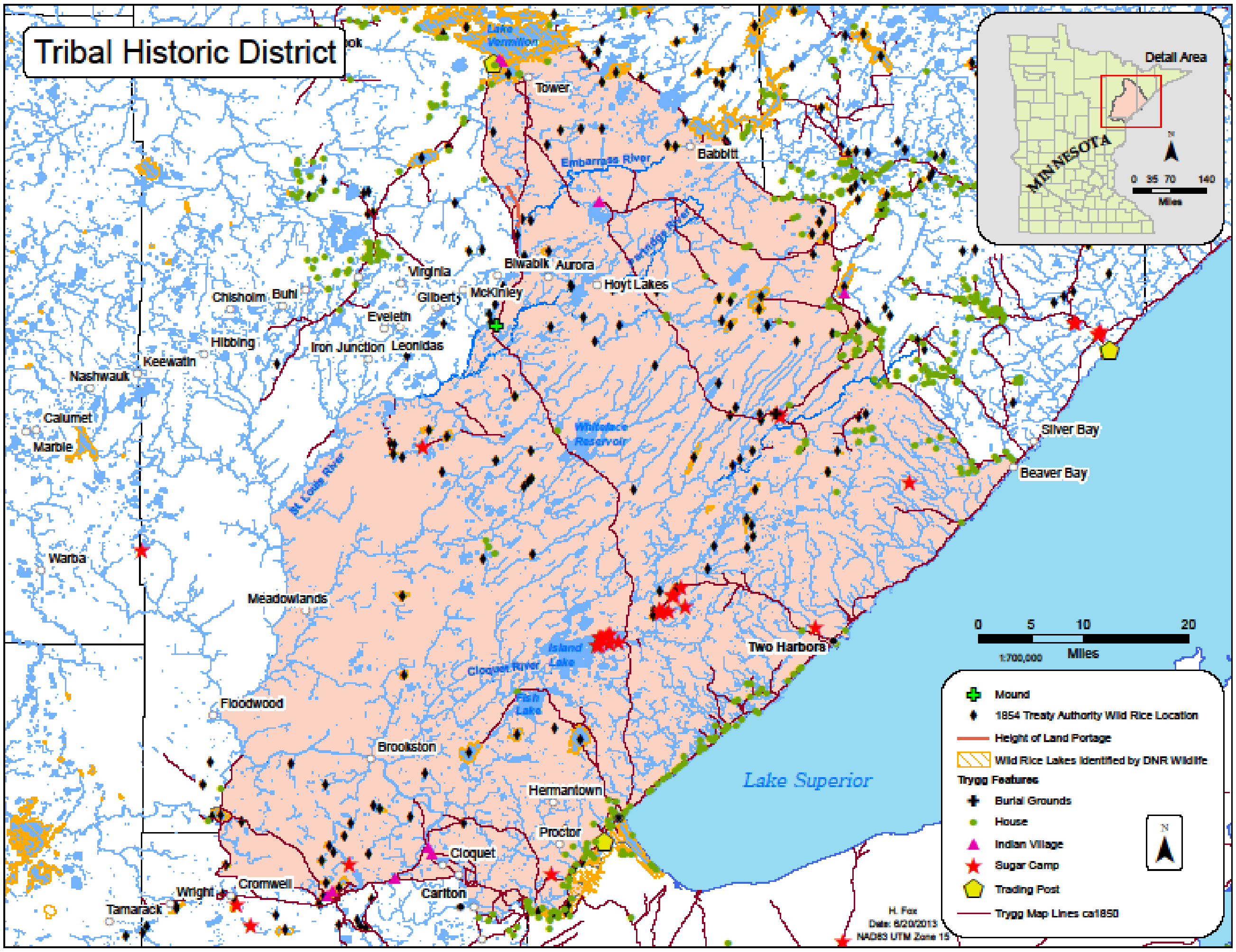


Figure 2. Tribal Historic District.

The tribal cooperating agencies use a resource-specific GIS-based approach as defined in the 2011 guidance to generate an alternative CEA that more accurately accounts for cumulative impacts to resources of tribal significance. From: *Applying Cumulative Impact Analysis Tools to Tribes and Tribal Lands:*

> The National Environmental Policy Act (NEPA) requires Federal agencies to evaluate the environmental impacts of their major projects. The scope of a federal Environmental Impact Statement (EIS) is spelled out in the NEPA legislation, in guidance documents published by the Council on Environmental Quality (CEQ) and EPA, and in various federal agencies' promulgated rules for implementing NEPA. An EIS evaluates the project's impacts to natural resources, the human environment, historical properties, and cultural properties. EIS documents are submitted for public review. Under Section 309 of the Clean Air Act, EPA is required to review and publicly comment on the environmental impacts of major federal actions including actions which are the subject of EISs.
>
> The assessment of cumulative impacts in NEPA documents is required by CEQ regulations. A cumulative impact is "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time." (Title 40 Code of Federal Regulations (CFR) Section 1508.7, CEQ Regulations for Implementing NEPA, 1987). Only resources that are directly impacted or indirectly affected by an action are subject to a cumulative impacts analysis….
>
> In 1984, EPA issued its Indian Policy stressing two related themes: EPA will (1) pursue the principle of Indian self-government and (2) work directly with tribal governments on a government-to-government basis. Consistent with this Indian Policy and other EPA's statutory and regulatory authorities, EPA will identify and consider potential effects to reservation environments and take these potential effects into account as the Agency fulfills its regulatory duties. As a regulatory agency, EPA does not manage tribal trust resources or treaty resources in ceded territory. The U.S. Department of Interior, Bureau of Indian Affairs, does manage tribal trust resources. However, the Agency acknowledges its general trust responsibility to tribal governments which derives from the historical relationship between the Federal government and Indian tribes as expressed in certain treaties and Federal Indian laws, and understands that its regulatory activities can affect tribes.
>
> Tribal lands are fixed; that is the reservations, Indian lands, and ceded territories are specific places, defined by treaty, and tribes may hold certain rights within these areas. In addition, tribal cultural identity may be tied to specific areas, cultural properties, natural resources found within these areas or properties, and traditions and uses involving these places and resources. For this reason, tribes are not considered mobile. For these

reasons, many tribes have expressed interest and concern about cumulative impacts of actions relative to the areas they govern and/or use….

Tribal concerns about impacts to natural and cultural resources and properties and to their particular uses may include, but are not limited to the following:

- Water with naturally high quality and impacts involving -
    - Changes in concentrations of unregulated substances
    - Synergistic effects of multiple individually unregulated or regulated substances
    - Changes to water that make it unsuitable for cultural uses
- Lakes, rivers, wetlands, and other water bodies where plants of significance to tribes grow (e.g., wild rice)
- Water quality and quantity and soil quality that enable wild rice to grow
- Water quality necessary to support fish populations
- Plants and wildlife (e.g., moose, grouse, deer) of significance to tribes
- Sufficient wildlife populations and habitat to support traditional hunting, fishing, and gathering
- Fish and wildlife without contaminants that preclude their frequent consumption
- Archeological locations or areas
- Traditional or historic properties, locations or areas (e.g., traditional locations for hunting, fishing, and gathering; springs and ceremonial sites; other places where historic events occurred)
- Sacred locations or areas (e.g., gravesites, spiritual sites) without visual or noise impacts that would make them unsuitable for traditional activities
- Habitats that host culturally important resources (e.g., pipestone, sage, other culturally important plants)
- Access to areas where tribes have hunting, fishing, or gathering rights and to lands where off-reservation harvest under treaty rights occurs, including trails or passageways that link tribal use areas.
- Cultural items as defined by the Native American Graves Protection and Repatriation Act, 25 United States Code (USC) 3001, including funerary objects, sacred objects, and cultural patrimony
- Social bonds associated with traditional activities
- Tribal jurisdiction and control over reservation lands, thus improving or maintaining quality of life for residents of the reservations

An EIS that addresses cumulative impacts with respect to tribal uses and practices related to natural and cultural resources and properties should consider an analysis approach that uses:

1. A geographic area that is relevant to the tribe, for which information is collected and evaluated,

2. Information that reflects and describes tribal uses and tribal rights, and

3. A timeframe that is relevant to tribal uses.

In short, considering cumulative impacts to tribes may require a wider focus area and a discussion of direct and indirect impacts of all projects in an area, relative to tribal traditions, values, and concerns that involve using the resources affected by the project.

Regarding the geographic scope for a tribally relevant cumulative effects analysis:

- Scale is a central issue in the ecosystem approach.
- The appropriate boundary is one that ensures adequate consideration of all resources that are potentially subject to non-trivial impacts.
- For some resources, that boundary can be very large. For example, the long-range atmospheric transport of nutrients and contaminants into water bodies such as the Great Lakes and Chesapeake Bay transcends even the boundaries of their vast watersheds.
- At the other end of the spectrum, significant contributions to biodiversity protection can be made by identifying and avoiding small sensitive areas, such as rare plant communities.
- Determining relevant boundaries for assessment is guided by informed judgment, based on the resources potentially affected by an action and its predicted impacts.

The 1997 CEQ document notes that, for a project-specific analysis, it is often sufficient to analyze impacts within the immediate area of the proposed action. When analyzing the proposed action's contribution to cumulative impacts, however, the geographic boundaries of the area should almost always be expanded. Project-specific analyses are usually conducted on the scale of forest management units, or facility footprints, or mixing zone in a waterbody pursuant to a discharge permit. Cumulative impacts analysis should be conducted in the scale of human communities, landscapes, watersheds, or airsheds.

Finally, EPA's 1999 document notes that the EPA reviewer can determine an appropriate spatial scope of the cumulative impact analysis by identifying a geographic area that includes resources potentially affected by the proposed project and extending that area, when necessary, to include the same and other resources affected by the combined impacts of the project and other actions. Furthermore:

- Geographical boundaries should not be extended to the point that the analysis becomes unwieldy and useless for decision-making.

- The analysis should use an ecological region boundary that focuses on the natural units that constitute the resources of concern.

- For non-ecological resources, other geographic areas, such as historic districts (for cultural resources) or metropolitan areas (for economics), should be used.

Cultural Resources

During the EIS scoping process for the NorthMet Project (see Section 2.1 of the Final Scoping Decision Document), no cumulative impact issues associated with cultural resources were identified. Tribes were not invited to participate in scoping. However, Tribal comments on the June 2008 PDEIS, the 2009 CPDEIS and the 2009 DEIS noted this cumulative impact and the need for analysis. The tribal cooperating agencies have repeatedly stated and commented in writing that there likely will be substantial impacts to cultural resources, and impacts to cultural resources need to be fully integrated into evaluation of potential impacts to cultural sites and cultural resources. However, there appears to be a concerted effort to diminish any and all comments on this subject and simply revert back to decisions made during the scoping phase.

The Traditional Use Survey conducted in 2011 (Latady and Isham 2011) focused on identifying and evaluating significance of places of importance to the Bands within the area to be affected by the proposed mine. Identification and evaluation is the first step before assessing adverse effects and integral to the development of a cultural resource management plan to facilitate preservation and management of cultural resources including traditional use areas. Beyond identification, the intent of the survey highlighted the potential to bridge the past and future in terms of native culture, history and natural resources.

Tribal cooperating agencies consider a 216,300 acre area bounded by the St Louis River, Lake Superior, Lake Vermilion and the Beaver Bay to Vermilion Trail to be a Tribal Historic District, and the pertinent area for consideration of cumulative effects to cultural resources. In addition to the St Louis River, the area supports three major drainage systems, the Cloquet, Embarrass and Pike Rivers. Trygg maps (1966), historic documents (Brownell 1967, Carey 1936, Chester 1902, Lancaster 2009, Trygg 1969, Van Brunt 1922, Jenks 1901, Moyle 1941) and information contained in site files located at the Bois Forte Tribal Historic Preservation Office were used to determine the extent of the district. Additional information on Historic places and properties are available at SHPO, Superior National Forest Headquarters and Duluth Archaeology Center. Included within the proposed historic district are the headwaters of the St. Louis River, the site of ongoing mineral exploration.

Ancestors of present day Band members resided in this area for centuries and many Band members followed traditional practices extensively until about a generation ago when the effects of mining devastated the rice beds in the Embarrass and St. Louis River watersheds and closed access to large tracts of public (USFS) land where traditional harvest and collection areas occur. This proposed Tribal Historic District encompasses complex trail systems, Indian villages, trading posts, encampments for fishing, hunting, wild rice harvest and processing, sugar bush, and other traditional subsistence practices. It includes what was essentially a 'water highway' used by the Ojibwe at the time of European contact, and subsequently by Voyaguers during the era of heavy fur trading. In addition, numerous medicinal plant gathering sites, Midewewin lodges, vision quest locales and other sacred places occur.

Land Use

The co-lead agencies define the CEAA for land use to include effects associated with the NorthMet Project Proposed Action combined with other industrial (including mining) or public works projects located within the portion of the Mesabi Iron Range encompassed by St. Louis County". Tribal cooperating agencies believe the CEA for land use should encompass the 1854 Ceded Territory, as the signatory Bands have lost access to substantial portions of the 1854 CT and the resources within (Figure 3). The 1854 Ceded Territory encompasses 6,283,836 acres in North Eastern Minnesota. Of that, 4,095,146 acres are public land ranging from Federal to CRP lands. The remaining 2,188,578 is private to private industrial land[1]. Band members generally do not exercise usufructuary rights on private lands without landowner permission, although the treaty does not hold that restriction. Lands within the 1854 Ceded Territory that have experienced urban and/or industrial development are permanently 'lost' as a source of treaty resources.

[1] http://deli.dnr.state.mn.us/data_catalog.html using GAP Stewardship 2008 – all Ownership Types shape file and database

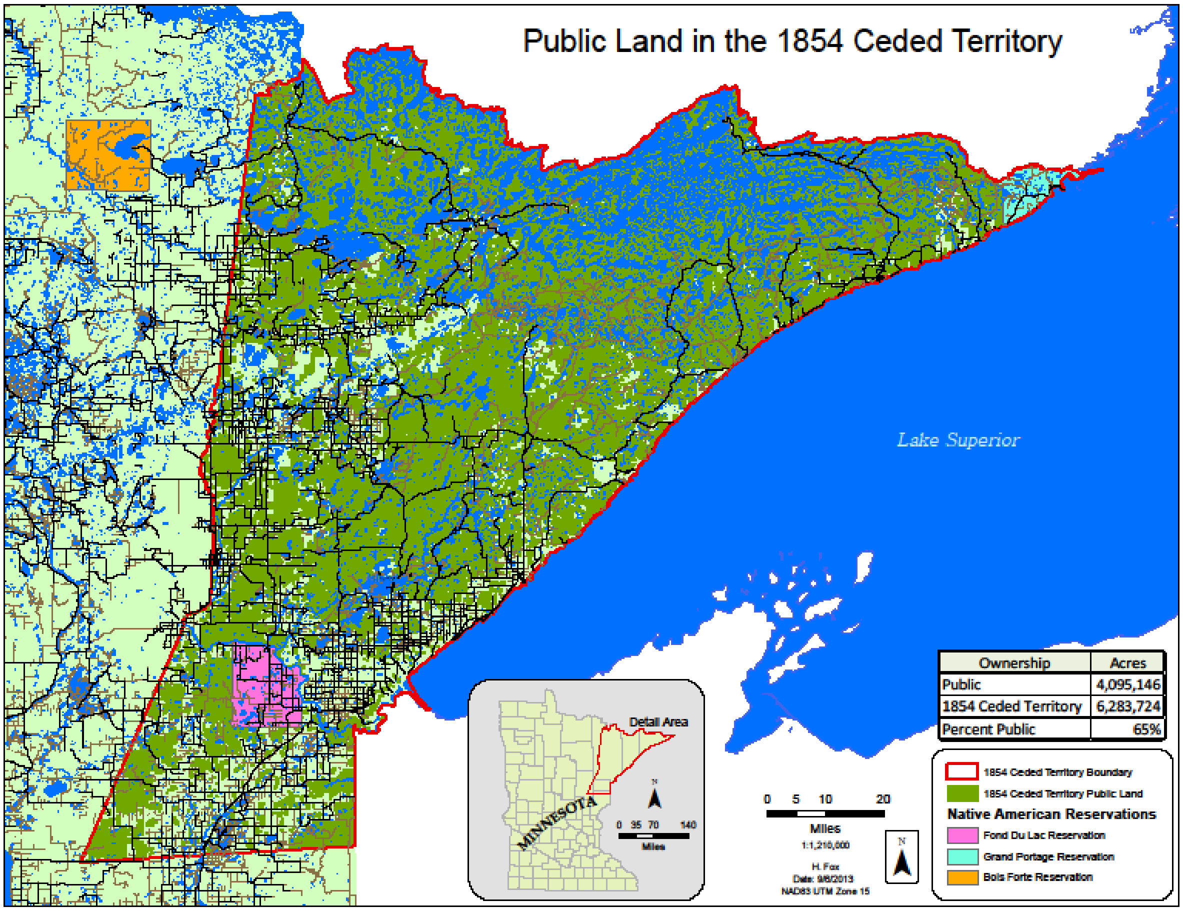


Figure 3. Public Lands within the 1854 Ceded Territory

Water Resources

The co-lead agencies evaluated cumulative impacts to surface water within the Partridge and Embarrass River watersheds only. From the preliminary SDEIS: "The St. Louis River was considered for inclusion in the cumulative effects assessment. The NorthMet Project Proposed Action is predicted to meet all water quality evaluation criteria or not make concentrations worse. Further, concentrations of sulfate and mercury, two key constituents of concern, are predicted to decrease as a result of the NorthMet Project Proposed Action. The NorthMet Project Proposed Action would also result in only minor changes in hydrology within the Partridge River and Embarrass River. Therefore, the NorthMet Project Proposed Action is not considered to have the potential for cumulative effects on hydrology and water quality in the St. Louis River. As a result, the CEAA for surface water is defined by the Partridge River and Embarrass River watersheds as shown on Figure 6.2.3-1."

The tribal cooperating agencies believe the relevant spatial scale for water quality and hydrologic cumulative effects analysis is the entire St. Louis River watershed. This watershed has experienced substantial historic, current and proposed expanded mining activities, as well as other industrial, agricultural and urban development. In addition to the direct surface water and wetland impacts (loss and/or degradation) from these activities, nearly half of the watershed has experienced hydrologic alteration from extensive ditching. It is reasonably foreseeable that an additional 3000 acres of wetlands within the watershed will be directly impacted by proposed new mining projects and expansions that are in active permitting and/or environmental review: the PolyMet NorthMet project, Mesabi Nugget Phase II, US Steel Minntac expansion, US Steel Keetac expansion, United Taconite Tailings Basin 3 construction. To date, virtually all required wetland mitigation for mining impacts has been implemented out of the basin, representing a permanent loss of high quality ecological resources and functions.

Modeling

The tribal cooperating agencies' review of the water modeling data packages for the NorthMet Project Proposed Action led to our conclusion that Goldsim did not accurately predict existing conditions, and cannot be relied upon to accurately predict future project conditions. While we feel that modeling of the existing conditions is an inadequate substitute for a realistic No-Action Alternative model and does not follow CEQ guidelines, it appears that Goldsim does not even accurately model existing conditions. As noted in spreadsheet comments submitted June 25, 2013, for many parameters at several waterbodies the No-Action P50 model of annual average value is substantially different than the observed average existing conditions. Because of the inaccuracy of the Goldsim predictions of current conditions it is not clear that use of the Goldsim estimates of project impacts are adequate to ensure protection of water resources. For example:

- PSDEIS Table 4.2.2-18 reports Colby Lake as currently having an observed mean Arsenic of 0.78 to 1.4 ug/L (depending on the data set), whereas Figure 5.2.2-35, the No-Action (continuation of current conditions) P50 model for Colby Lake Arsenic shows annual maximum values of 0.5 ug/L

- PSDEIS Table 4.2.2-34 reports PM-10 (seep at the basin north toe) as having an observed mean Mn value of 100,192 ug/L, whereas Figure F-01-18.1 (Water Modeling Data Package Vol 2-Plant Site v9 MAR2013) shows the No-Action (continuation of existing conditions) P50 as an annual maximum Mn of 390 ug/L. at the north toe.
- PSDEIS Table 4.2.2-34 reports PM-10 as having an observed mean Aluminum of 39.6 ug/L yet Figure F-01-02.1 (Water Modeling Data Package Vol 2-Plant Site v9 MAR2013) shows an annual maximum for No-Action (continuation of existing conditions) at the north toe as 11 ug/L.
- PSDEIS Table 4.2.2-14 shows that observed average SO4 at SW-005 (9.11 mg/L) is nearly identical to the Goldsim P50 predicted current annual maximum for that site (PSDEIS Fig. 5.2.2-27, 9 mg/L). This suggests that Goldsim is under-predicting SO4 at SW-005. (The authors of the text on page 5.2.2-125 of the PSDEIS seem to misinterpret the P50 of the figure as a predicted annual average. This is not the case. The P50 of that figure is the "best" estimate of the annual maximum. The Goldsim model estimate of the annual average at SW-005 is shown as the P50 in Mine Site Data Package Attachment K Figure K-06-24.2, i.e. 6 mg/L) Again, this suggests that Goldsim is underpredicting SO4 at SW-005.
- PSDEIS Table 4.2.2-29 shows that observed average Al at PM-13 is 221 ug/L. This observed average is much higher than the modeled No-Action (continuation of existing conditions) P50 annual maximum (PSDEIS Table 5.2.2-47, 159-166 ug/L). The modeled No-Action P50 annual average for Al at PM-13 of 75 ug/L (attached Fig.I-05-02.2, Water Modeling Data Package Vol 2-Plant Site v9 MAR2013) is only 1/3 of the observed average.

Tables 1-3 below compare the observed existing conditions values found in various PSDEIS tables to the P50 existing conditions predicted by Goldsim. While a very few of these model predictions are presented in the PSDEIS, many are not and therefor, the tables below refer back to the underlying data packages from which the PSDEIS was written.

Parameter (ug/L)	Average existing water quality (PSDEIS Table 4.2.2-14)	Annual average P50 existing conditions predicted by Goldsim (Mine Site Data Package Attach.K)
Mn	SW-002 = 142	SW002 = 80 (Fig.K-01-18.2)
Tl	SW-002 = 0.6	SW002 = 0.11 (Fig.K-01-25.2)
Mn	SW-003 = 147	SW003 = 85 (Fig.K-02-18.2)
B	SW-004a = 126.5	SW004a = 30 (Fig.K-04-05.2)
K	SW-004a = 2,700	SW004a = 1,600 (Fig.K-04-16.2)
SO4	SW-004a = 15,900	SW004a = 8,000 (Fig.K-04-24.2)
Pb	SW-005 = 1.3	SW005 = 0.26 (Fig.K-06-21.2)
SO4	SW-005 = 9,110	SW005 = 6,000 (Fig.K-06-24.2)
Tl	SW-005 = 0.4	SW005 = 0.05 (Fig.K-06-25.2)

Table 1. Observed existing conditions in the Partridge River vs. annual average existing conditions predicted by Goldsim.

Parameter (ug/L)	Colby Lake mean existing water quality (PSDEIS Table 4.2.2-18, Barr data)	Colby Lake Annual average P50 existing conditions predicted by Goldsim (Mine Site Data Package Attach.K)
Al	108	75 (Fig.K-08-02.2)
As	0.78	0.4 (Fig.K-08-04.2)
Cu	2.4	0.7 (Fig.K-08-13.2)
Ni	2.5	1.1 (Fig.K-08-20.2)
SO4	33,800	~10,000 (Fig.K-08-24.2)
Tl	0.1	0.025 (Fig.K-08-25.2)

Table 2. Observed mean existing conditions in Colby Lake vs. annual average existing conditions predicted by Goldsim.

Parameter (ug/L)	Mean seep measured value at Basin Toe (Table 4.2.2-34)	Annual maximum P50 existing condition predicted by Goldsim (Plant Site Data Package Attach.F)
Al	PM-8 = 25.7	West toe = 14 (Fig.F-04-02.1)
AL	PM-9 = 29.9	NW toe = 13 (Fig.F-02-02.1)
AL	PM-10 = 39.6	North toe = 11 (Fig.F-01-02.1)
Mn	PM-8 = 3,039	West toe = 1,250 (Fig.F-04-18.1)
Mn	PM-10 = 100,192	North toe = 380 (Fig.F-01-18.1)
F	PM-8 = 2,900	West toe = 1,100 (Fig.F-04-14.1)
As	PM-8 = 3	West toe = 2 (Fig.F-04-04.1)
B	PM-10 = 379	North toe = 330 (Fig.F-01-05.1)
Pb	PM-10 = 1.3	North toe = 1 (Fig.F-01-21.1)

Table 3. Observed mean existing conditions at the tailings basin toe vs. annual maximum existing conditions predicted by Goldsim. (Goldsim predicted mean concentrations are not provided in Modeling Data Package Vol 2-Plant Site v9 MAR2013).

The above examples are not an exhaustive list of discrepancies between observed existing water quality data and the Goldsim P50 prediction of the No-Action alternative (continuation of existing conditions) but highlight some of the most notable discrepancies. What the discrepancies demonstrate is that the Goldsim model is a relatively poor predictor of current conditions. If a model is unable to accurately predict current conditions it is even less likely to accurately predict future Project conditions. The Goldsim models need to be better calibrated to existing conditions (the calibration effort reported in "Calibration of the Existing Natural Watershed at the Plant Site v4 MAR2012" only compared model output to upstream site PM-12 and apparently did a poor job of preparing the models to predict either the lower reaches of the Embarrass or the Partridge River.) and model results recalculated.

Surface water quality

Evaluation Criteria that are used by the Project Proponent to evaluate the impacts of pollutants that are currently exceeding WQS do not comply with the Clean Water Act. 40 CFR § 122.44 (d) requires that all effluents be characterized to determine the need for a

Water Quality Based Effluent Limit (WQBEL). If a projected concentration of a specific pollutant exceeds the applicable numeric WQS, there is a reasonable potential that the discharge may cause or contribute to an excursion above WQS. Where existing data demonstrates an excursion from WQS, a WQBEL may be imposed without facility-specific effluent monitoring. In order to calculate a WQBEL, a Waste Load Allocation (WLA) for each permitted discharge must be established. The WLA is the portion of a Total Maximum Daily Load that is allowed for each point source to ensure compliance with WQS. However, it is very difficult to determine based on the information that has been provided by PolyMet if the additional contribution of each pollutant that currently exceeds WQS will exceed the load limit that would be required by a WLA to ensure compliance with WQS. And, the additional loading of pollutants that already exceed WQS demonstrates cumulative water quality impacts from the Project. Therefore, the Area of Potential Effect for water quality extends from the Embarrass and Partridge rivers to the mouth of the St. Louis River.

The Embarrass River, Partridge River and Colby Lake already have several constituents including sulfate, manganese, and mercury in concentrations that already exceed Minnesota Water Quality Standards ("WQS"). The existing large number of water-quality exceedances and the suite of constituents, particularly trace metals, exceeding WQS indicate the site has not been remediated from previous mining activities, and that the required reclamation was not adequate to ensure compliance with WQS. Concentrations of sulfate, specific conductance, manganese, mercury and arsenic that exceed MN WQS have been measured for NPDES permit Data Monitoring Reports and by the PolyMet project proponent demonstrate both water quality contamination issues and cumulative water quality impacts.

Specific conductance

Tribal staff have noted that elevated specific conductance is a water chemistry ‘signature’ for mining discharges. Specific conductance is the ability of a material to conduct an electric current measured in microSiemens per centimeter (µS/cm) standardized to 25°C. Specific conductance reflects concentrations of dissolved solids, including metal and other contaminants from mining, other industrial activities, and agriculture.

Tribal staff conducted analysis of specific conductance downstream of mine discharges using agency monitoring data (1990-2013). Analysis of specific conductance downstream of mine discharge sites indicated that specific conductance was highest nearest to mine discharge sites, and tended to only gradually decrease downstream of mine discharge sites. Linear regressions demonstrated that specific conductance was significantly negatively related to distance across all sample sites ($P < 0.01$, $R^2 = 0.15$; $n = 123$ sites; Fig. 4) and within the St. Louis River and Swan River systems ($P < 0.05$, $R^2 = 0.18$ and 0.52, respectively; Fig. 5). This analysis included stream and river monitoring only (not lakes). The regression suggests that specific conductance could drop to 150 µS/cm only 203 km (126 mi) downstream of the nearest upstream mine discharge site.

Specific conductance downstream of mine point discharges (1990-2013)

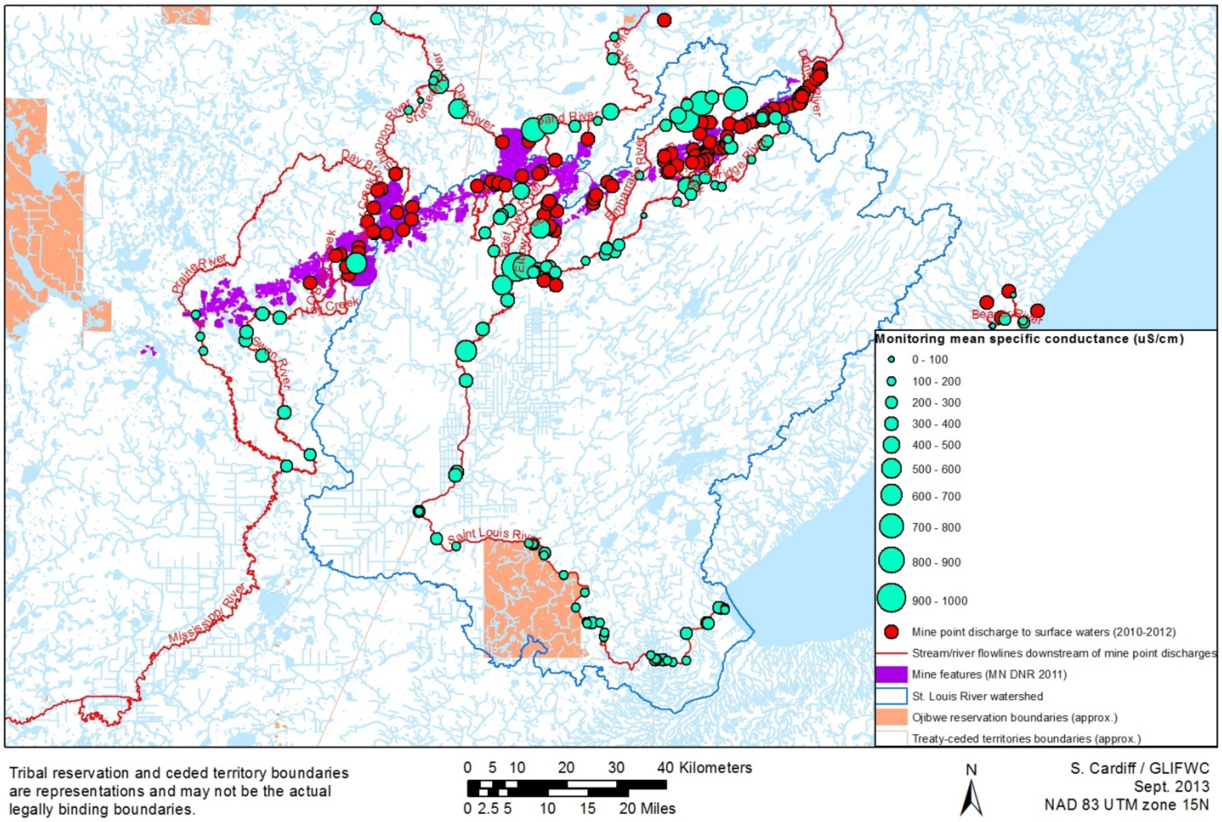


Figure 4. Mean specific conductance measurements at monitoring stations downstream of mine point discharges were inversely related to distance downstream from mine point discharge sites.

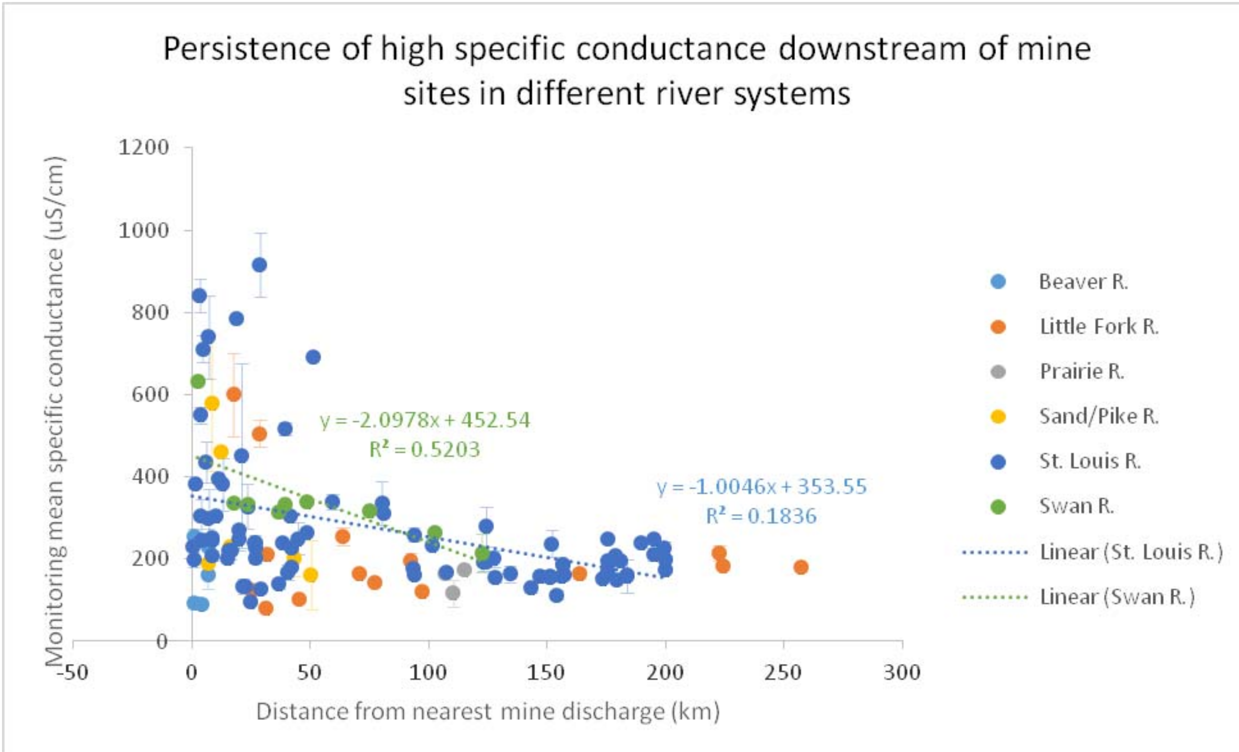


Figure 5. Linear regression indicated that mean specific conductance (±1 SE) was significantly negatively related to distance of the monitoring location downstream of the nearest mine discharge in two of the main downstream river systems, with highest specific conductance nearest to mine discharges and decreasing relatively gradually downstream (St. Louis River system $P < 0.01$, $R^2 = 0.18$, $n = 85$; and the Swan River system ($P < 0.05$, $R^2 = 0.52$, $n = 9$).

These analyses demonstrate that existing mining discharges result in elevated concentrations of pollutants that persist far downstream in the St. Louis River, which is consistent with the findings of the USEPA in their assessment report on the effects of mountaintop removal and valley fill mining[2].

Manganese

The Health Risk Limit (HRL) for manganese is 100 micrograms per liter (µg/l) because it is a potent neurotoxin known to cause brain damage when formula fed infants are exposed to high concentrations, and can cause Parkinsons-like symptoms in adults exposed to high concentrations. The average measured concentration of manganese in Wyman Creek between April 2005 and December 2012 was 1383 µg/l. Water discharging from Area Pit 5 to Spring Mine Creek, a tributary to the upper Embarrass River, between July 2010 and

[2] U.S. EPA (Environmental Protection Agency). 2011. The Effects of Mountaintop Mines and Valley Fills on Aquatic Ecosystems of the Central Appalachian Coalfields. Office of Research and Development, National Center for Environmental Assessment, Washington, DC. EPA/600/R-09/138F.

October 2011, had an average measured concentration of 804 µg/l. Test results from sixteen private drinking water wells located between the proposed project and the Embarrass River in 2008 revealed concentrations of manganese that exceeded the HRL in eight wells. The range of manganese concentrations from all of the wells was 0.66 – 4710 µg/l. The PolyMet project will contribute additional manganese to the groundwater from tailings basin water that is not captured and treated, and the water that seeps through fractures in the mine pit walls once the pit has filled with water.

In the Partridge river watershed, measured concentrations of manganese increase dramatically from the most upstream measurements to the furthest downstream measurements (Figure 6).

In the Embarrass River watershed, high concentrations of manganese are associated with mining features. SD033 is the discharge from Area Pit 5, and the former LTV tailings basin appears to be the source of pollution for monitoring locations MLC-2, PM-19, and PM-11 (Figure 7).

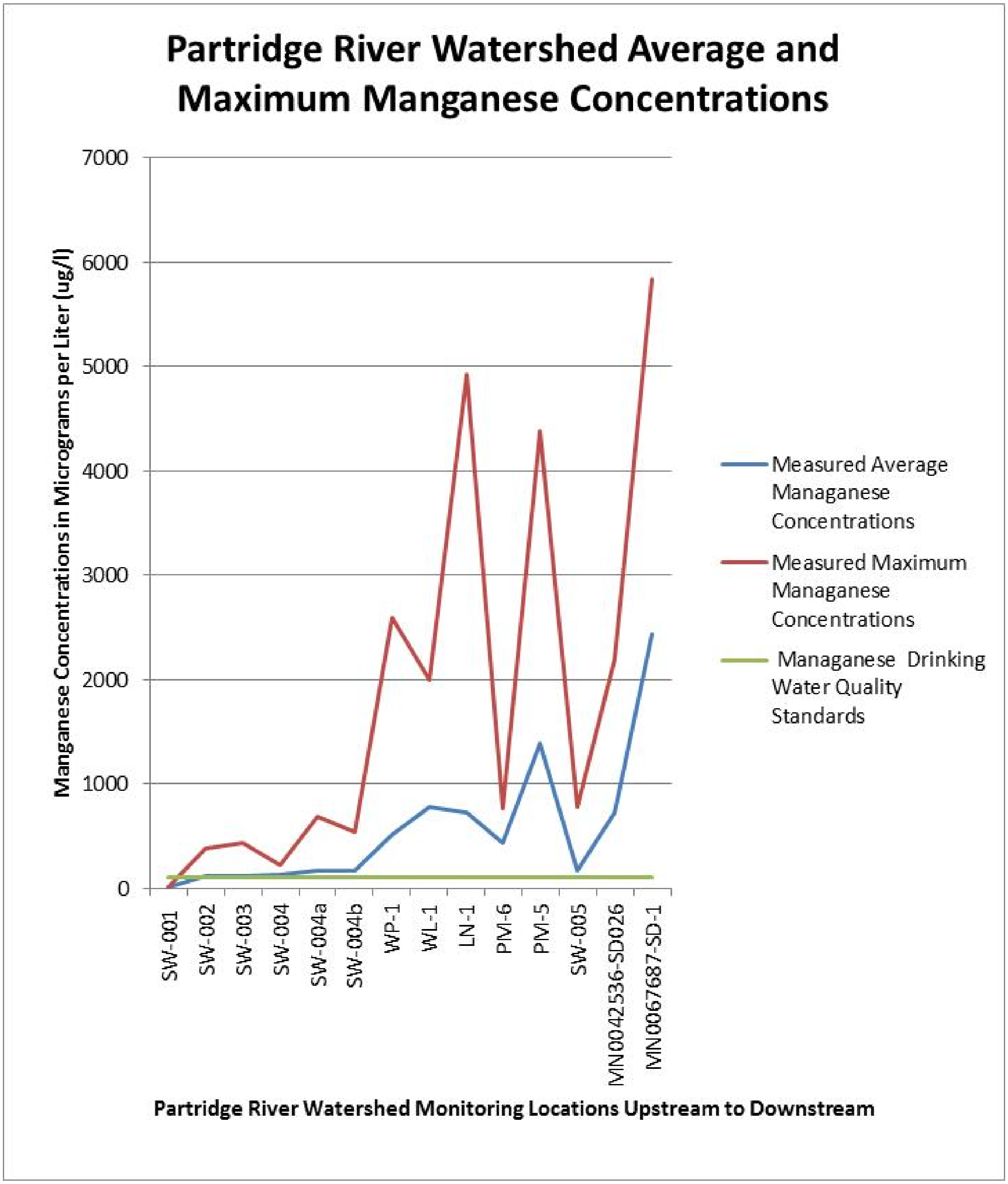


Figure 6. Partridge River Watershed Manganese Concentrations.

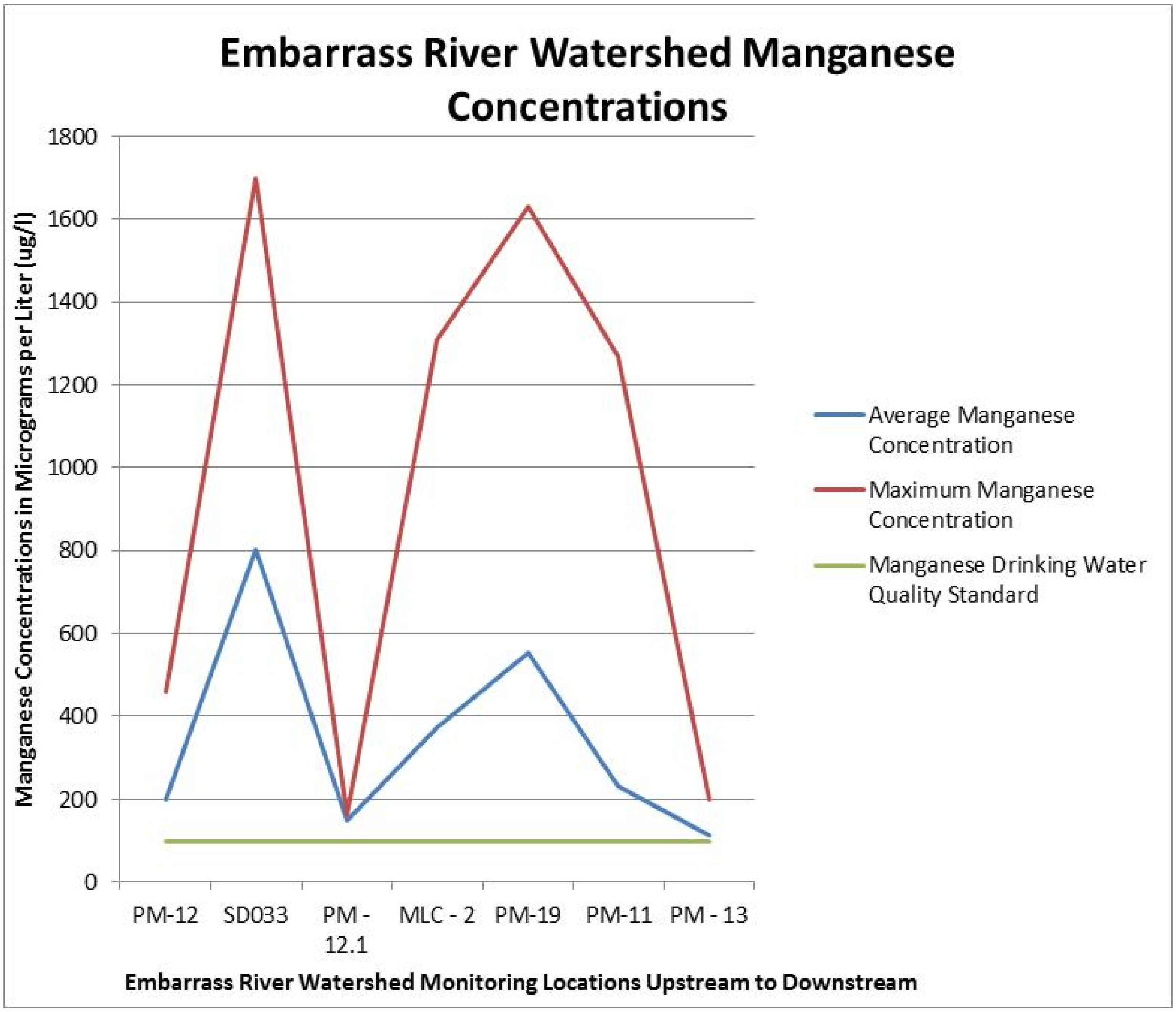


Figure 7. Embarrass River Watershed Manganese Concentrations.

Arsenic

Arsenic is a known carcinogen. The drinking water standard for arsenic is 10 µg/l, based on both human health and the economics of treating drinking water to meet the standard. Based on human health alone, the standard for arsenic is less than 2 µg/l[3]. Arsenic concentrations measured in sixteen private drinking water wells between the proposed project and the Embarrass River in 2008 ranged from less than the detection limit of 2 to 7.5 µg/l. Arsenic concentrations are projected to increase as a result of the PolyMet project[4].

In the Partridge River watershed, measured maximum arsenic concentrations exceed Class 2A and 2Bd water quality standards at all but three locations (Figure 8). The locations where the maximum measured concentration of arsenic does not exceed the Class 2A and 2Bd water quality standards are in the upper portion of the watershed.

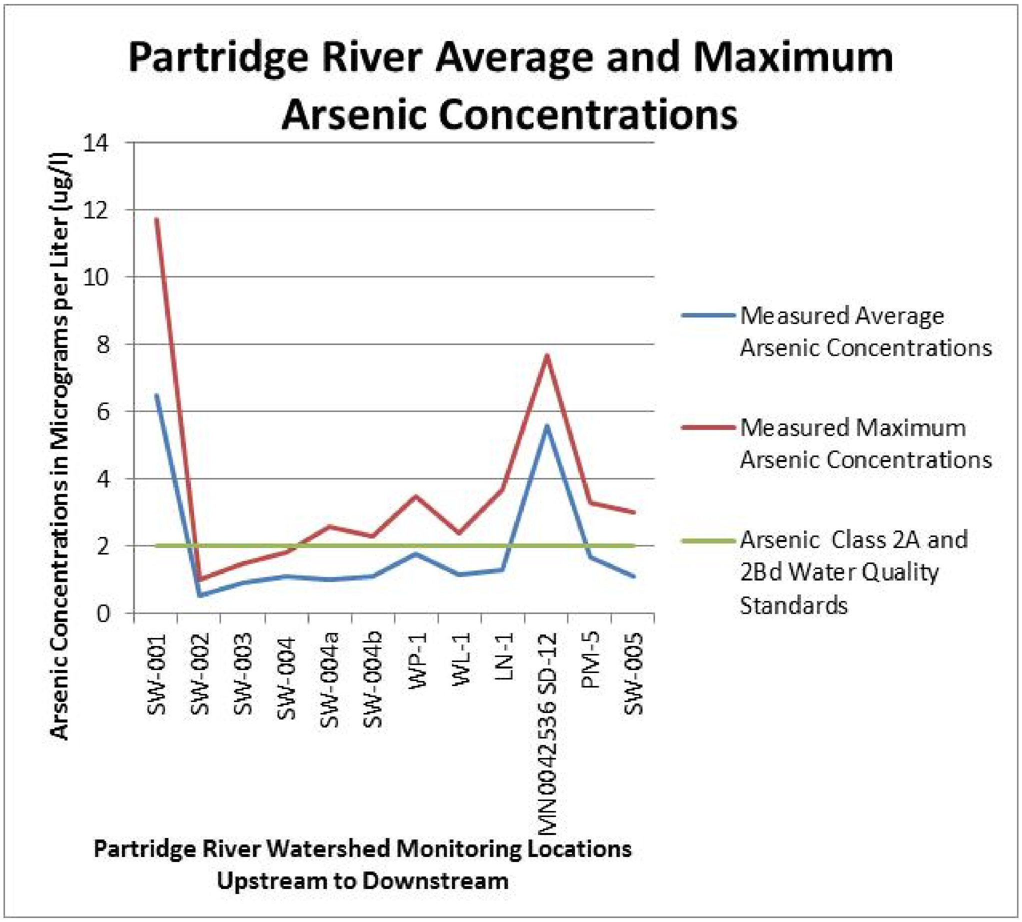


Figure 8. Partridge River Arsenic Concentrations.

[3] 40 CFR 131.36
[4] PolyMet Water Modeling Data Package

In Colby Lake, which is the City of Hoyt Lakes drinking water source, the increase in arsenic from the PolyMet project would be 38.5% (5.2.2-127 Table 5.2.2-33 Maximum Modeled Monthly P90 Surface Water Concentrations for the Colby Lake). This is significant because the US EPA's Priority Toxic Pollutants rule suggests that this level of arsenic would be more than an order of magnitude higher than what would prevent cancer in humans. The increased arsenic in the Partridge River — up to 55% at SW-004b are even more striking (p. 5.2.2-113, Table 5.2.2-29 Maximum Modeled Monthly P90 Surface Water Concentrations for the Mine Site), which may affect humans through fish consumption, even if the water isn't used for drinking.

Aluminum

The Class 2A chronic standard for total aluminum, applicable to Wyman Creek, is 87µg/l. The quality of Class 2Bd surface waters shall be such as to permit the propagation and maintenance of a healthy community of cool or warm water sport or commercial fish and associated aquatic life and their habitats. These waters shall be suitable for aquatic recreation of all kinds, including bathing, for which the waters may be usable. The Class 2Bd standard for aluminum is 125µg/l, applicable to the Embarrass River, Partridge River and St. Louis River. As Figure 9 below demonstrates, at every site where data is available the maximum aluminum concentrations exceed WQS, except at SW-001. The average aluminum concentration exceeds WQS at one quarter of the sites where monitoring data is available for aluminum.

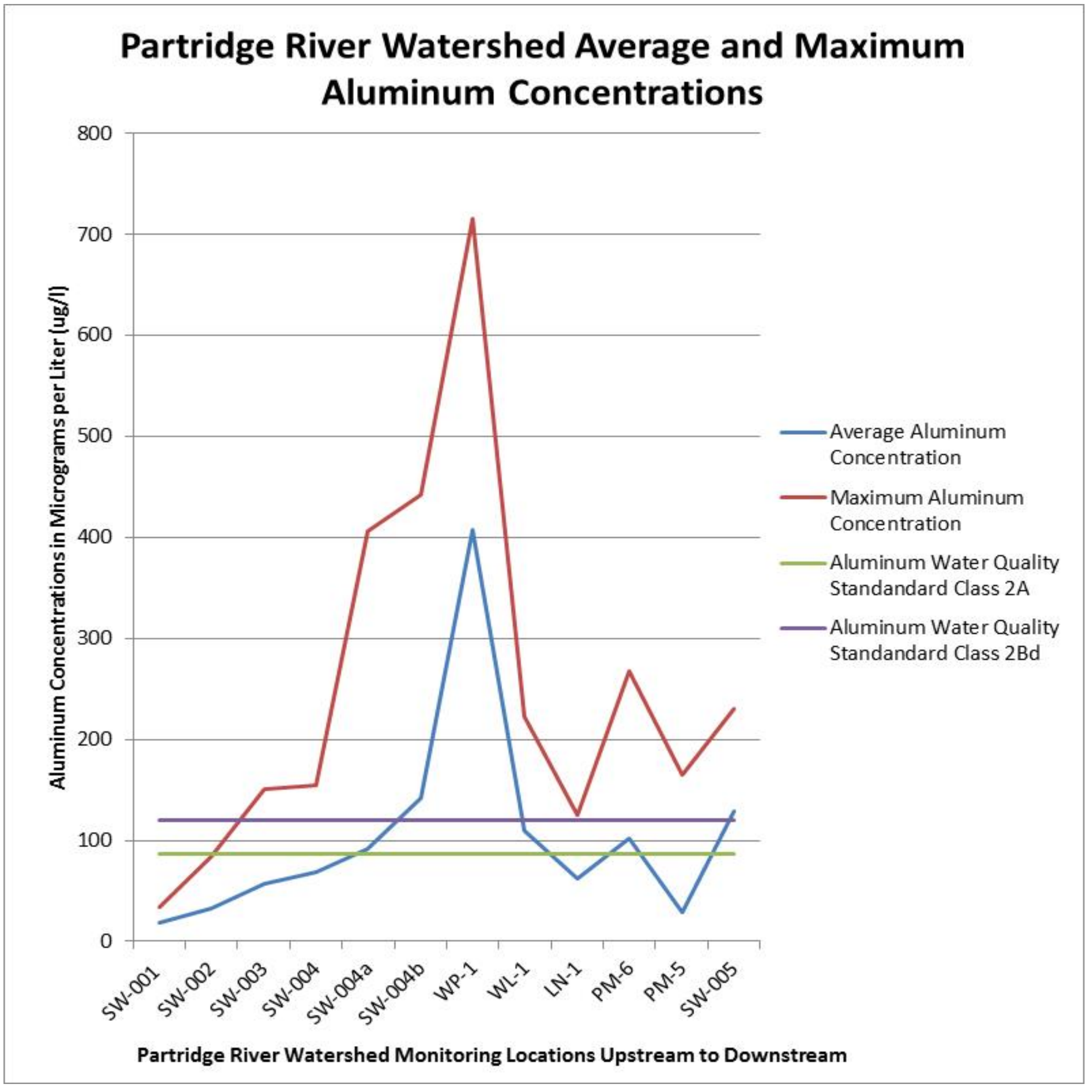


Figure 9. Partridge River Watershed Aluminum Concentrations.

Aquatic Species

Within the CEA area defined by the co-leads for impacts to aquatic species (the Partridge and Embarrass Rivers from their headwaters to a point approximately 15.5 miles downstream of the NorthMet Project Proposed Action activities, where the rivers form the St. Louis River), the MPCA has assessed and identified waterbodies that are impaired for fish and/or benthic macroinvertebrate communities, based upon recent monitoring data (since 2009). The draft 2012 §303(d) list prepared by the MPCA includes more headwaters streams and rivers in the St. Louis River watershed that are also impaired for aquatic communities (Figure 10). It is likely that the state-led stressor identification process underway will identify historic and existing mining operations as major causal factors for these impairments. The tribal cooperating agencies believe that the appropriate spatial scale for considering cumulative impacts to aquatic species is the St. Louis River watershed.

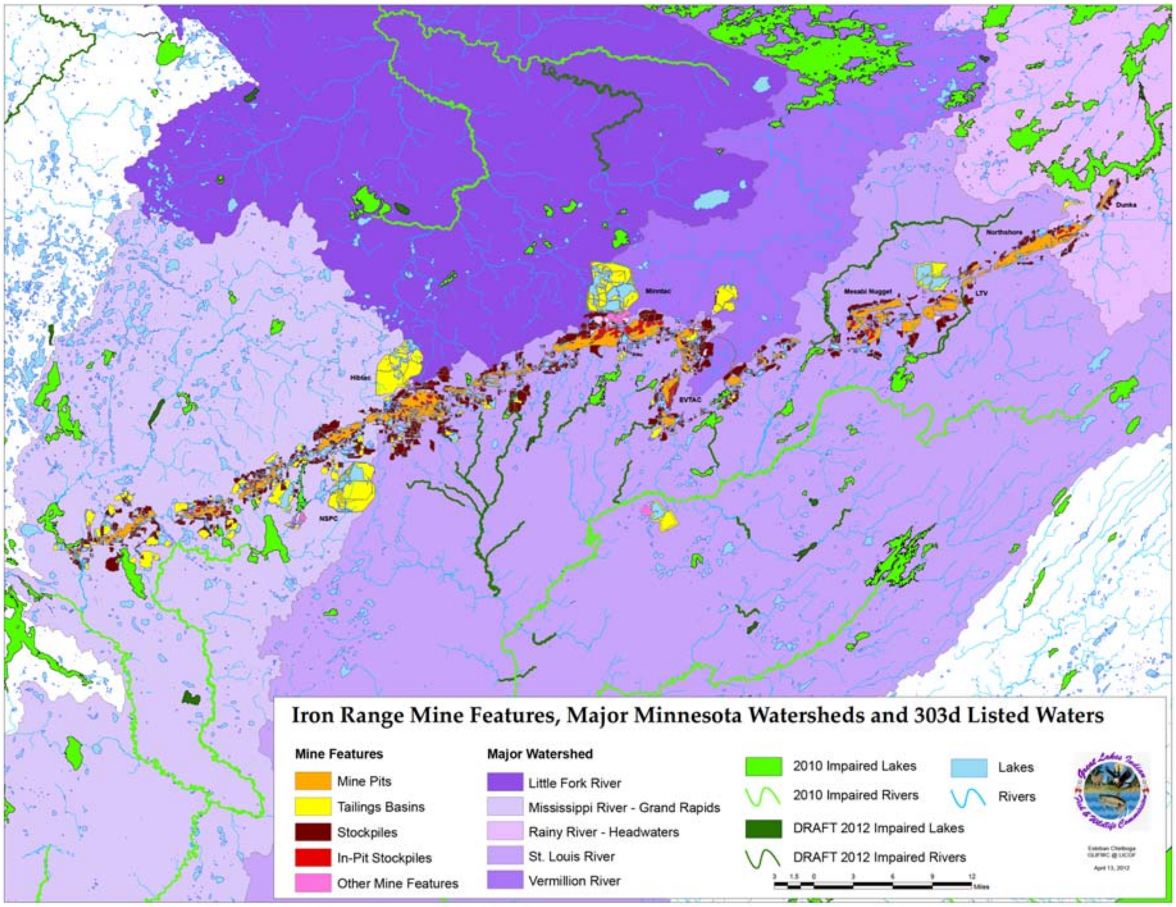


Figure 10. Impaired Waters (§303(d) Listed) within the St. Louis River and other mining-impacted watersheds.

The co-lead agencies conclude that, since the NorthMet Project Proposed Action is not predicted to result in any short- or long-term exceedances of surface water chronic standards in the Partridge River, Colby Lake, or the Embarrass River, even under extreme low-flow conditions during operations, no cumulative effects on aquatic resources are predicted within the CEAA. The co-lead agencies also conclude that there will be no effects on current baseline habitat conditions (as defined by hydrologic changes) from the NorthMet Project Proposed Action; therefore, no cumulative effects are anticipated. Both of these assumptions are major differences of opinion between the co-lead agencies and the tribal cooperating agencies. Clearly there are already adverse effects of mining operations and other development within these subwatersheds.

Mercury

From the PSDEIS: "The NorthMet Project Proposed Action is predicted to result in a net decrease in mercury loadings to the Partridge River from 24.2 grams per year to 23.0 grams per year. This would primarily be a result of a decrease in natural runoff (with a total mercury concentration of 3.6 ng/L) and a proportional increase in water discharged from the West Pit via the WWTF (with a total mercury concentration of 1.3 ng/L)."

The understanding of mercury dynamics in the St. Louis River watershed is very limited and is insufficient to lead to the conclusion reached in the PSDEIS that “the NorthMet Project Proposed Action would not exceed applicable environmental evaluation criteria.” This lack of scientific information is explicitly stated throughout the PSDEIS and is what led the Minnesota Pollution Control Agency (MPCA) early this year to delay the establishment of a St. Louis River TMDL until further mercury cycling data could be collected.

The PSDEIS also states that the current fish tissue concentration in the five local lakes results in Hazard Quotients (HQs) that exceed 1 (page 6-58), but gives no further information. The *Cumulative Impacts Analysis, Local Mercury Deposition and Bioaccumulation in Fish (July 2012)* (Barr report) showed modeled contributions from both the Mesabi Nugget LDSP and PolyMet; this information should be included in the SDEIS for public review. The Barr report provides the actual HQs, rather than just saying “they exceed 1”. The SDEIS should state clearly that in one case, the existing HQ equals 46.2, which is 46 times as high as the number where action is recommended.

The Barr report also states that “the existing health risk under Scenario 1 and 2 to subsistence/tribal and subsistence anglers eating three pounds or more per week of fish from these lakes would be significantly higher – up to fifteen times the EPA assumed safe risk intake level for a pregnant mother or child under the age of 15”. While the incremental risk from the project may be small, the existing risk is large and has not yet been addressed through a total maximum daily load (TMDL) or other reduction program. Table 5 and Figure 9 from the Barr report should be included to give the public a clear idea of the existing condition of the local waters and why the tribes believe that no additional mercury should be added at this time. The SDEIS does not provide any rationale for more mercury to be added to a system that is already so high in mercury, but rather only suggests that the TMDL should take care of this.

Mercury is potent neurotoxin, with the primary human and wildlife route of exposure through consumption of fish. The Embarrass River, Wyman Creek, Whiteface Reservoir, Stony Creek, West Two River, numerous lakes, and the entire St. Louis River all have fish consumption advisories in place for recreational fishing. These advisories do not consider subsistence fishing. Mercury concentrations in fish from these impaired waters will require additional load reductions beyond the emissions reductions required by the statewide mercury TMDL.

Mercury levels in Lake Superior lake trout remain higher than the other Great Lakes, despite significant reductions in the amount of mercury being released from sources around the lake. The largest source of mercury from within the Lake Superior basin is the mining sector, at 63% of total emissions.[5] There has not been significant “ground-truthing” of mercury deposition rates that were used in the modeling assessment. Tribal cooperating agencies note that no studies have been conducted within this region of active mining to determine why fish tissue mercury concentrations are so high if the local sources mainly emit ‘non-locally polluting’ forms of mercury.

[5] Lake Superior Lakewide Management Plan Annual Report 2012, Catalogue No.: En161-9/2012E-PDF

A 2011 Minnesota Department of Health study[6] of infants in the Lake Superior basin found that 1 in 10 infants are born with unsafe mercury levels in blood. Blood spot mercury concentrations in infants from Minnesota were significantly higher than infants born in the Lake Superior basin in Wisconsin and Michigan.

Increased sulfate concentrations increase bioaccumulation of mercury. Additionally, mercury loadings to surface waters from the project is expected to increase from removing peat and storing peat in the overburden storage layout area without a cover or liner. Stormwater run-off containing concentrations of mercury that exceed MN WQS have been well documented (Aitkin AgriPeat). The Laskin Energy Center NPDES permit MN000990-SD-2 has a permit limit of 19.1 ng/l[7], even though the aquatic life WQS for the Lake Superior basin is 1.3 ng/l. Other existing permitted facilities contribute mercury loadings to the Partridge and Embarrass Rivers, in addition to the local atmospheric deposition (Figures 11, 12).

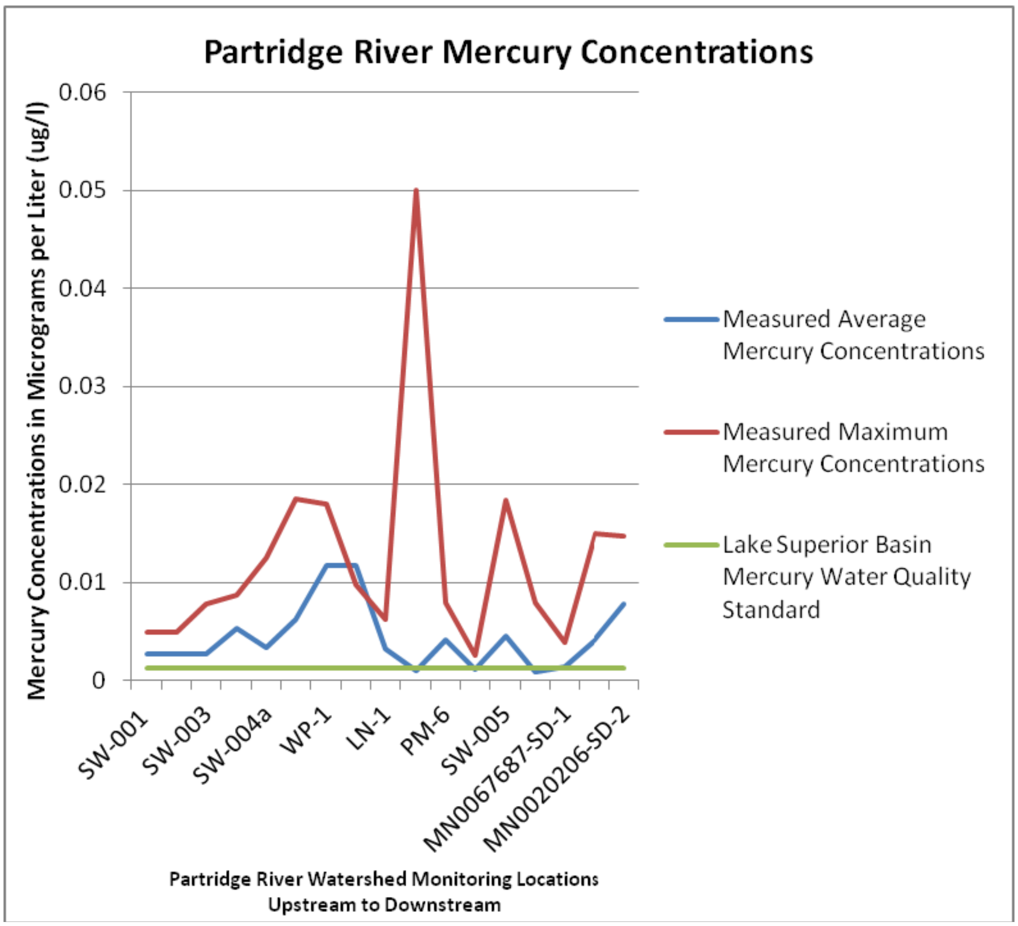


Figure 11. Partridge River Mercury Concentrations

[6] McCann, P. (2011). *Mercury Levels in Blood from Newborns in the Lake Superior Basin* (Minnesota Department of Health: Environmental Health, pp. 181)

[7] MPCA DMR data for NPDES permit MN0000990-SD-2 2000-2013.

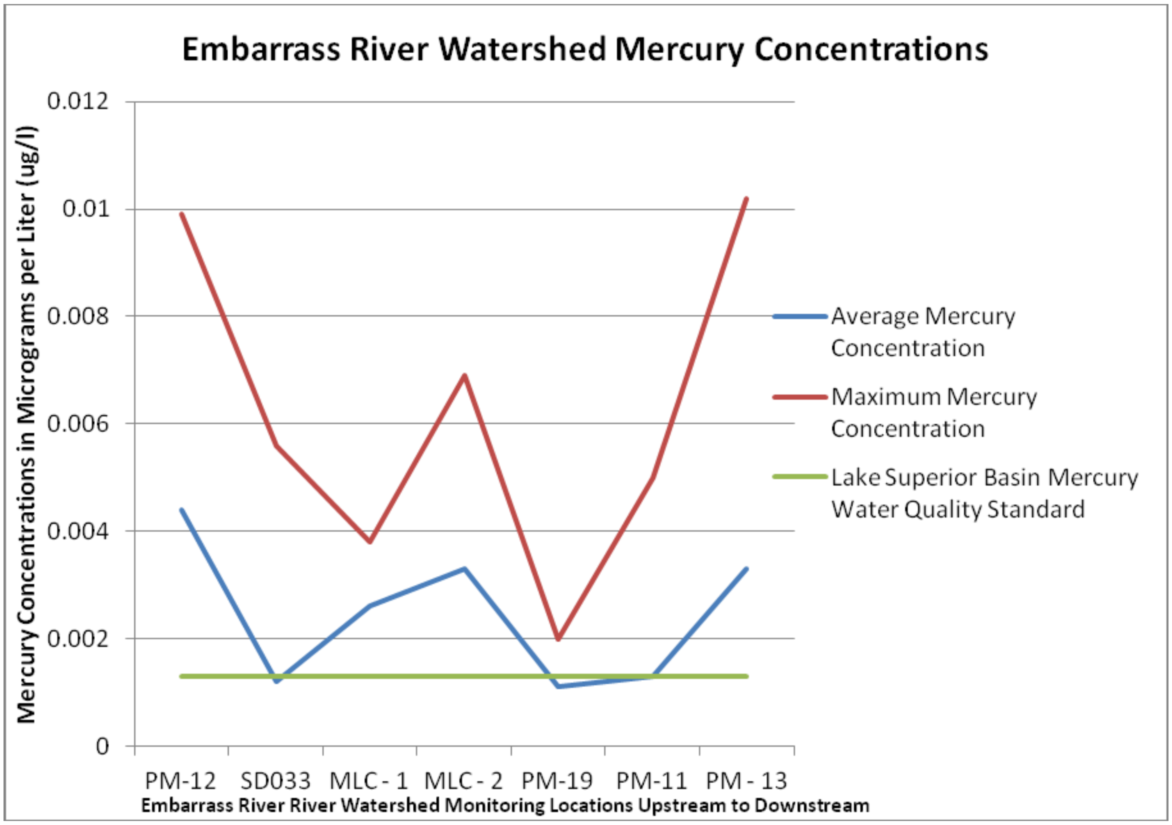


Figure 12. Embarrass River Mercury Concentrations.

Cumulative effects associated with mercury deposition and increased mercury methylation (mediated by increased sulfate loading and hydrologic alteration of peatlands) therefore extend from the plant site down the Embarrass River to the St. Louis River estuary. Additional analyses of predicted mercury impacts from the NorthMet Project Proposed Action have been provided by GLIFWC[8].

Sulfate

From the preliminary SDEIS: "Sulfate concentrations increase to an average of approximately 150 mg/L downstream of the confluence with Second Creek at the County Road 110 bridge (Mesabi Nugget monitoring location MNSW12). The wild rice surveys found sulfate concentrations as high as 289 mg/L below Second Creek during a relatively dry period. The baseline sulfate concentrations found in the Partridge River reflect the effects of discharges from existing activities within the watershed. The NorthMet sulfate load to the Partridge River would total an average of about 41 kg/d, which represents a 0.1 percent

[8] Great Lakes Indian Fish and Wildlife Commission (GLIFWC) Comments Related to Mercury on the "Northmet Mining Project and Land Exchange: Preliminary Supplemental Draft Environmental Impact Statement"

increase over existing loads. Therefore, the NorthMet Project Proposed Action should not adversely affect downstream waters that support the production of wild rice."

Sulfate concentrations in Trimble Creek, the Embarrass River, and the Partridge River currently exceed the wild rice standard of 10 mg/l. The drinking water standard and the cold water fisheries standard for sulfate is 250 mg/l. Discharge from Area Pit 5 near the proposed PolyMet tailings basin has measured sulfate concentrations that range from 170 to 2520 mg/l, averaging 1,083 mg/l between 2001 and 2013[9]. Sulfate concentrations measured in the discharge from the Peter Mitchell Pit to the upper Partridge River for NPDES permit MN0046981-SD-9 ranged from 14-37 mg/l. Sulfate concentrations measured in the discharge from the LTV Tailings basin to Second Creek for NPDES permit MN0042536-SD026 ranged from 118-360 mg/l in the period between 2008 - 2013[10]. Sulfate impaired wild rice waters, for the first time ever, will be included in the MPCA impaired waters list in 2014. The Bands believe that the Embarrass River, Second Creek, the Partridge River, Dunka River, and Bobs Bay of Birch Lake should be included on that list. In addition, the Swan River, Swan Lake, Sand River and the Twin Lakes (Sandy and Little Sandy Lakes, adjacent to the US Steel Minntac tailings basin) are all impaired wild rice waters due to concentrations of sulfate that exceed the MN wild rice sulfate standard.

The wild rice sulfate WQS is exceeded at almost every point where data is available in the Embarrass River watershed (Figure 12), and the drinking water standard is exceeded at half of the monitoring locations. In the Partridge River watershed, the wild rice sulfate WQS is exceeded at fourteen of seventeen locations (Figure 13). And, the sulfate drinking water standard is exceeded at two locations in the Partridge river watershed. The NorthMet Project Proposed Action will contribute additional sulfate to the groundwater from tailings basin water that is not captured and treated, water that seeps through fractures in the mine pit walls once the pit has filled with water, and stockpile infiltration and run-off.

[9] MPCA DMR data for NPDES permit MN0042536-SD033 2001 -2013.
[10] MPCA DMR data for NPDES permit MN0042536-SD026 2008 -2013.

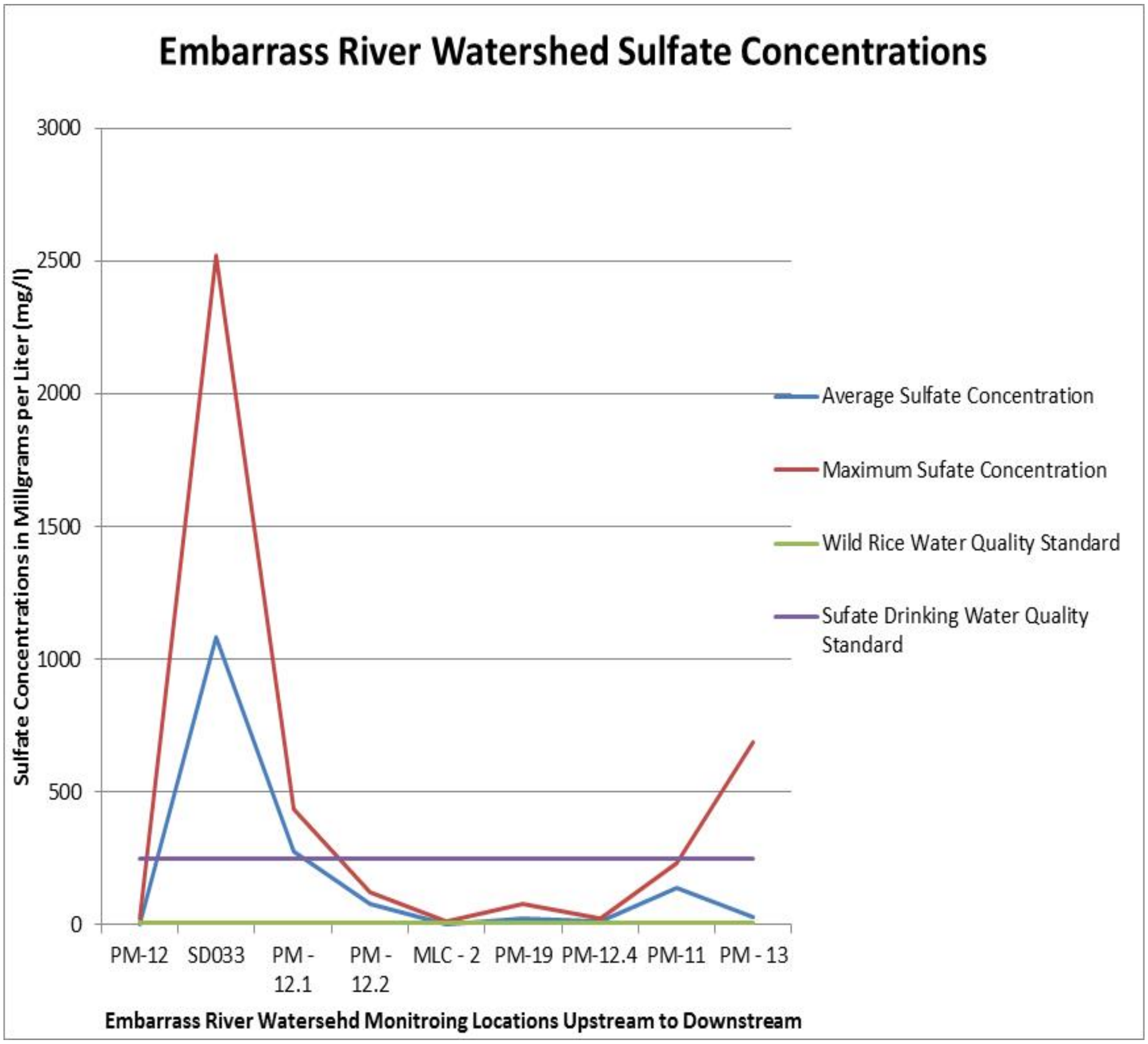


Figure 12. Embarrass River Watershed Sulfate Concentrations.

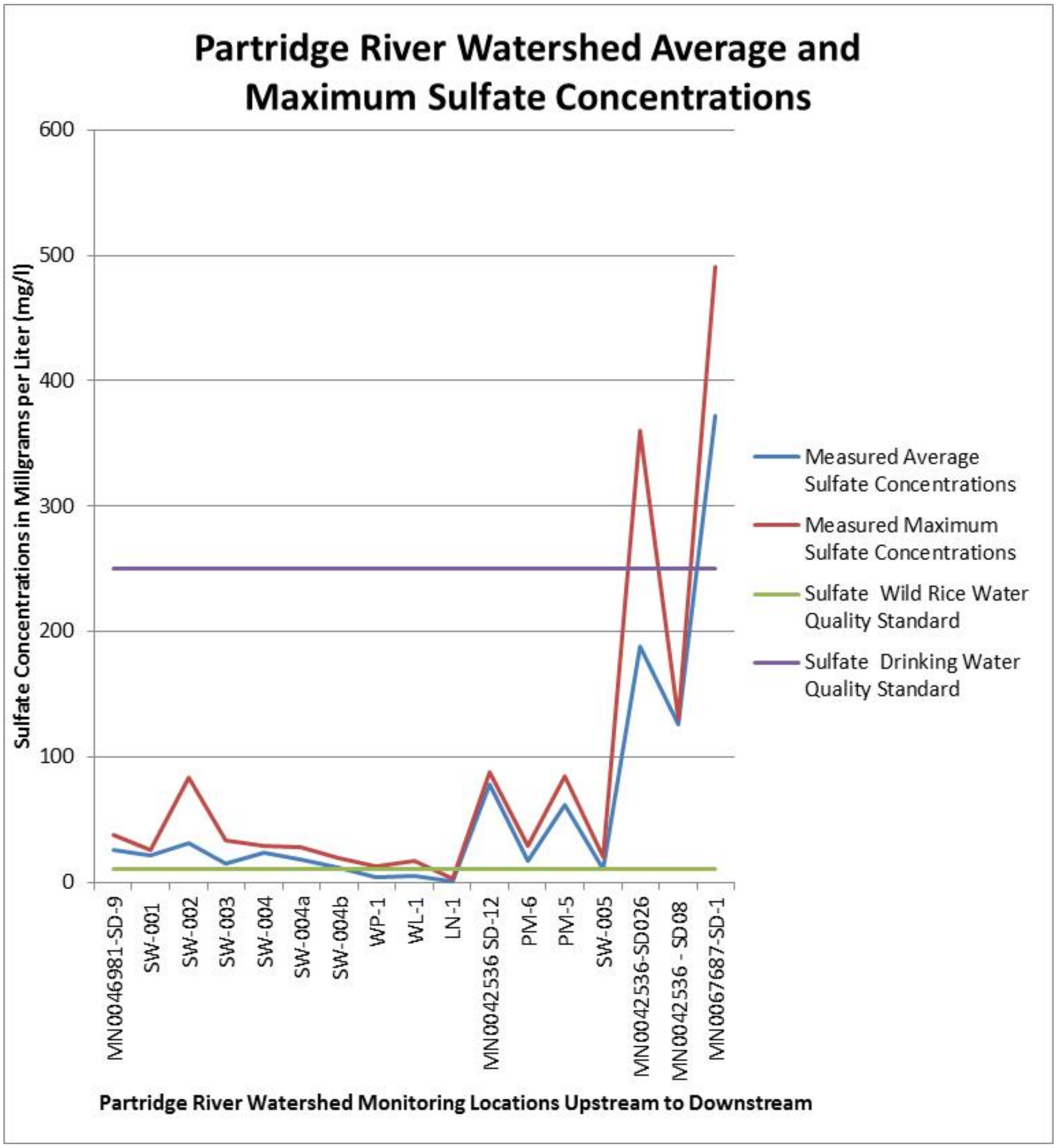


Figure 13. Partridge River Watershed Sulfate Concentrations.

Tribal staff did additional analysis of sulfate concentrations throughout the St. Louis River watershed. Analysis of sulfate concentrations downstream of mine discharge sites indicated that sulfate concentrations were highest nearest to mine discharge sites, and tended to only gradually decrease downstream of mine discharge sites. Linear regressions demonstrated that mean sulfate was significantly negatively related to distance across all sample sites ($P < 0.01$, $R^2 = 0.14$, $n = 92$) and within the Saint Louis River system ($P < 0.01$, $R^2 = 0.17$, $n = 73$; Figure 14). This analysis included stream and river monitoring only (not lakes).

The regression suggests that sulfate concentrations could drop to less than 10 mg/L only 170 km (105 mi) downstream of the nearest upstream mine discharge site (Figure 15).

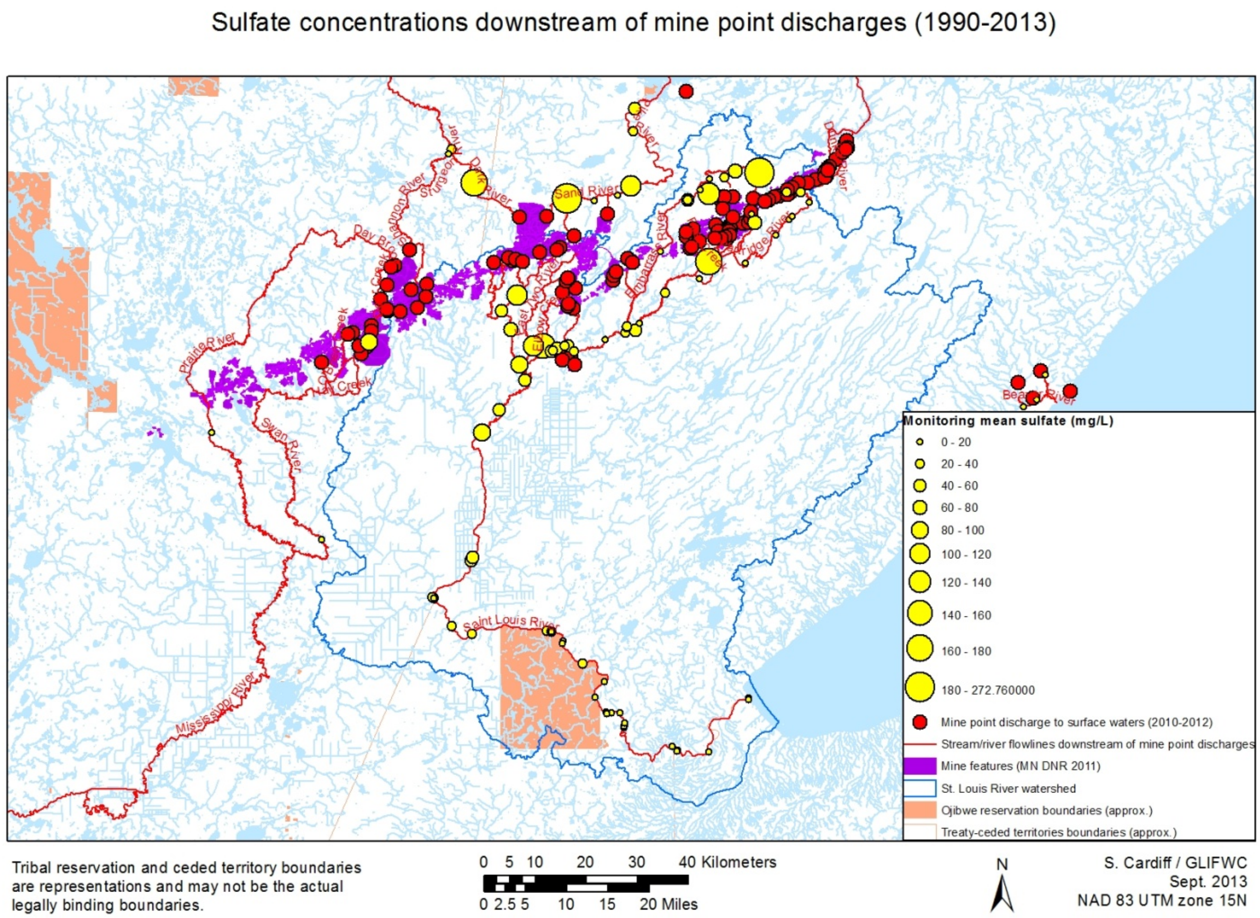


Figure 14. Mean sulfate concentrations at monitoring stations downstream of mine point discharges was inversely related to distance downstream from the discharge sites.

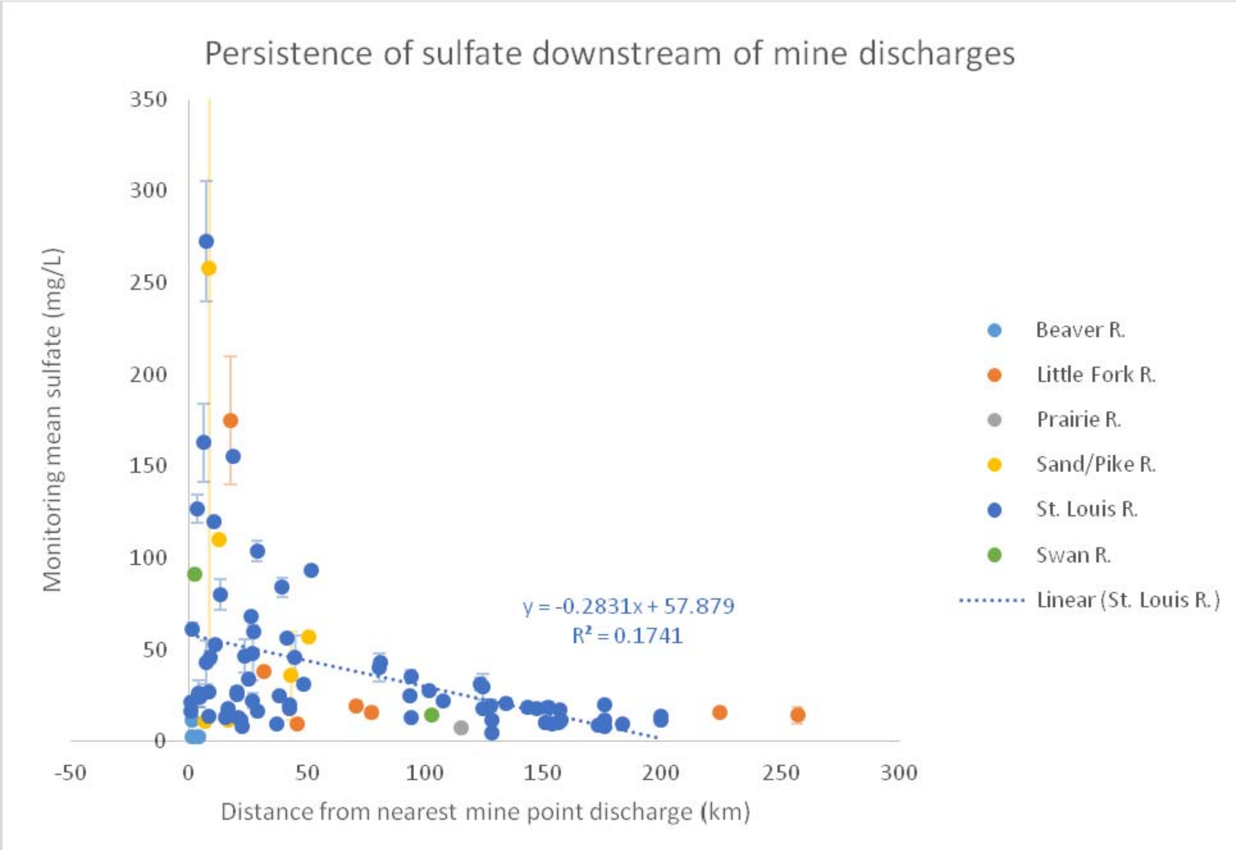


Figure 15. Linear regression indicated that mean sulfate (±1 SE) was significantly related to distance of the monitoring location downstream of the nearest mine discharge in the St. Louis River with highest sulfate concentrations nearest to mine discharges and decreasing relatively gradually downstream ($P < 0.01$, $R^2 = 0.17$, $n = 73$).

Ground water quality

From the PSDEIS: "Neither the Scoping Decision Document nor the SDEIS identified potential cumulative effects on groundwater. Although the NorthMet Project Proposed Action would affect groundwater levels, this effect would be very limited geographically and temporally (e.g., groundwater levels would be restored once pit dewatering ceases) and not subject to any off-site cumulative effects. The effects of mine dewatering are considered in terms of effects on surface water flows."

The cumulative effect of blasting ore, or vibration, has not been mentioned in the SDEIS, or even considered. It is evident that effect of blasting ore will increase fractures in the Virginia Formation and the Duluth Complex in the vicinity of the Project[11]. And, that

[11] ISEE Presentation Wesley L. Bender, Understanding Blast Vibration and Airblast, their Causes, and their Damage Potential (updated 2009), available at http://www.iseegoldenwest.org/Blast%20Effects.pdf (last visited 9/5/13)

fractures have already hydrologically connected the Biwabik Iron Formation with the Virginia Formation and Duluth Complex, as a result of blasting in the Peter Mitchell Pit. The increase in fractures from blasting has likely hydrologically connected some of the known and inferred faults in the vicinity of the Peter Mitchell Pit, too. And, there will be a cumulative impact on water quality and water quantity resulting from blasting ore in the proposed PolyMet mine pit because the fractures from blasting in the Peter Mitchell Pit will overlap fracturing resulting from blasting in the PolyMet Pit. The area where most of the new fractures are likely to be created lie within the Virginia formation between the two pits. The Virginia Formation is known to have the highest sulfur content of the three bedrock formations found within the area between the proposed PolyMet mine pit and the Peter Mitchell mine pit, and the second highest transmissivity rate.

The PolyMet SDEIS section on vibration (Chapter 5.2.8) does not discuss impacts of blasting in creation of fractures. However, fractures created by blasting and shoveling ore would extend far beyond the pit walls. Section 5.2.8-9 **Vibration** of the preliminary SDEIS states: “permanent ground displacement occurs close to the blast. For heavily confined rocks, ground vibrations of 25.4 mm/sec will occur as far away as 1,581 meters. For free face average rock, ground vibrations of 25.4 mm/sec will occur as far away as 627 meters.” “Permanent ground displacement” is a discreet way to refer to the creation of new fractures without having to discuss the resulting increase in groundwater flow and connectivity to surface waters. In fact, all of the PolyMet predictions regarding discharge from the mine pits and waste rock piles, including the more reactive waste rock piles and the ore surge pile as well as the unlined permanent Category 1 waste rock pile, are made without considering the effects of fractures on discharge to groundwater and surface water.

Excerpts from three reports produced for the PolyMet project regarding groundwater/surface water interactions include the following:

“Groundwater samples were collected from three of the deep borings at the site. Two of the samples were collected from 6-in diameter exploratory boreholes. The remaining sample was collected from the water supply well (Unique Well Number 717972). This well is open to both the Duluth Complex (20-150 feet below ground surface) and the Virginia Formation (150-200 feet below ground surface)….The water sample from well MW-05-02 exceeded criteria for ammonia (240 ug/l), pH (10),aluminum (322 ug/l), and copper (11.2 ug/l). The sample from MW-05-08 exceeded criteria for aluminum (1,040 ug/l), copper (10 ug/l), and mercury (0.0053 ug/L). The sample from MW-05-09 exceeded criteria for aluminum (4,640 ug/L), chromium (28.6 ug/l), cobalt (5.4 ug/l), copper (72.2 ug/l), lead (5.6 ug/l), and mercury (0.0181 ug/l)…. The presence of ammonia in the deep boreholes may indicate that the water in the borehole came from the shallow surficial deposits. Ammonia is not typically found in deep bedrock systems but is common in wetland environments.”[12]

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[12] Hydrogeologic Investigation- PolyMet NorthMet Mine Site report RS-02. Barr Engineering. 2006

"The water samples from wells P-2 and P-4 exceeded the nitrogen (ammonia as N) criteria (270 ug/L and 110 ug/L respectively). The presence of ammonia nitrogen in the samples likely indicates that there is a hydraulic connection between the bedrock aquifer and the surficial aquifer; however, the nature of this connection cannot be determined at this time."[13]

"The samples from pumping well P-2 all contained measurable tritium, indicating that at least a portion of the source water is post-1952 water."[14]

The Peter Mitchell Pit lies approximately one mile north of the proposed PolyMet mine pit. Taconite production began in 1955 at the Peter Mitchell Pit. Based on the review of the Peter Mitchell NPDES permit MN0046981 at various discharge locations, unionized ammonia nitrogen has exceeded permit limits on numerous occasions[15]. Unionized ammonia nitrogen is used to blast rock. Though PolyMet did not determine what the source unionized ammonia or tritium found in the deep boreholes was, it seems likely that because of the Peter Mitchell Pit's close proximity to the proposed PolyMet mine site, the Peter Mitchell Pit is the source of contamination. The approximate fifty- year travel time of the pollutants found in the P-2 bore hole from the Peter Mitchell Pit were not used to estimate travel time for pollutants leaving the PolyMet mine pit and reaching the Partridge River, or even to calibrate the model.

In fact, bedrock groundwater flow paths have not been determined using standard methods for hydrogeologic investigations. Instead, a model has been developed that uses extremely low baseflows in the Partridge River in order to suggest that peak concentrations of contaminants will not reach surface water features for hundreds or even thousands of years. Even though data collected for PolyMet in the three hydrologic investigations between 2006 and 2007 demonstrate a strong connection between boreholes in the bedrock aquifer and the surficial aquifer and surface water (including wetlands). This information, and the results from winter flow monitoring have not been incorporated into the PolyMet project projections for surface and groundwater quality and quantity.

Groundwater contamination from the previous mining activities is still an issue near the LTV tailings basin and mine pits more than twenty years after operations have ceased. The above evidence suggests that, whatever the degree of fractures now existing in the rock, blasting at the levels proposed by PolyMet will create damage to rock masses and rock fractures over an extensive area, including the entire mine site and extensive adjacent wetlands areas (Figure 16). This evidence requires that the impacts of fractures on propagation of pollutants from all mine sources be analyzed in detail and calls into question PolyMet's claims that discharge of sulfates and toxic metals from the mine site will not impact wetlands and exceed water quality standards. The impacts of vibrations and airblast on slope stability of waste rock piles are not discussed in the SDEIS either.

[13] Hydrogeologic Investigation – Phase II PolyMet NorthMet Mine Site RS-10. Barr Engineering. 2006

[14] RS10A –Hydrogeological – Drill Hole Monitoring and Data Collection – Phase 3. PolyMet Mining, Inc. March 2007.

[15] MPCA DMR data for MN0046981 from website "What's in My Neighborhood" (http://www.pca.state.mn.us/index.php/data/wimn-whats-in-my-neighborhood/whats-in-my-neighborhood-text-search.html) (last visited 9/4/13)

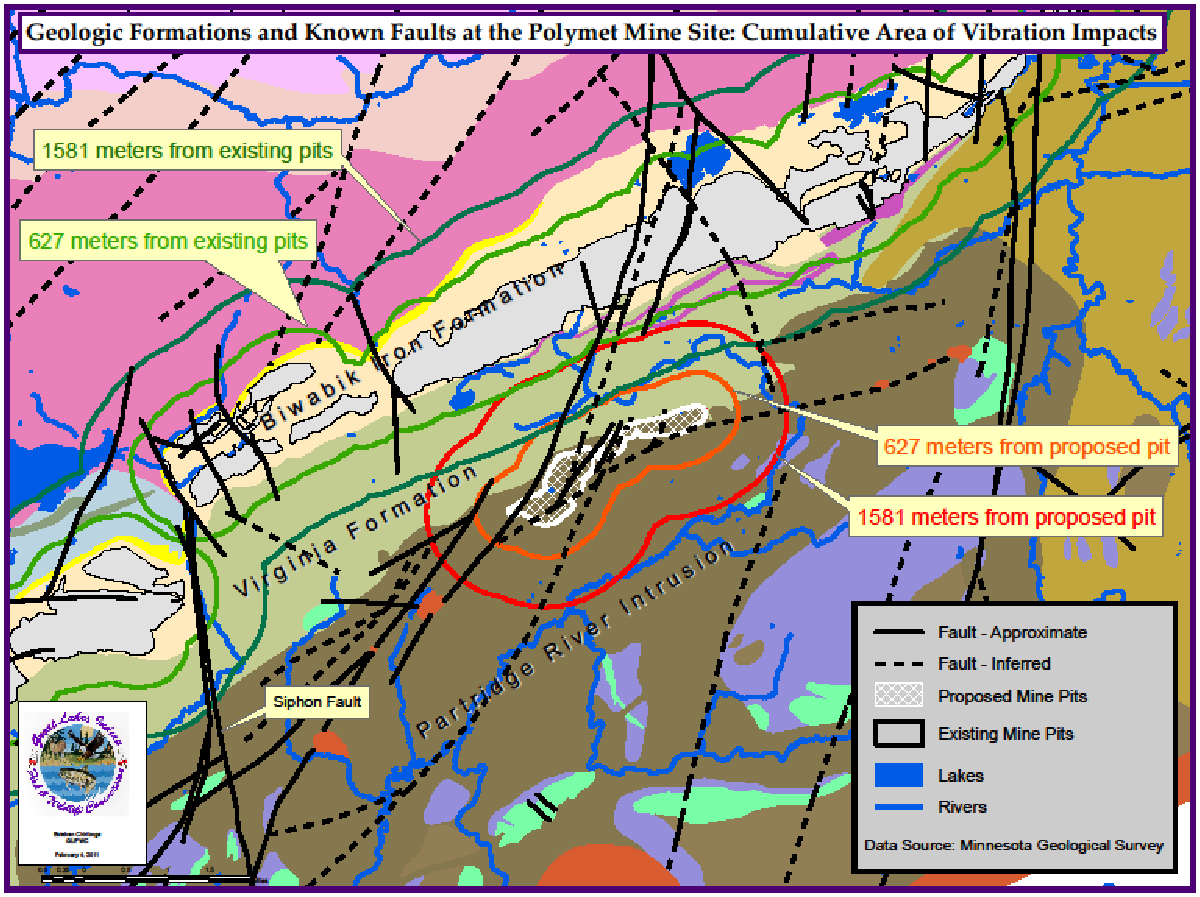

Figure 16. Cumulative Area of Vibration Impacts.

Impacts to water quality in the immediate vicinity of the project area from mining activities include:

Peter Mitchell Pit: Expansion of the Peter Mitchell Pit to the South towards the proposed PolyMet project and the in-pit disposal of Virginia Formation waste rock.

Former LTV Site (Cliffs): Dunka Pit, Area Pit 5, Tailings Basin, Area Pit 2, Area Pit 3

Mesabi Nugget: Area Pit 1, Area Pit 9, Area Pit 9S, Area Pit 6, Area Pit 2WX, Stevens Pit

Considering there are domestic wells south of the property, and pit 2WX will likely overflow to surface water features when mining has ceased, contaminant transport models for surface and groundwater need to be developed if pit 2WX or pit 6 are mined due to the presence of the Virginia Formation and the Aurora Sill.

Wetlands

The co-lead agencies confined their cumulative effects analysis for wetlands to the Partridge and Embarrass River watersheds, simply quantifying the wetland acreage change from pre-settlement conditions to the present, then projecting the estimated acres in the future based upon impacts due to the NorthMet Proposed Project. The co-lead agencies, relying upon the XP-SWMM model developed for the Partridge River, conclude that "changes in annual flow (and therefore stage) in the Partridge River would be within the naturally occurring annual variation for the Partridge River. Therefore, no potential indirect cumulative wetland effects are identified for the wetlands abutting the Partridge River.

The PSDEIS states: "The St. Louis River is located downstream of the Partridge River. Effects on flows (and, by extension, water surface elevations) generated by the NorthMet Proposed Action are anticipated to be less than those estimated for the Partridge River and within the natural variation of flow within the St. Louis River. Therefore, no potential indirect cumulative wetland effects are identified for the wetlands within the St. Louis River below the ordinary high water mark from its confluence with Embarrass River to Lake Superior."

The tribal cooperating agencies take a different approach to quantifying cumulative wetland impacts for the NorthMet Proposed Action. Referencing the alternative indirect wetland impacts analysis provided by GLIFWC for the PolyMet mine site, tribal cooperating agencies believe that cumulative wetland impacts within the St. Louis River watershed should be the scale of the analysis, and that direct and indirect wetland impacts due to hydrologic modification (ditching) should be included (Figure 17). There are 1,387,630 acres of wetlands in the St. Louis River watershed, with 1732 individual wetlands impacted by ditching, totaling 198,989 acres. Ditching has occurred in 14.3% of the wetlands in the watershed. Approximately 50% of the subwatersheds have had some degree of impact from ditching, while some have experienced ditching in nearly 100% of their wetlands. Clearly, this has a profound impact to the connected surface waters, and impacts to specific stream reaches should be assessed.

There are direct impacts to wetlands that occurred when the ditches were constructed. Those impacts depend on the length and width of each ditch. The second, and larger, set of impacts is indirect. The ditches have converted some percentage of the wetlands to upland, and changed the functions and values of another percentage of wetlands.

St. Louis River Sub-watershed impacted by Ditching

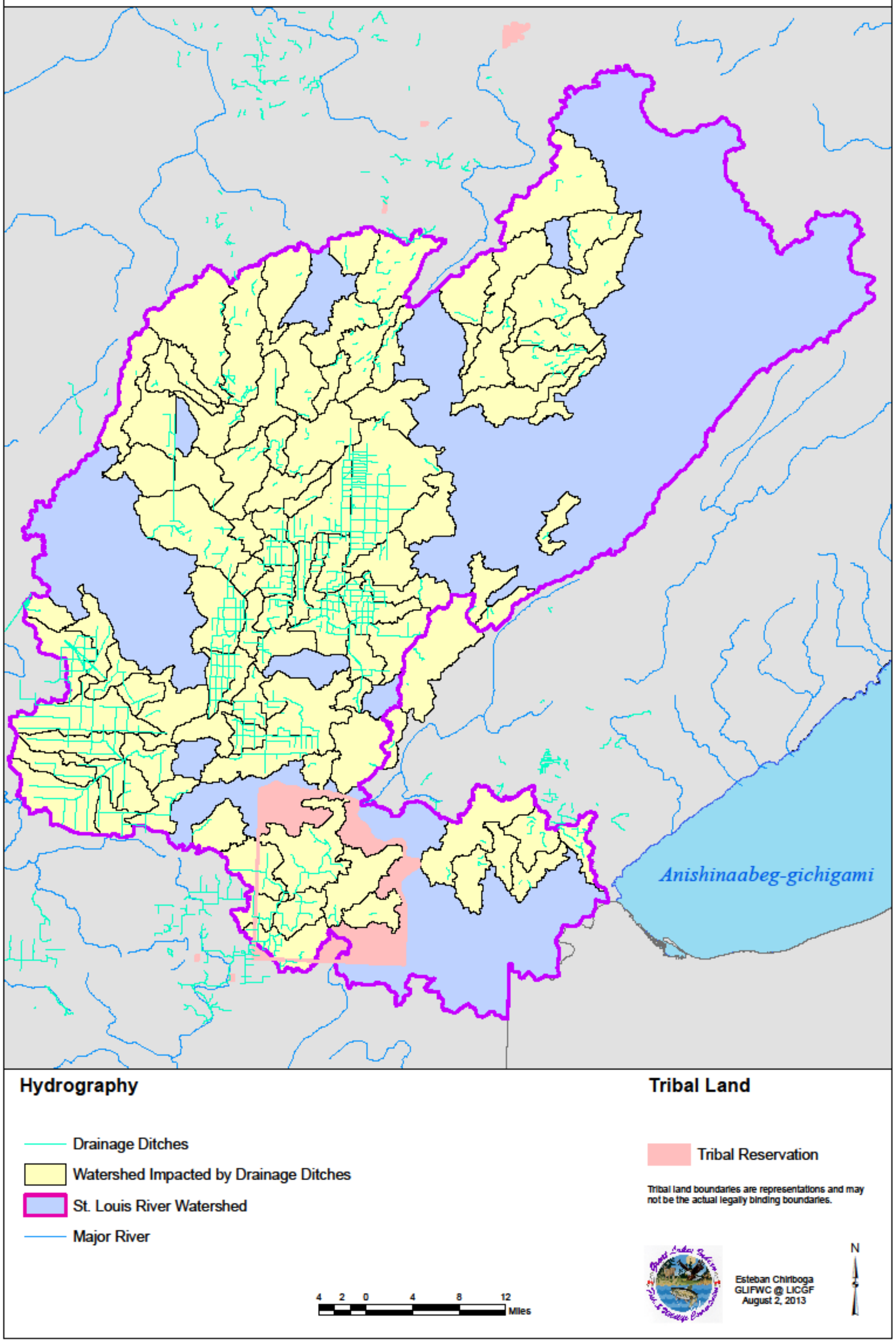

Figure 17. St. Louis River Watershed Hydrologic Impacts from Ditching

Tens of thousands of acres of high quality wetlands within the St. Louis River watershed have been entirely and permanently lost to historic and current mining operations, prior to regulatory requirements for mitigation. Since the initiation of state and federal wetland mitigation requirements for permitting wetland dredge and fill activities, most mitigation has taken place outside the St. Louis River watershed and has not replaced the wetland types and functions that have been lost. Nearly 3000 additional wetland acres will be directly impacted under several reasonably foreseeable mining projects within the watershed (Figure 18).

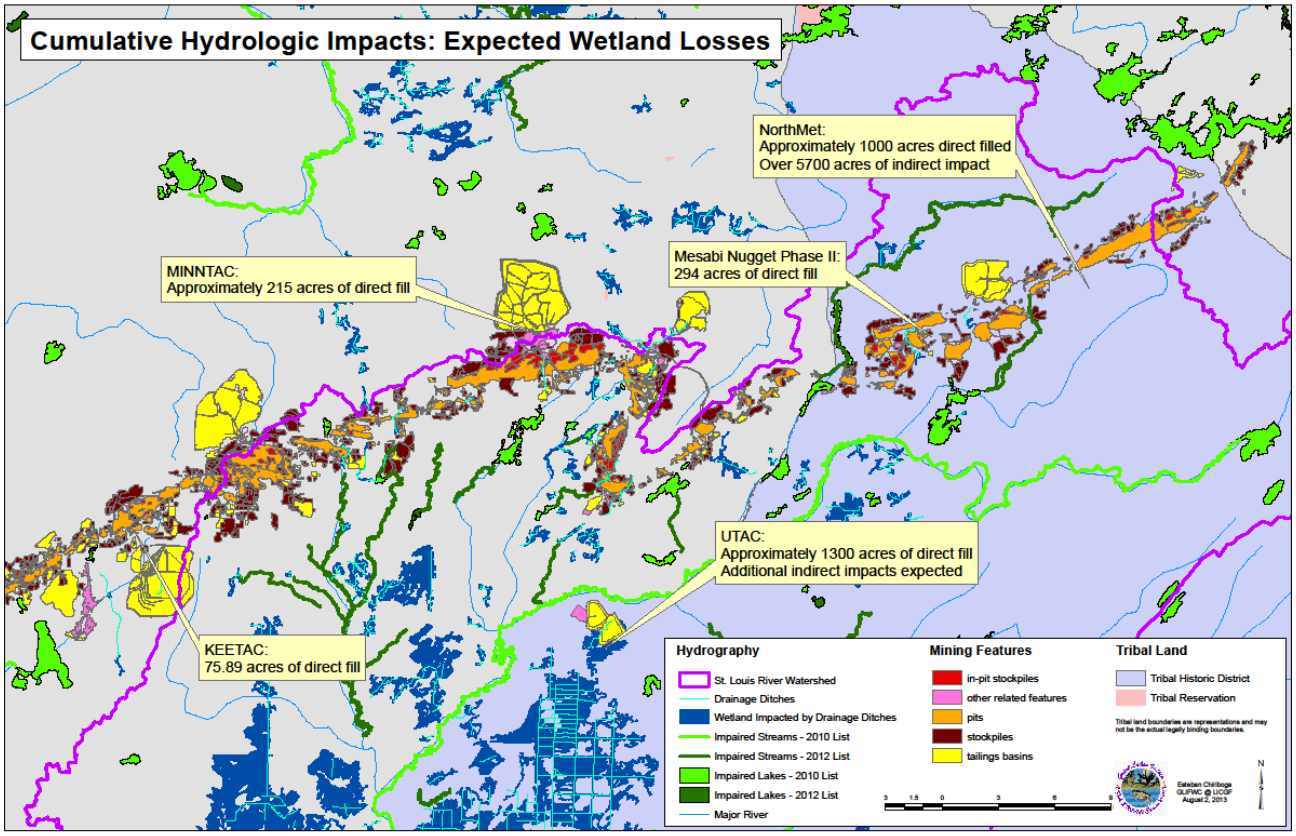

Figure 18. Cumulative Hydrologic Impacts: Expected Wetland Losses within the St. Louis River watershed

When all impacts to water quality, aquatic communities, wetlands, and hydrology are considered in a comprehensive manner, the cumulative effects on water resources are extensive (Figure 19).

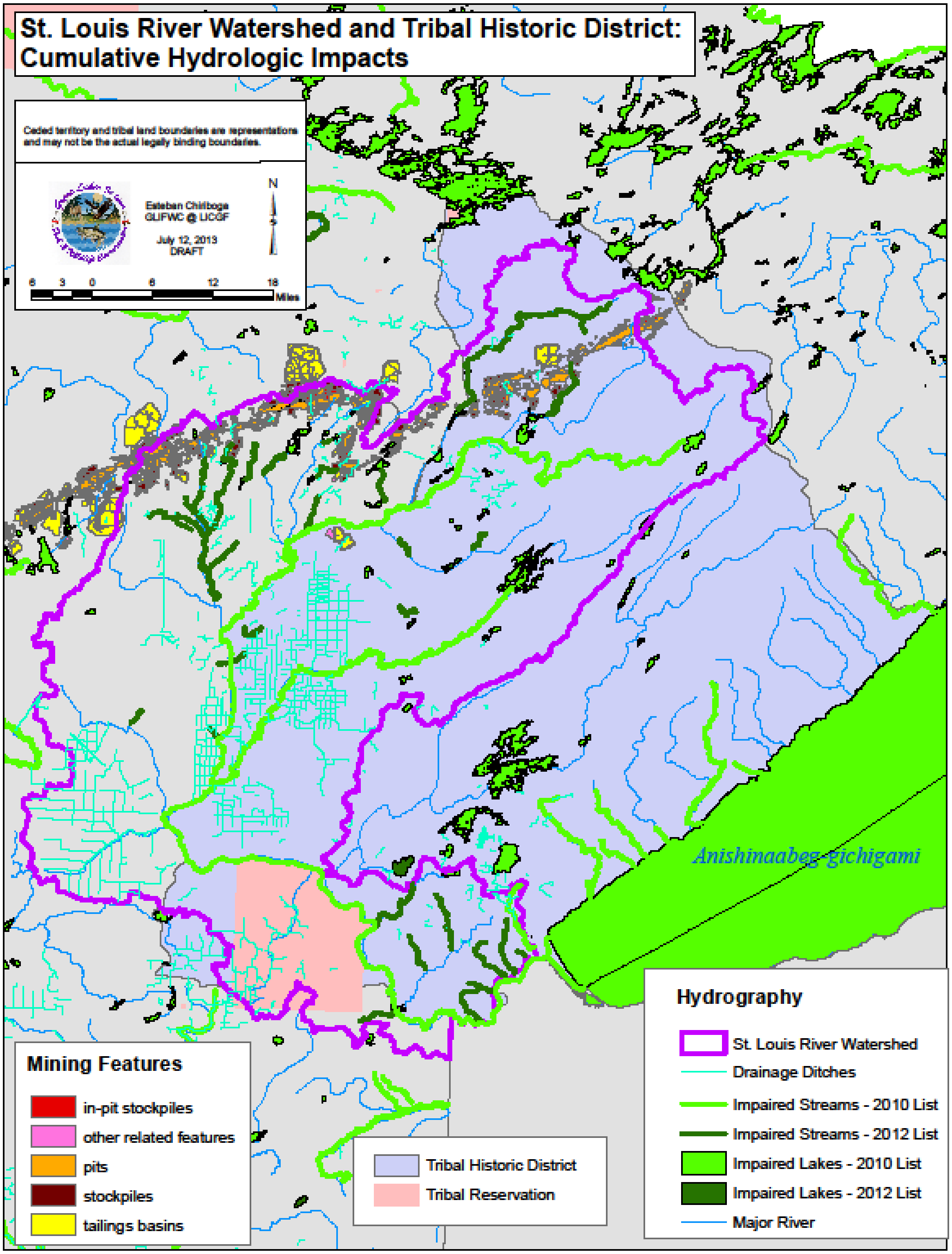

Figure 19. St. Louis River Watershed and Tribal Historic District: Cumulative Hydrologic Impacts.

Vegetation

The co-lead agencies evaluated cumulative effects on vegetation within the portion of the Mesabi Iron Range encompassed by the Nashwauk Uplands and Laurentian Uplands ecological subsections. From the preliminary SDEIS:

"Minnesota Biological Survey
The MDNR operates the MBS program, which includes spatial information from survey reports on native plant communities and rare species. Sites of Biodiversity Significance are designated and ranked by the MDNR based on the environmental conditions present, including native plant communities, rare species, and unique habitat. The MBS utilizes a four-tiered ranking system: Outstanding, High, Moderate, and Below (from highest to lowest). Sites of High Biodiversity Significance contain very good-quality occurrences of the rarest species, high-quality examples of rare native plant communities, and/or important functional landscapes (MDNR 2008a). The entire 3014.5-acre Mine Site has been characterized by the MBS as various Sites of High Biodiversity Significance due to the presence of the One Hundred Mile Swamp site, which covers 15 percent of the Mine Site, and the Upper Partridge River site, which is 85 percent of the Mine Site (MDNR 2008a)."

The tribal cooperating agencies believe a more relevant spatial reference for cumulative effects to vegetation would include the One Hundred Mile Swamp and the Headwaters Site. Additionally, the "Contributing Past, Present and Reasonably Foreseeable Actions should include the extensive mineral exploration taking place within the headwaters of the St. Louis River. The degradation and destruction of this landscape and the vegetation that provides forage and habitat for culturally important species, as well as sustenance and medicine for band members, has been a cumulative impact to cultural and natural resources since the signing of the treaty.

From Danielson and Gilbert (2002):
"The Ojibwe gather over 350 wild plant species for food, utilitarian, medicinal, ceremonial, and commercial purposes (Meeker, Elias and Heim 1993; Densmore 1928). Examples include sweet grass (*wiingashk*), white sage (*mashkiki*), basswood (*wiigob*), yellow birch (*wiinizik*), paper birch (*wiigwaas*), wintergreen (*wiinisiibag*) red-osier dogwood (*miskoobimizh*), bearberry (*miskwaabiimag*), wild sarsaparilla (*waaboozojiibik*), white water lily (*akandamoo*), bluebead lily (*odotaagaans*), Canada mayflower (*agongosimin*), swamp milkweed (*bagizowin*), wood lily (*mashkodepin*), rue anemone (*biimaakwad*), wild ginger (*namepin*), blue cohosh (*beshigojiibik*) bloodroot (*meskwiijiibikak*), black ash (*aagimaak*), yarrow (*ajidamoowaanow*), wild rose (*oginiiminagaawanzh*), Labrador tea (*waabashkikiibag*), sweet flag (*wiikenh*), wild black current (*amikomin*), wild blackberry (*odatagaagominagaawanzh*), blueberry (*miinagaawanzh*), nannyberry (*aditemin*), and highbush cranberry (*annibiminagaawashk*). Tribal members may gather wild plants, as guaranteed by their treaty rights, on all public lands within the ceded territories.

The Ojibwe have been "managing" (e.g., respecting, observing and utilizing) the land and its resources since time immemorial. However, tribal members seldom use the term "managing." Through the sharing of stories and spiritual beliefs, elders transfer a wide spectrum of skills and information to younger generations. Some scholars refer to this information as traditional ecological knowledge and wisdom (TEKW). Berkes (1999) defines TEKW as “a cumulative body of knowledge, practice, and belief, evolving by adaptive processes and handed down through generations by cultural transmission, about the relationship of living beings (including humans) with one another and with their environment. TEKW does not reflect a stagnant inventory of information but rather, without disregarding past wisdom, continues to transform through time.

TEKW and contemporary ecosystem management, though not identical, share common characteristics. A report published by the Ecological Society of America Committee on the Scientific Basis for Ecosystem Management states: “Ecosystem management is management driven by explicit goals, executed by policies, protocols, and practices, and made adaptable by monitoring and research base on our best understanding of the ecological interactions and processes necessary to sustain ecosystem composition, structure, and function. In additions, “ecosystem management assumes intergenerational sustainability as a preconditions for management rather than an afterthought” (Christensen et al. 1996). Clearly, shared principles include adaptive management through observation and monitoring and an intergenerational sustainability, including the relationship and dependence of humans and all life on each other.

The tribes remind (these) land managers that, as necessitated by trust responsibility and treaty law, they must ensure the availability and sustainability of wild plant harvest. Irrevocably, the Ojibwe worldview teaches values based on an understanding that humans depend on all other earth beings (Johnston 1976).”

Further documentation of the high quality and ecological function of this landscape is found in *An Evaluation of the Ecological Significance of the Headwaters Site, Northern Superior Uplands Ecological Land Classification System Section; Laurentian Uplands Subsection Lake and St. Louis Counties, Minnesota*, March 2007):

“The Headwaters Site straddles the continental divide, with water from the Site flowing both east through the Great Lakes to the Atlantic Ocean and north to the Arctic Ocean. Paradoxically, the divide runs through a peatland. Although the peatland appears flat, water flows out of it from all sides, forming the ultimate source of rivers that eventually reach two different oceans. The Site is the headwaters of four rivers: Stony River, Dunka River, South Branch Partridge River, and the St. Louis River, which is the second largest tributary to Lake Superior…

The Headwaters Site encompasses vast peatlands on its eastern side, unfragmented upland forests in the west, and broad transition zones between them. Within the Site are two distinct areas, referred to in the document as the “Extensive Peatlands” and the “Big Lake Area,” which are linked hydrologically as part of the Upper St. Louis River watershed. The Extensive Peatlands area is a mosaic of open and forested wetland communities and includes forested upland islands and peninsulas. The Big Lake Area, in the southwestern quarter of the Site, includes Big Lake and surrounding unfragmented upland forest interspersed with small wetlands.

The Headwaters Site is unique in northeastern Minnesota in several ways. The size and complexity of the peatlands in the Extensive Peatlands are unmatched in the Northern Superior Uplands Ecological Land Classification System (ECS) Section. The Sand Lake Peatland Scientific and Natural Area (SNA), established by the Wetlands Conservation Act of 1991, protects one of the 15 most significant peatlands in the state, and it is by far the largest SNA in the Section (MNDNR 1984).

The Nature Conservancy's (TNC) Superior Mixed Forest (SMF) Ecoregion Plan identifies the Sand Lake/Seven Beavers (SL7B) conservation area, including the entire Headwaters Site, as one of 51 conservation areas in the Ecoregion that best represent the ecosystems and species of the Ecoregion, and serve as a blueprint for conservation action…According to the SMF Ecoregion Plan, these conservation areas are the best opportunities for conserving the full diversity of terrestrial and aquatic ecosystems and globally rare or declining species. The SMF Ecoregion Plan identifies these areas as critical places for conserving biodiversity…and outlines the threats to conservation and conservation targets for these areas…recognizing that more detailed site planning is needed to address how to implement conservation efforts…

The Minnesota Pollution Control Agency has ranked the Upper St. Louis River watershed in the second highest category in the Lake Superior Basin for watershed integrity (Minnesota Pollution Control Agency 2003). The Headwaters Site is among the highest quality areas within the watershed. The upland forest surrounding Big Lake is among the largest, if not the largest, unfragmented, predominantly upland forest in the North Shore Highlands, Toimi Uplands, and Laurentian Uplands (NTL) ECS Subsections. The upland forest area covers 7,920 acres (including 788-acre Big Lake). This high-quality, fire-dependent forest has not been logged in recent decades, except for two stands totaling 140 acres, along the northern edge of the Site.

Covering an area roughly 11 to 12 miles (from northeast to southwest) by 7 to 8 miles (from northwest to southeast), the Headwaters Site is a mosaic of high-quality native plant communities that have functioned under relatively undisturbed conditions since the nineteenth and early twentieth century, when parts of the Site were logged and then burned by wildfires. A corridor containing a railroad grade and power line crosses this vast area, representing the only major permanent conversion of the natural landscape. Minnesota County Biological Survey (MCBS) sites bordering about two-thirds of the Site's boundary have been assigned High or Moderate statewide Biodiversity Significance (Figure 4, page 85). The lack of roads, absence of recent large-scale logging, and large size of the Site allow for natural functioning of ecological processes. These processes include disturbances such as wind, fire, and flooding, as well as plant species competition, nutrient cycling, and hydrology. Natural landscape patterns, such as patch size of the various plant communities, have not been altered, in comparison with most other parts of northeastern Minnesota (White and Host 2003). Minimal recent human disturbance also results in a landscape with very few populations of exotic or invasive species.

The predominant upland forest native plant community in the Big Lake Area is Aspen – Birch Forest [FDn43b], with inclusions of Upland White Cedar Forest [FDn43c] and White Pine – Red Pine Forest [FDn43a] (Figure 5, page 87). Isolated wetlands within the Big Lake

Area's upland forest support a variety of native plant communities, including Northern Poor Conifer Swamp [APn81], Northern Rich Spruce Swamp (Basin) [FPn62], White Cedar Swamp (FPn63a), Northern Alder Swamp [FPn73a], and Black Ash - Conifer Swamp [WFn64a]…

The Extensive Peatlands are composed of a complex of native plant communities, including Northern Cedar Swamp [FPn63]; Northern Rich Spruce Swamp (Basin) [FPn62]; Northern Alder Swamp [FPn73]; Northern Rich Tamarack Swamp (Water Track) [FPn81]; Northern Rich Fen (Water Track) [OPn91]; Northern Rich Fen (Basin) [OPn92]; Northern Shrub Shore Fen [OPn81]; Northern Spruce Bog [APn80]; Northern Poor Conifer Swamp [APn81]; Northern Open Bog [APn90]; and Northern Poor Fen [APn91]. The many upland islands in this portion of the Site provide additional native plant community diversity, supporting community types in the Northern Dry-Mesic Mixed Woodland [FDn33] and White Pine-Red Pine Forest [FDn43] classes…

The Headwaters Site supports healthy known populations of eight state-listed plant species, all of which are listed as Special Concern (SPC) in Minnesota: coastal sedge *(Carex exilis)*, Michaux's sedge *(Carex michauxiana)*, English sundew *(Drosera anglica)*, bog rush *(Juncus stygius),* small green wood orchid *(Platanthera clavellata),* Lapland buttercup *(Ranunculus lapponicus)*, sooty-colored beak rush *(Rhynchospora fusca)*, pedicelled woolgrass *(Scirpus cyperinus/S. pedicellatus)*, and Torrey's mannagrass *(Puccinellia pallida)*...The unfragmented complex of high-quality native plant communities within and across the Site's landforms provide excellent habitat for a wide variety of animal species distinctive of the landscape, including moose, gray wolf, sandhill cranes, American bitterns, boreal and great gray owls, and numerous amphibians, butterflies, and small mammals.

In 2005 and 2006 the Minnesota County Biological Survey of the MN DNR conducted rare plant and native plant community fieldwork, mapped the native plant communities and completed this Ecological Evaluation of the Headwaters Site. Based on the natural features and conditions revealed through this recent work and that of others since the 1980s, MCBS recommends the primary management objective for the Headwaters Site be to protect, enhance, or restore ecological processes and native plant community composition and structure. In accordance with this objective, the site or portions of the site may be identified by landowners or land management agencies for conservation activities such as special vegetation management, including ecologically based silviculture and forest development activities, or for designation as a park (city, county, state, or private), research natural area, non-motorized recreation area, scientific and natural area, or other reserve. This Ecological Evaluation has been written to characterize the ecological significance of the MCBS Site as a whole and to serve as a guide for conservation action by the various landowners.

MANAGEMENT RECOMMENDATIONS

Overview

The Headwaters Site is a large, natural area with features of widely recognized statewide ecological and biological significance. These include:

- one of the 15 most significant peatlands in the state (MN DNR 1984, Wright et al. 1992);
- the largest SNA in the Northern Superior Uplands Section;

- one of the largest, unfragmented, predominantly upland forest patches in the Laurentian Uplands,
- Toimi Uplands, and North Shore Highlands subsections;
- an ecologically functional mosaic of high quality native plant and animal communities;
- a concentration of excellent occurrences of rare species populations;
- support of species with large home ranges;
- six state-designated old-growth stands;
- remote, undeveloped lakes.

The documented condition and quality of the aquatic and vegetation resources within this headwaters region of the St. Louis River watershed meet the resource-based threshold of an Aquatic Resource of National Importance, under the Memorandum of Agreement reached by the EPA and the US Army Corps of Engineers in 1992[16].

Wildlife

The word "moose" does not appear at all in the SDEIS cumulative effects analysis, despite consistent concerns raised by tribal cooperating agency staff to co-lead agency staff during the environmental review process. As of August 19, 2013, moose are now proposed to be listed as a MNDR species of concern.

The tribal profile for the Grand Portage Band, states the unique importance of this species:

"Moose are the primary subsistence species for the Grand Portage Band and define the subsistence culture."
http://www4.nau.edu/tribalclimatechange/tribes/greatlakes_lschippewa.asp

From the Fond du Lac Wildlife Biologist: "In my experience at FDL, moose have always had a loyal core of hunters who pursue moose every year. Primarily for meat, but some for hide, bone and antler related crafts. I think also for the camaraderie, family traditions, etc – same as the rest of us for deer or duck camp. For the last couple of years at least, FDL has been supplying other bands with moose hides for drums.

Until very recently, the demand for moose hunting opportunities at FDL has always been greater than the supply. It's unique among locally hunted or trapped wildlife species that way. As the moose population has rapidly dwindled in the last couple of years, I believe more and more potential moose hunters are deciding it's not worth the effort.

Of all wildlife species, moose has required the most back and forth discussions between staff, legal counsel and the DNR regarding co-management of resources within the 1854 Ceded Territory. This again is a supply and demand issue, and reflects the relatively low density at which moose populate the landscape – even when times were good. -My program invests more effort and money in annual population surveys of moose than any other wildlife species."

[16] Clean Water Act Section 404(q) Memorandum of Agreement, Part IV (August 11, 1992)

The rationale for a comprehensive cumulative impacts analysis for moose can be found in the MDNR SONAR proposing listing of moose as a species of special concern:
(p. 21) “Between 1990 and 2000, the northwestern Minnesota Moose population underwent a substantial decline, and a 2007 Minnesota DNR aerial survey determined that as of that date, fewer than 100 Moose comprised the northwestern population. Aerial surveys currently estimate the northeastern Minnesota population at roughly 4,230 individuals. The northwestern Minnesota Moose population decline occurred in less than a decade. Recent surveys document a slow decline in the northeastern Minnesota Moose population.

“Increased temperatures are likely to increase heat stress and lead to increased mortality within the state’s remaining Moose populations. Changes in land ownership and changes in forest management practices within the state’s Moose range may be having a significant adverse effect on the quantity and quality of the species’ habitat within the state, and particularly on thermal refuges in warmer weather. The state’s northeastern Moose population has not shown as rapid a decline, but is very likely to be dramatically impacted by rising temperatures resulting from climate change. This will likely lead to a marked decline in this population within the foreseeable future.”

From the *Report to the Minnesota Department of Natural Resources(DNR) by the Moose Advisory Committee (18 August 2009)*:
“In MN, moose habitat can be characterized as young forest stands, older forest stands with gaps of regenerating forest, wetlands, muskeg, marsh, riparian areas and brushlands with abundant deciduous browse within reach of moose and adequate winter and summer thermal cover. Functionally, habitat provides forage and cover. Moose forage has a primarily deciduous browse component and a seasonal aquatic component. Cover has several potential components for moose: protection from heat, protection from deep snow, moderation of cold temperatures, predator avoidance and presence of calving locations. In addition to the functional aspects of habitat, spatial distribution of habitat must also be considered at a variety of scales (from subhome range to the landscape level).

“As moose are increasingly challenged by warmer temperatures and changing precipitation patterns due to climate change, changes in land ownership and changes in forest management practices that occur within MN moose range have the potential to significantly affect the quantity, quality, and distribution of moose habitat. Examples include but are not limited to: habitat fragmentation due to expected and occurring ownership changes and shifting landowner objectives, changes in the extent of forest management due to national and state economic effects on the primary wood- using industry in Minnesota, and increased harvesting of smaller diameter trees and brush used by moose for browse as the demand for woody biomass increases. Focused management to provide high quality habitat (forage and cover) may be necessary to slow population declines and maintain or recover moose in appreciable numbers in Minnesota.”

A cumulative impacts analysis must be done for this species of concern that it is of particular cultural importance to the Bands.

Air

<u>Fugitive dust:</u>

The tribal cooperating agencies believe that wind-blown dust particles containing sulfate compounds that are emitted from mining and beneficiation activities could contaminate wetlands, lakes, and streams near the project site and could cause harm to the Species of Special Concern that have been found in this area and to the animals that depend on these plants for food. While the PSDEIS attempts to address this issue, this is the first time details of this analysis have been available for review, and the tribes have identified some areas that require more work. The tribes do not agree with the assumption that only those areas showing model-estimated deposition rates greater than 100% of background deposition will be impacted. The choice of the "100% of background" level of deposition appears to be arbitrary and is not supported by any documentation. Further, the modeled deposition rates do not include the effects of contamination to wetlands and water bodies that may occur through other mechanisms, such as pit leaks and seepage, nor how additional sulfate will impact waters that are already experiencing elevated sulfate levels, with regard to the growth of wild rice. The work that has been done so far in this section does not meet the definition of a cumulative review.

The text describing this analysis is also unclear in places, as described below. In addition, tribal cooperating agency air staff members were not consulted regarding the impact of fugitive dust on historic properties and the definition of intra-property APE, especially with regard to mercury or acid dust (See page 4.2.9-9 of the PSDEIS).

All figures and page numbers cited below refer to the PSDEIS.

<u>Misleading Description</u>

- While areas of fugitive dust deposition may not exceed the ambient air quality standard beyond the property boundary, as stated in the PSDEIS, this information is irrelevant with regard to the tribes' concerns regarding sulfide dust, because there is no ambient air quality standard that is applicable to sulfide dust. Therefore, statements of this nature should be removed.

<u>Acid and Metallic Dust</u>

- Figure 5.2.3-23 (PSDEIS) shows that there are indeed potential indirect impacts to wetlands outside of the ambient air boundary due to deposition of dust. Figure 4.2.9-3 corroborates this claim by showing that the Fugitive Dust Area of Potential Effects extends well beyond the plant site.

- Page 5.2.3-6 lists the fugitive sources that were modeled for deposition. Rail cars and tailings basins were not included. Section 5.2.3.2.2 (page 5.2.3-58) states that the air IAP group determined that emissions from railcars would be coarse in nature and would not be dispersed to any great extent; therefore these emissions were not modeled. The section also states that "Based on this conclusion, air modeling of potential release of dust from railcars will not be performed because the potential wetlands effects would not be significant". The analysis also assumes "that all spillage of the coarse material would occur in a 2-meter-wide strip on both sides of the center line of the railway over the entire haul distance." While the dust may settle near the tracks, there is no evidence that it will not subsequently disperse and cause impacts. The dust can easily be spread through run-off.

- Tailings basin emissions were not modeled. Pages 5.2.3-50 and 5.2.3-51 and page 5.2.3-74 discuss fugitive dust somewhat, but do not make it clear whether "dust" is meant to address the acidic composition of the dust, or some other component. There are also contradictory statements on page 5.2.3-51: "All of the receptor nodes with the highest model-estimated deposition rates were located within the ambient air boundary" versus "Of the 234 acres of wetlands, 228 acres (97%) would be located within the Mine Site ambient air boundary". "97%" does not equal "all"; apparently 6 acres of wetlands with the highest model-estimated deposition rates are outside of the ambient air boundary.

- Figure 5.2.3-17 indicates that the Partridge River could be impacted by fugitive dust, however this is not stated or addressed in the text.

- From page 5.2.3-51 "The potential release of dust from railcars transporting ore from the Mine Site to the Plant Site was addressed in an Air Quality IAP Workgroup that concluded potential wetland effects would not be significant and, therefore, air modeling was not performed (PolyMet 2013b). The tribal cooperating agencies have not been provided with any report that was generated by that workgroup, nor do they have any information about how that conclusion was reached. Also, "Of the 19,914 acres of wetlands identified within the Mine Site receptor grid, deposition modeling results indicated that 234 acres of wetlands could be potentially indirectly affected (modeled metal deposition rates greater than 100% of the background". It is unclear whether modeling was performed for both metals and sulfide dust, and whether the results discussed on page 5.2.3-74 are for metals or sulfide dust. While Figures 5.2.3-16, 5.2.3-17, 5.2.3-22, and 5.2.3-23 differentiate between metals or dust modeling results, the discussion needs to be clearer.

- There are a number of unclear or incorrect statements under the heading *Fugitive Dust/Metals and Sulfide Dust Emissions* on page 5.2.3-74. Initially, the section states that "all receptors have model-estimated dust deposition of 50% or less of the effects-level background of 365 $g/m^2/yr$" but the next sentence states that "at the Plant Site, there would be two locations showing model-estimated deposition rates greater than 100% of background deposition". These two statements are contradictory.

- It is not clear which metals were modeled and whether the background concentrations mentioned (365 $g/m^2/yr$) was for metals or sulfide dust. There is no explanation for the origin of this background concentration and how the metals concentrations in dust were obtained. There is also no explanation of why 100% of background deposition was chosen as an indicator of whether potential effects could occur. To our knowledge, no discussion of this modeling or the assumptions contained within it was conducted with tribes or the co-leads before the PSDEIS was released.

- This section also indicates that the "southern and western two-thirds of the basin" shows model-estimated deposition rates greater than 100% of background deposition (exactly what constituent is being discussed is not clear). However, this same paragraph goes on to state that only 193.9 acres of wetland out of 25,846 could be potentially indirectly affected. These two statements appear to contradict one another. Without knowing what constituent is being discussed, it is hard to know which figure (5.2.3-16, 5.2.3-17, 5.2.3-22 or 5.2.3-23) corresponds to the text. Also, the yellow highlighted area on Figure 5.2.3-23, which indicates the "extent of the highest estimated deposition receptors with deposition of 100% of background", appear to cover a much larger area than 193.9 acres out of 25,846 total acres.

- The paragraph also states that "approximately 90% of the receptor nodes with the highest model estimated deposition rates are located within the ambient air boundary". It is impossible to verify this statement, because a map showing the location of the receptor nodes does not seem to have been included. If this statement is true, it overlooks that fact that 90% of the ***area*** predicted to be impacted does not lie within the ambient air boundary - only about 60% does, judging from Figure 5.2.3-23.

- The tribal cooperating agencies do not agree with the statement that "no potential indirect wetland effects from fugitive dust to Second Creek would occur" (page 5.2.3-74). A portion of Second Creek appears within the area predicted to experience deposition of 100% of background.

- Chapter 5's discussion of fugitive sulfide dust calls for future wetlands monitoring where predicted deposition will exceed 100% of the background value (first full paragraph on page 5.2.3-51). This monitoring should look at water chemistry, hydrology, soil color, texture, and composition and should take place annually for the first three years of operation and then every five years afterward. Baseline numbers should be obtained before construction starts.

- Page 5.2.4-4, *Indirect Effects* calls for water spraying areas of fugitive dust release during dry periods. Page 5.2.7-8 also calls for watering haul roads and other unpaved roads. In the case of dust that may have high acidic content, this would be a poor option, as the addition of water to the dust could simply create problems with run-off. The fugitive dust control plan also lists several monitoring options that "could" be done. These are left as vague ideas, but are not required. These options should be made more concrete.

Fibers

The tribes believe that the cumulative impacts of mineral fibers are not adequately addressed in the PSDEIS. In fact, no cumulative impact analysis of mineral fibers was performed because the PSDEIS asserts that mineral fibers will not be contacted in this project. This is a reckless assumption to make, with little evidence provided for justification, and it leaves a potentially harmful situation completely unaddressed. For example, the distance of the PolyMet project to known deposits of mineral fibers should be given in the PSDEIS. Rates of mesothelioma on the Iron Range are already alarmingly high, making it irresponsible for potential cumulative impacts to remain unaddressed. Although preliminary results from the University of Minnesota indicate that exposure to dust from today's taconite operations is "generally within safe exposure limits", it is possible that exposure to additional dust could lead to more cases of mesothelioma 30-40 years in the future, after the mine has closed. This is an issue that should unquestionably have received a cumulative impacts analysis. While the mine is expected to close in 20 years, this is not a timeframe that is relevant to either tribal concerns or to the development of mesothelioma. Tribal members live and recreate in areas close enough to the mine for this to be a source of concern. The proximity of fish, game, and culturally significant plants to the project site cause this issue to be an item of concern.

Only one year of mineral fiber monitoring in Hoyt Lakes is proposed in the PSDEIS, which the tribes believe is insufficient for detecting the potential release of fibers from portions of the formation that will be encountered during later years of operation. It is also not clear why Hoyt Lakes was chosen as a monitoring site, or if this where air dispersion modeling predicts maximum impacts. The tribes would expect to see monitoring performed for the entire life of the mine, at the site of maximum predicted impact. Since no "safe" mineral fiber concentration level has yet been specified, the tribal cooperating agencies urge the State of Minnesota to move forward to set this limit as soon as possible.

Noise

The co-lead agencies simply state that there are no other past, present, or reasonably foreseeable actions that would interact in such a way as to have a cumulative effect on the receptors identified in Sections 4 and 5 and no further evaluation of cumulative noise effects has been conducted. The tribal cooperating agencies believe it is indefensible to conclude that, amidst a "mining district" with multiple active mine facilities operating in close proximity, that there is no cumulative effect of 24 hour/day, seven days/week of heavy industrial and blasting noise on sensitive wildlife and on traditional cultural practices.

Cumulative Impacts of Noise, Vibration and Airblast Overpressure

Tribal cooperating agencies note that the noise information presented in the PSDEIS will be replaced with new data in the SDEIS. We have not been afforded the opportunity to review this information and must withhold detailed comment on the noise analysis for a later date.

With respect to cumulative impact analysis, tribal cooperating agencies do not believe that an adequate analysis has been done. Meeting ambient noise standards is a different question than assessing impacts. Impacts should be fully characterized in this document and contour maps showing overlapping noise pollution from different projects provided. Without this information, it is not possible for the public to review the cumulative impacts of noise. In addition, the cumulative impacts of mine related vibration have not been assessed. As shown in Figure 20, the cumulative effects of vibration are spatially extensive.

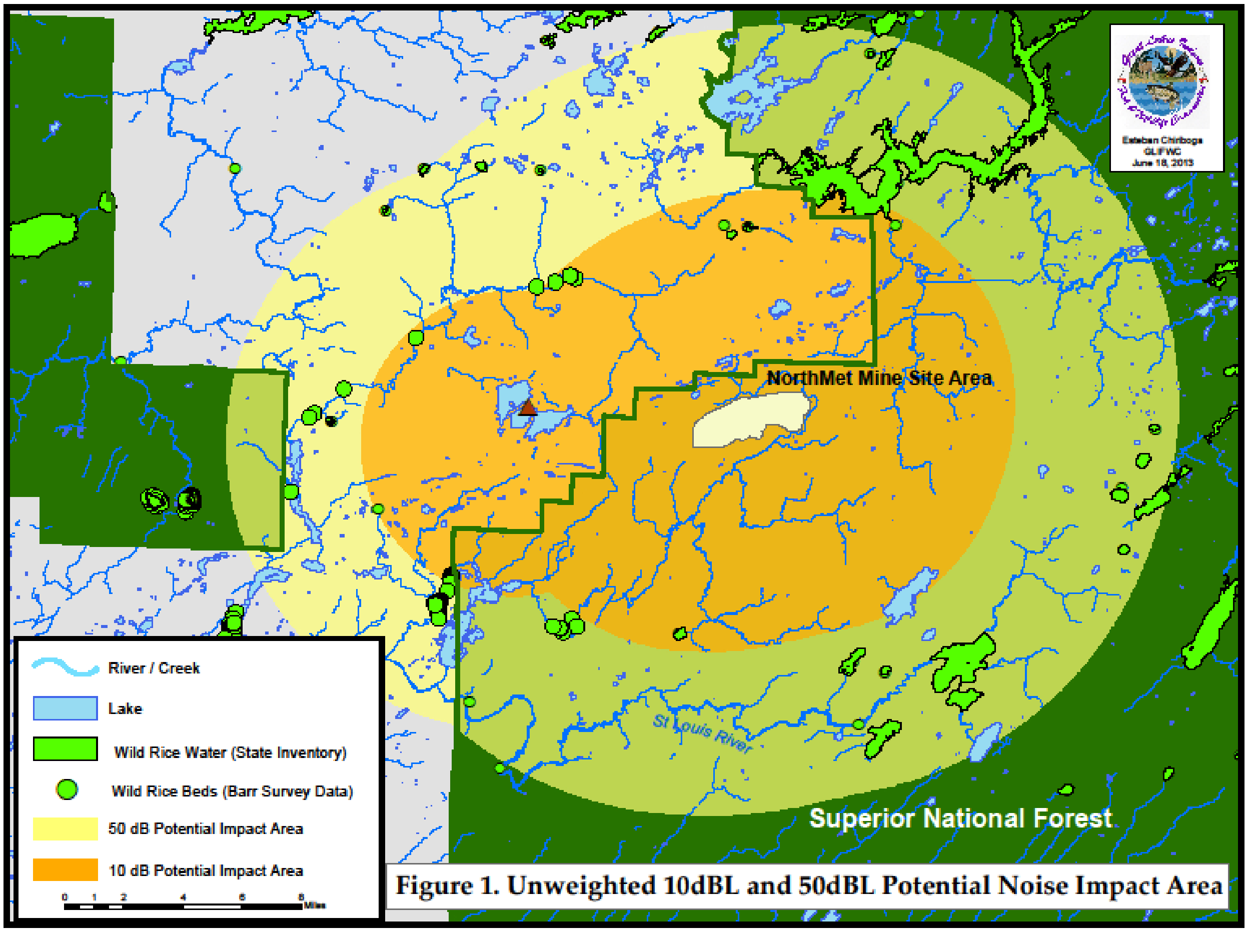

Figure 20. Unweighted 10 dBL and 50 dBL Potential Noise Impact Area

Tribal cooperating agencies also note that the noise, vibration, and airblast overpressure analysis confuses baseline noise levels with existing conditions and assumes they are the same thing. Baseline noise levels in the SDEIS should be natural noise levels that do not include existing mine operations such as Northshore. In other words, baseline is the pre-mining condition. Existing conditions are the noise levels currently recorded at the site of the proposed mine which include any contributions from the Northshore mine, the Dunka road, etc. The analysis would then use both of these pieces of information to assess the effects of the project as a single entity and in combination with other projects in the cumulative section. The lead agencies have indicated that they are using existing conditions (currently measured noise levels) as background. This is not appropriate and should be corrected.

The noise data presented in the SDEIS used A-weighted decibel data (dBA). This is appropriate when considering the effects of noise on humans because it focuses on the frequencies that the human ear can perceive. However, this weighting is not appropriate when assessing the effects on animals because they can perceive different, and often greater, ranges of frequencies than humans. The United States Department of Transportation (USDOT) has developed a document[17] describing the effects of noise on animal populations. In general the document indicates that the sensitivities of various groups of wildlife can be summarized as:

- Mammals < 10 Hz to 150 kHz ; sensitivity to -20 dB
- Birds (more uniform than mammals) 100 Hz to 8-10 kHz; sensitivity at 0-10 dB
- Reptiles (poorer than birds) 50 Hz to 2 kHz; sensitivity at 40-50 dB
- Amphibians 100 Hz to 2 kHz; sensitivity from 10-60 dB

Figure 21 indicates the noise area of impact for wildlife. The noise contours are unweighted decibel values (dB). A more complete analysis of these impacts in the SDEIS document for the NorthMet project is needed. Known locations of wild rice are included in the map because it is an important source of food for waterfowl. We also note that the entire area of impact is important habitat for Canada Lynx.

As illustrated in Figures 21 and 22, the impacts of noise, airblast and ground vibration overlap in a large area surrounding the mine site. Figure 21 (Cumulative Impacts on Wildlife) also provides the location of the remaining wildlife corridors in the area. The wildlife corridor immediately northwest of the mine site would be cumulatively affected by noise (10dBL and 50 dBL) airblast overpressure and ground vibration. These impacts when thought of in the context of its proximity to the mine site, wetland destruction and fragmentation of the 100 mile swamp lead to a conclusion of a severe and significant impact to this corridor. Figure 22 (Cumulative Impacts on Humans) indicates areas of tribal significance that are affected.

[17] *Synthesis of Noise Effects on Wildlife Populations*, USDOT Publication No. FHWA-HEP-06-016, September 2004

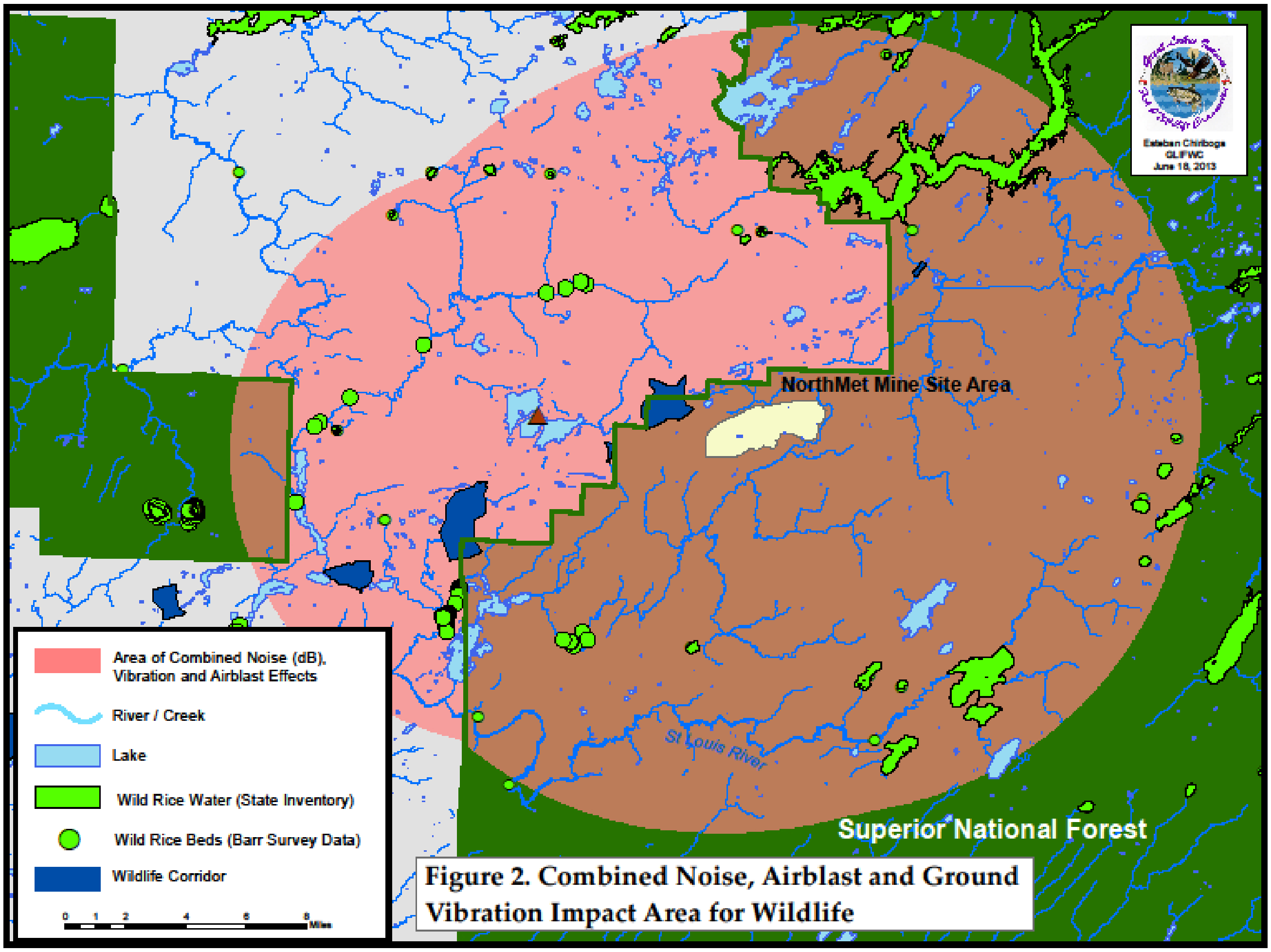

Figure 21. Combined Noise, Airblast and Ground Vibration Impact Area for Wildlife

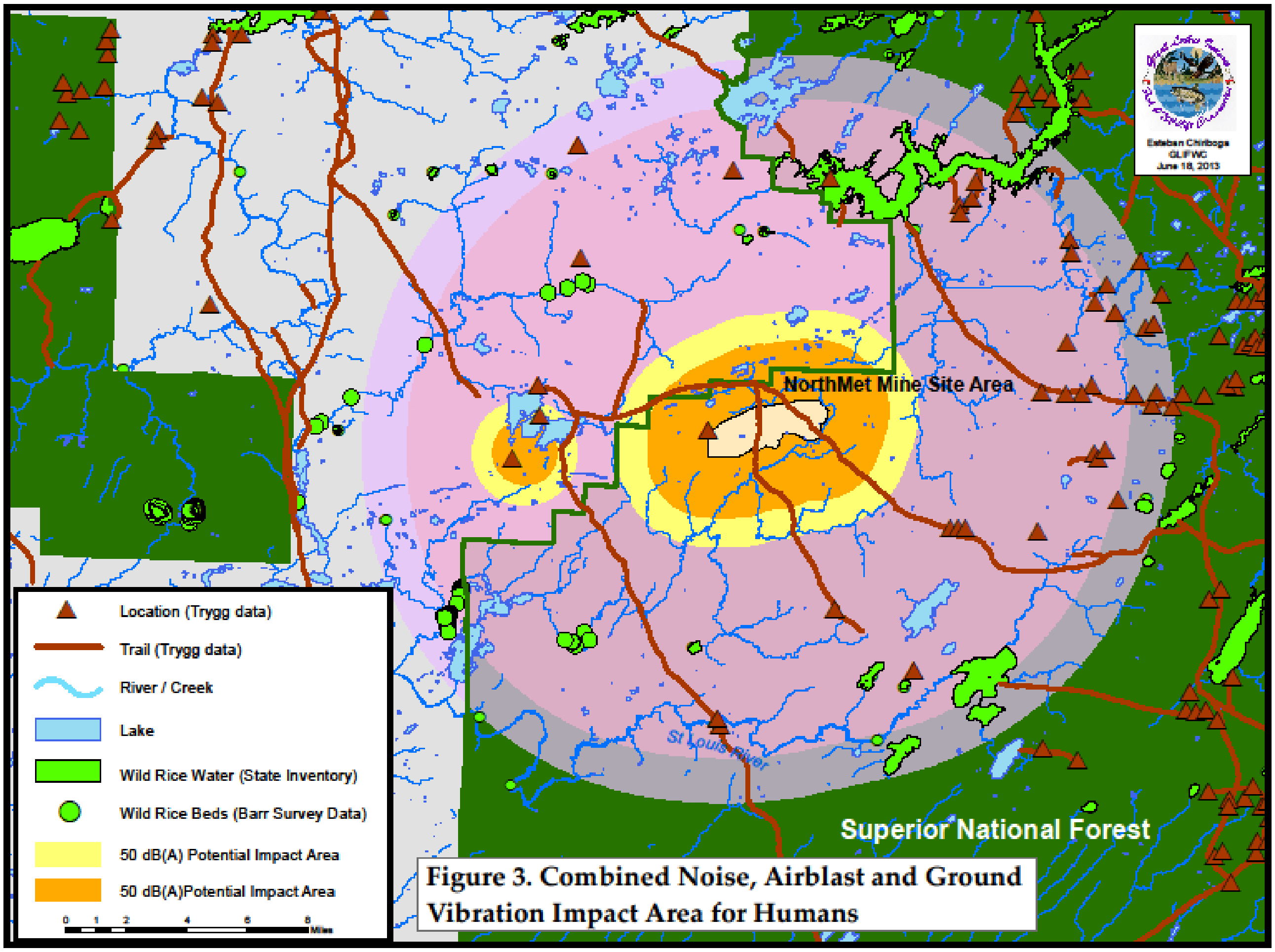

Figure 22. Combined Noise, Airblast and Ground Vibration Impact Area for Humans

No Action Alternative

A December 3, 2008 memo from NTS to the MPCA regarding the Area of Concern (AOC) Summary for the VIC Projects on the Cliffs Erie Property shows twenty-nine AOCs within the Project area. Only three AOCs have been remediated. Twenty of the remaining twenty-six sites' status is listed as "Area within property under Contract for Sale with PolyMet. No actions have been taken with regard to this site."

Some of those sites include: "Oily Waste Disposal Area, Private Landfill, Dunka WTP Sludge, Tailings Basin Reporting, Transformers, Emergency Basin, Cell 2W Salvage Area, Hornfels..." It also appears that there has not been a brownfield/superfund site investigation for the properties PolyMet intends to acquire for the Project area to assess existing contamination. Therefore, critical information to determine cumulative impacts at the site are not included in the SDEIS, and natural background water quality cannot be differentiated from existing contamination requiring remediation.

According to CEQ guidelines:

"No action" in such cases would mean the proposed activity would not take place, and the resulting environmental effects from taking no action would be compared with the effects of permitting the proposed activity or an alternative activity to go forward.

Where a choice of "no action" by the agency would result in predictable actions by others, this consequence of the "no action" alternative should be included in the analysis. For example, if denial of permission to build a railroad to a facility would lead to construction of a road and increased truck traffic, the EIS should analyze this consequence of the "no action" alternative."

Based on the above CEQ guidelines, it is clear that activities that will occur under the Cliffs Consent Decree should be included in modeling of a No Action alternative. Unfortunately not only are the consent decree activities not included, but the fact that it will be precipitating on the tailings basin for the foreseeable future has not been included in the No Action modeling. This is evident by the model results that show stable levels of chloride coming from the basin for the next 200 years (Figure 23) when there is no ongoing source for chloride. With no source for new chloride, rainwater will gradually dilute the residual chloride in the basin and levels will drop. The PSDEIS claims that the basin's water quality has stabilized and that the current conditions will not change over time. The claim of chemical stability is based on basin pond water sampling for only 4 years (2001 – 2004, PSDEIS Table 4.2.2-23).

Since there has been no water quality data collected in the basin pond for 9 years it is reasonable to assume that the past 9 years of precipitation has diluted the water chemistry in the basin pond, and that eventually the more dilute water will percolate through the basins and be discharged at the toe. If chemical stability is to be assumed, more recent data on basin pool water chemistry is needed. While the CEQ makes it clear that a blind "continuation of existing conditions" model is inappropriate as a No Action alternative, a "continuation of existing conditions" model that ignores simple environmental processes such as precipitation is even less appropriate.

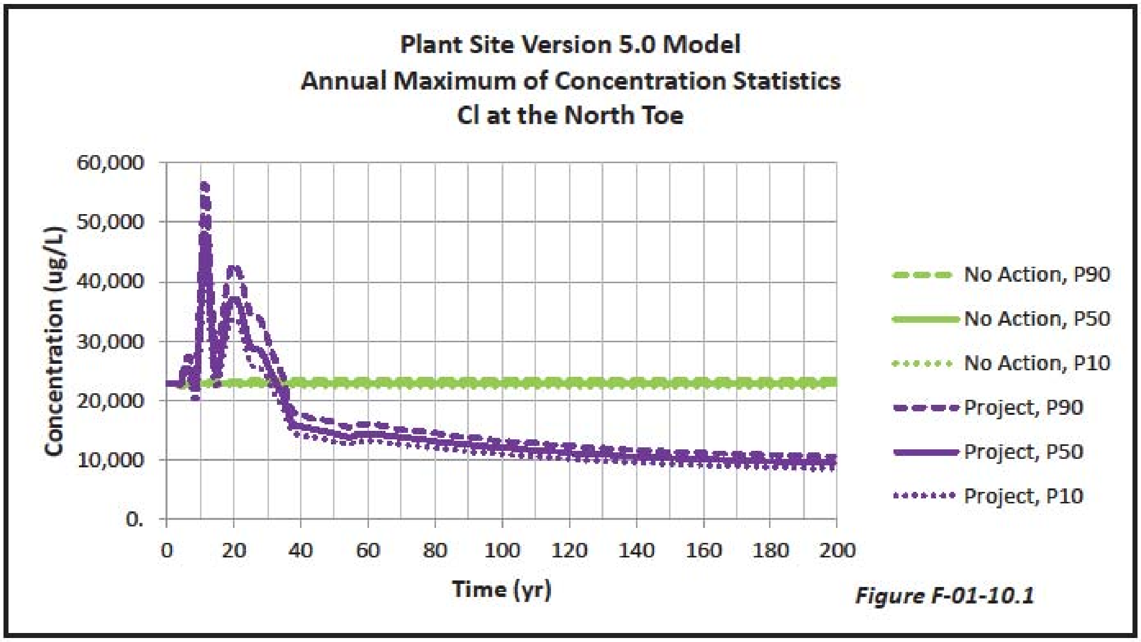

Figure 23. Annual Maximum of Concentration Statistics: Chloride at the North Toe.

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Proposed Transport of Ore

GLIFWC staff disagrees that the amount of ore that could escape from rail cars would be "small." Taconite pellets currently litter the railroad right-of-way between the plant site and the proposed mine site, confirming that spillage from rail cars does occur (attached Figure 1). Second, fugitive dust escaping through these gaps is also a concern. Given the duration of this proposed project and the large quantity of materials to be moved, approximately 228 million tons of ore and 394 million tons of waste rock, there will be tracking, dusting, and spillage of material that has been demonstrated to leach contaminants when exposed to air and water. Even a loss of only one thousandth of one percent (0.001%) of the extracted material to tracking, dusting or spillage would result in 6,220 tons of fine leachable material being released into the environment. Our experience with a much smaller, shorter duration, sulfide mine in Wisconsin (Flambeau Mine) indicates that tracking and dusting of ore and waste rock, even at a level that is unnoticed during operations, can result in soil and runoff contamination that exceeds standards.

Transport of ore between mine site and processing plant would be done by rail using the rail cars previously used by LTV. These cars are not sealed and will readily spill a fraction of the approximately 228 million tons of ore they are transporting. Attached are pictures of the cars proposed for transporting the sulfide ore (Figures 2 and 3). The rail line between the mine and the processing plant is approximately 8 miles long, 1 mile of which is over wetlands, and crosses over at least 3 creeks. The current proposal to use existing rail cars for ore haulage raises concerns about impacts to biotic endpoints along the rail corridor. Given the design and current condition of the rail cars proposed for transport an ecologically significant amount of spillage could occur into these streams, wetlands and their watersheds. Because transport will deposit some level of ore and ore dust along the rail line, methods for control of contaminated runoff from along the rail line must be developed and implemented in the mine plan.

The PSDEIS states that rail maintenance crews can collect spilled debris along the rail track. The material of significant concern would be too small to pick up. GLIFWC staff is unsure how ore debris can be visually distinguished by rail track maintenance crews from other rocks and ore that litter the embankments. In addition, spillage of fine ore pieces and dust (the most leachable sizes) into the wetlands and creeks that are located along the rail line could not be easily identified and recovered. It is reasonable to assume that some acid drainage and metal leaching would occur along the waterbodies located along the rail line.

GLIFWC staff does not believe that the method described in the PSDEIS to segregate fines in the center of the rail car is realistic. GLIFWC has suggested incorporating new rail cars with sealed compartments as a mitigation measure but that alternative has not been included in the PDEIS.

Finally, The PSDEIS states that monitoring of the creeks that could be affected by ore dust deposition will be done. We agree that this is important. However, monitoring would only detect impacts after that have already occurred. The example of the Flambeau mine illustrates that cleanup of ore dust contamination in an aquatic environment is a long and difficult process. A serious examination of the issue of fugitive dust from rail cars should be conducted and included in the DEIS and mitigation options that require the use of sealed rail cars to transport ore from the mine site to the plant site are needed.

Figure 1. Spilled taconite pellets on a bridge above the Partridge River.

Figure 2. Gap in the side hinge of the rail car.

Figure 3. Rail cars proposed for use at the NorthMet project.

Perpetual Maintenance and Water Treatment at the NorthMet Project

The lead agencies position on post closure maintenance and water treatment needs in the SDEIS states:

"Both mechanical and non-mechanical treatment will require periodic maintenance and monitoring activities. Modeling predicts that treatment activities will be a minimum of 200 years at the mine site and 500 years at the plant site. While long term, these time frames for water treatment are not necessarily perpetual. The owning company would be held accountable to maintenance and monitoring required under permit and would not be released until all conditions have been met"

GLIFWC staff disagrees with the characterization of long term maintenance for the NorthMet project. The notion of water treatment and maintenance for hundreds of years, supported by financial assurance instruments that must also be available for hundreds of years, is illogical. Specific flaws in the rationale presented by the lead agencies in the SDEIS follow.

The NorthMet Project is a Perpetual Water Treatment and Maintenance Project

In the statement above, the lead agencies attempt to say that the proposed project does not necessarily require perpetual treatment. That statement is only true if a narrow definition of "perpetual" is used. The term perpetual is used in several ways. These are:

per·pet·u·al
adj.
1. Lasting for eternity.
2. Continuing or lasting for an indefinitely long time.
3. Instituted to be in effect or have tenure for an unlimited duration: a treaty of perpetual friendship.
4. Continuing without interruption.
5. Flowering throughout the growing season.

In the SDEIS the lead agencies are strictly using the term as defined in #1 above. While it is true that it is not likely that water treatment and maintenance needs of the NorthMet project will last for eternity, we believe that definition #2 above is a more realistic use of the term. The project has predicted minimum water treatment timeframes (200 years at the mine site and 500 years at the plant site), but no modeling has been done that would give an indication of when water quality standards would be met without treatment. It could be hundreds of years or thousands. In fact, water treatment needs for the NorthMet project will be required for an indefinite period of time.

The lead agency rationale also ignores a part of the project that will require perpetual maintenance under definition #1 above. The hydrometallurgical residue facility is proposed to contain tailings generated from the hydrometallurgical beneficiation process. These tailings are the most heavily contaminated materials that would be produced at the site and must be separated from the surrounding aquatic environment. This facility has a double liner and cover system that will likely be an effective containment system in the short term. But, given time, this containment system, like all human-made structures, will degrade and fail. No human-made structure has lasted forever, so it is illogical to assume that this facility will. Therefore, this facility will need maintenance, repair and monitoring in perpetuity.

There are many engineered features that will be needed to be maintained in perpetuity (as defined in #2 above). These include the water treatment plants at the mine and plant sites, the water capture and pumpback systems at the flotation tailings basin, the category 1 stockpile cover system, the hydrometallurgical tailings facility, the overflow control structure at the west pit lake, etc. The SDEIS also includes a goal to transition from mechanical water treatment (water treatment plant using reverse osmosis) to non-mechanical methods such as constructed wetlands, permeable reactive barriers, etc. The SDEIS does not provide detail on the passive systems, because it states that their effectiveness would have to be demonstrated at a later date. However, available literature indicates that non-mechanical systems require periodic maintenance as well. Therefore, the hypothetical transition to a non-mechanical treatment method does not eliminate the need for perpetual maintenance.

Minnesota Rule 6132.3200, regarding closures and postclosure maintenance of mines, states that the goal of closure and reclamation is that "[t]he mining area shall be closed so that it is stable, free of hazards, minimizes hydrologic impacts, minimizes the release of substances that adversely impact other natural resources, and is maintenance free." Because perpetual maintenance will be required at the hydrometallurgical residue facility, as well as at the numerous engineered features listed above, the position of GLIFWC staff is that this project does not meet this goal.

The Assumption that PolyMet Will Exist Decades or Centuries after Closure is Not Logical

The lead agency statement above assumes that the mining company will exist for decades or centuries after closure. This is not a realistic assumption. Historically, mining companies are temporary entities that disband soon after a mine project comes to an end. The most reasonable scenario for long term closure is that a state or federal agency will be responsible for monitoring, maintenance, and cleanup activities because a mining company cannot be held accountable if it no longer exists. Similarly, the assumption that financial assurance instruments can be developed to ensure that funds will be available centuries from now is not logical. The State of Minnesota has existed for 155 years. The United States of America has existed for 237 years. The notion that a mining company and financial assurance instruments will be available to work on a mine site 500 years from now is not believable.

The Assumption that Water Quality Standards will be met is Not Logical

Throughout the SDEIS, the Co-Lead agencies state that they expect the proposed project to meet all applicable water quality standards. This expectation is based on modeling and GLIFWC does not believe that the modeling is robust enough to support such a statement. However, even assuming that the modeling accurately represents the real future of the project, it is illogical to assume that standards will be met because the modeling assumes effective operation of water capture and treatment facilities. As stated above, the idea that water treatment plants will operate for hundreds of years is not believable. Therefore, the statement that water quality standards will be met is also not believable.

NorthMet Mining Project and Land Exchange PSDEIS (ver.2) - Tribal Comments and Co-Lead Agencies' Dispositions
8/19/2013

Executive Summary

Comment_No.	Agency	Section	Comment	Co-Lead Disposition	GLIFWC Response
GLIFWC 1	GLIFWC	ES Executive Summary-NorthMet Project Proposed action	As with the first 2 bullets, the third bullet should indicate the length of time that post-closure maintenance and water treatment would last. Therefore, it should indicate that water treatment and maintenance of permanent facilities would be required in perpetuity.	Text edited to reflect that the closure objective is to provide mechanical and non-mechanical treatment for as long as necessary to meet regulatory standards at evaluation locations in groundwater and surface water. Both mechanical and non-mechanical treatment will require periodic maintenance and monitoring activities. Modeling predicts that treatment activities will be a minimum 200 years at the Mine Site and a minimum of 500 years at the Plant Site. While long-term, these time frames for water treatment are not necessarily perpetual. The owning company would be held accountable to maintenance and monitoring required under permit and would not be released until all conditions have been met.	GLIFWC does not agree with the language in the co-lead disposition. Provide a link to the Perpetual care language in the appendix.
GLIFWC 2	GLIFWC	ES Executive Summary	The description of the history of the 2009 DEIS and the need for the SDEIS is not accurate. The reason for the development of a supplemental document and the continuation of the NEPA process is the the EPA gave the 2009 DEIS the lowest possible rating. The EPA found the project to have unacceptable environmental consequences and found that the DEIS failed in its purpose of accurately describing the project and the potential environmental impacts.	The EU-3 rating is discussed in section 1.2.2. "This process culminated in October 2009, with the publication of the NorthMet Project Draft EIS (DEIS) that analyzed the project as it was then designed proposed by PolyMet. After issuing the DEIS, the Co-lead Agencies, responding to public, other federal (including US EPA) and state agency and tribal comments and concerns, analyzed an alternative design that sought to resolve several major environmental concerns and permitting barriers."	ok
GLIFWC 3	GLIFWC	ES Executive Summary	Map is misleading. The area labeled Mesabi Iron Range / Historic mining district encompases areas that have never been mined and are outside the geologic formations where iron mines have operated. It suggests that the NorthMet mine site is part of a mined area which is not correct. The GIS layer depicting all the mine features on the range (pits, tailings basins, etc) should be used instead.	Text editited. This is now called "General Mesabi Iron Range-Historic Mining".	GLIFWC staff disagree with the disposition. We maintain that the figure is misleading.
GLIFWC 4	GLIFWC	ES Executive Summary	Describes the NorthMet deposit as low-medium quality. We disagree with this characterization. The deposit had a low ore grade compared to most other ore bodies in the Great Lakes region. It should be characterized only as low quality.	It is ERM's professional judgment that the NorthMet Deposit should be classified as low-medium grade. Classification of the ore-body in simplified terms is relative and subjective and does not have any implications to the economic viability of the resource, nor does it influence the environmental evaluation presented in Chapter 5. Full description of the mineral resource may be found in PolyMet's 43-101 document. No text edit.	We disagree. In GLIFWC's professional judgement the deposit should only be described as low quality.

Executive Summary

Comment_No.	Agency	Section	Comment	Co-Lead Disposition	GLIFWC Response
GLIFWC 5	GLIFWC	ES Executive Summary - Closure and Post-Closure Maintenance	Text should state that water treatment would be perpetual .	Text edited to reflect that the closure objective is to provide mechanical and non-mechanical treatment for as long as necessary to meet regulatory standards at evaluation locations in groundwater and surface water. Both mechanical and non-mechanical treatment will require periodic maintenance and monitoring activities. Modeling predicts that treatment activities will be a minimum 200 years at the Mine Site and a minimum of 500 years at the Plant Site. While long-term, these time frames for water treatment are not necessarily perpetual. The owning company would be held accountable to maintenance and monitoring required under permit and would not be released until all conditions have been met. Text clarified.	GLIFWC does not agree with the language in the co-lead disposition. Provide a link to the Perpetual care language in the appendix.
GLIFWC 6	GLIFWC	ES Executive Summary - Closure and Post-Closure Maintenance	Should state that because water treatment would be perpetual, maintenance and monitoring needs would also be perpetual.	Text edited to reflect that the closure objective is to provide mechanical and non-mechanical treatment for as long as necessary to meet regulatory standards at evaluation locations in groundwater and surface water. Both mechanical and non-mechanical treatment will require periodic maintenance and monitoring activities. Modeling predicts that treatment activities will be a minimum 200 years at the Mine Site and a minimum of 500 years at the Plant Site. While long-term, these time frames for water treatment are not necessarily perpetual. The owning company would be held accountable to maintenance and monitoring required under permit and would not be released until all conditions have been met. Text Clarified.	GLIFWC does not agree with the language in the co-lead disposition. Provide a link to the Perpetual care language in the appendix.
GLIFWC 7	GLIFWC	ES Executive Summary	What are environmental evaluation criteria? We assume that in many instances these criteria are also standards (eg. Water quality, noise, etc.) When legal standards are the same as environmental evaluation criteria, the term "standard" should be used throughout the document.	Environmental evaluation criteria is the framework selected for use in this NEPA EIS. Discussion of "standards" is a part of the regulatory/permitting process. No text edit.	GLIFWC disagrees with the disposition. We maintain that the language in the SDEIS should be clarified
GLIFWC 8	GLIFWC	ES Executive Summary - NorthMet project effects on water resources section	We disagree that current operating mines are subject to strict environmental rules. Historically, enforcement of water quality standards on these mines has been lax. Sentence should be removed.	Paragraph deleted. The stringency of environmental rules is open to interpretation. Edited as requested.	ok

Executive Summary

Comment_No.	Agency	Section	Comment	Co-Lead Disposition	GLIFWC Response
GLIFWC 9	GLIFWC	ES Executive Summary - NorthMet project effects on water resources section	This discussion is misleading. Compliance with water quality standards for this project is only possible with successful operation of water capture and treatment facilities in perpetuity. The section should state that without perpetual treatment, water quality standards would be excceeded. In addition the decreases in concentrations for some solutes after the project is built may be artifacts of incorrect modeling assumptions. We will provide more detail in the water sections.	See response for GLIFWC 5 & 6. Will consider revisions to text accordingly.	GLIFWC does not agree with the language in the co-lead disposition. Provide a link to the Perpetual care language in the appendix.
GLIFWC 10	GLIFWC	ES Executive Summary	The PSDEIS discussion on mercury states that there is a great deal of uncertainty on these mercury issues. Therefore it is not appropriate for the executive summary to present these results as definitive. See GLIFWC mercury attachment for more information.	No text edit recommended because ES consistent with text in body of SDEIS.	GLIFWC disagrees with the disposition. Provide a link to the mercury section in the appendix.
GLIFWC 11	GLIFWC	ES Executive Summary - NorthMet project effects on water resources section	There are wetlands within the mine project area that will be severely impacted by several different types of mine related effects (fragmentation+drawdown+air deposition). While these wetlands will not be filled, the Corps should require up-front mitigation for them. More information is in GLIFWC wetland attachment.	A wetland monitoring plan would be developed and implemented if the NorthMet project is permitted. The plan would require wetland hydrology monitoring, vegetation monitoring, and wetland water quality monitoring to identify if indirect wetland impacts occur during implementation of the project. If indirect wetland impacts resulting from the project are determined by the monitoring program, compensatory wetland mitigation would be required for those indirect wetland impacts. Fragmented wetlands are classified as indirect impact; however, fragmented wetlands are included in upfront mitigation. Total upfront mitigation is for the 912.5 acres of direct effects and 26.4 acres of fragmented wetlands (indirect effect). Tables have been revised to reflect this. Text clairifed.	GLIFWC disagrees with the disposition. Provide a link to the wetland section of the appendix.
GLIFWC 12	GLIFWC	ES Executive Summary - NorthMet project effects on water resources section	Disagree with this paragaraph.The conclusions written here are based on fatally flawed modeling of surface and groundwater hydrology for the Partridge River watershed. The statements in the paragraph are unsupported.	No change to SDEIS text recommended because subject experts believe that the hydrology for the Partridge River watershed was properly characterized. No text edit.	GLIFWC disagrees with the disposition. Provide a link to the hydrology section of the appendix.
GLIFWC 13	GLIFWC	ES Executive Summary - NorthMet project effects on water resources section	We disagree with the assumption that constituents exceeding water quality standards in the Embarrass River area are natural in origin. It is an accepted fact that tailings basin seepage water has saturated the aquifer in the area. Therefore, the constituent loads exceeding standards are the result of historic mining operations and seepage from the LTV tailings basin.	There is no mention of constituents natural in origin, so no change warranted. No text edit.	ok

Executive Summary

Comment_No.	Agency	Section	Comment	Co-Lead Disposition	GLIFWC Response
GLIFWC 14	GLIFWC	ES Executive Summary - NorthMet project effects on biological resources section	The discussion on restoration of Lynx habitat at the mine site is misleading. The open water feature at the mine site is the re-flooded west pit. The water in the pit is expected to be contaminated and in need of treatment for centuries. In addition, there will be fencing around the pit lake. The speculative language about restoring lynx habitat should be removed.	Edited as requested. "Restoration of disturbed areas as part of mine closure would potentially create lynx habitat, although this successional process could take decades."	ok
GLIFWC 15	GLIFWC	ES Executive Summary- NorthMet project effects on cultural and socioeconomic resources section	Just because a site is not eligible for listing does not mean that it will not be impacted. The conclusion of no impact should be removed or rewritten.	Deleted second half of the second sentence. Text clarified.	ok
GLIFWC 16	GLIFWC	ES Executive Summary- NorthMet project effects on cultural and socioeconomic resources section	A paragraph discussing natural resources as cultural resources from the tribal perspective is needed in this section. Impacts to natural resources are an impact to Ojibwe culture.	Added sentence where appropriate. "Natural resources and the lands on which they are gathered are important to the Bands for a number of reasons, including cultural, spiritual, and/or historic meanings, and will be considered under federal agency tribal trust responsibilities as outlined above and also as cultural resources under NEPA."	ok
GLIFWC 17	GLIFWC	ES Executive Summary- NorthMet project effects on cultural and socioeconomic resources section	Information on the negative socioeconimic effects of mining is conspicuously absent. Extensive information has been provided as part of the socioeconomic IAP. A fair representation of possible benefits AND possible negative effects of mining is expected in the executive summary.	See discussion in Section 5.2.10.14.	Additional detail is needed for section 5.2.10.14. Incorporation of the Freidenburg mining article is needed.
GLIFWC 18	GLIFWC	ES Executive Summary - Environmental Consequences of the Land Exchange section	Modeling in this PSDEIS assumes that the no action alternative is a continuation of existing consitions. Therefore, the statements in this paragraph are not carried forward into the modeling. This should be stated here.	Text to be clarified per response to GLIWFC comment 144.	The co-lead disposition does not provide enough information for us to remove our comment. Provide a link to hydrology section in the appendix.
GLIFWC 19	GLIFWC	ES Executive Summary - Environmental Consequences of the Land Exchange section	The phrase "smaller net gains in environmental resources" is not a supported assumption. The Superior N.F. has indicated that the land exchange is a real estate transaction only and that specific environmental resources are not necessarily a part of that transaction. The assumption of environmental gain should be removed.	Edited as requested. "In comparison to the combined Proposed Action, the combined Alternative B (NorthMet Project Proposed Action and Land Exchange Alternative B) would have the same direct impacts from the NorthMet Project Proposed Action, but would convey fewer lands through the land exchange. Removed "resulting in similar net gains in environmental resources"."	ok
GLIFWC 20	GLIFWC	ES Executive Summary - Table 1	99.9% water capture number is not supportable. Other areas of the document say 90% or 93% based on the location where water is captured. In all cases, there should be a range describing water capture ammounts. 99.9% is neither correct not plausible.	Edited as requested. "Greater than 90% of water would be captured and treated to meet effluent limits set to protect water quality standards."	ok
GLIFWC 21	GLIFWC	ES Executive Summary - Table 1	The conclusion that mercury loading will decrease is not supportable. See GLIFWC mercury attachment.	The aquatic species summary points in the SDEIS table have been revised and does no longer include the mercury loading conclusion commented on.	ok
GLIFWC 22	GLIFWC	ES Executive Summary - Table 1	Need aditional bullet stating: loss of carbon sink and release of stored carbon through wetland desctruction. For proposed action and alternative B.	Acknowledge partial loss of carbon sink and release of stored carbon from wetlands destruction. Suggested text change. "Wetland mitigation plan will be implemented to offset increased carbon dioxide emissions to extent practicable." Text clarified.	Disagree. Wetland mitigation will not offset the emission of carbon from the peat rich wetlands at the 100 mile swamp.

Executive Summary

Comment_No.	Agency	Section	Comment	Co-Lead Disposition	GLIFWC Response
GLIFWC 23	GLIFWC	ES Executive Summary - Table 1	For noise and vibration bullet delete text describing effects to nearest receptors. Using receptors limits the impact analysis - see GLIFWC noise attachment.	Edited as requested. "Noise, ground vibration, and air blast impact area/zone would be limited to 11,456, 11,469, and 11,334 acres, respectively. The BWCAW, which is 20 miles away, is outside the maximum area of audibility (247,613 acres)."	GLIFWC has concerns about the analysis. Provide a link to the cumulative impact section in the appendix.
GLIFWC 24	GLIFWC	ES Executive Summary - Table 1	add: increase in cumulative destruction of trail network and Mesabe Widjiu	No text edit, The existing text address the Mesabe Widjiu	The comment applies to a cumulative effects analysis which is, in our opinion, inadequate in the PSDEIS. Provide a link to the cumulative effects section of the appendix
GLIFWC 25	GLIFWC	ES Executive Summary	The PSDEIS concludes that "Based on the results of the modeling and impacts analysis, the Northmet Project Proposed Action would not exceed applicable environmental evaluation criteria." Due to a general lack of understanding of mercury dynamics in the St. Louis River watershed, this conclusion is not defensible with regard to mercury. See the supplemental document "Great Lakes Indian Fish and Wildlife Commission (GLIFWC) Comments Related to Mercury" [Comment 1] for additional rationale.	Text clarified in SDEIS. See response to GLIFWC 195	GLIFWC disagrees with the co-lead disposition. Provide a link to the mercury section in the appendix.
GLIFWC 26	GLIFWC	ES Executive Summary	The executive summary should clearly state that the proposed NorthMet project requires perpetual water treatment and perpetual maintenance. Therefore, the proposed project violates Minnesota Rule 6132.3200 regarding closure and postclosure maintenance of mines. This rule states that the goal of closure and reclamation is that "The mining area shall be closed so that it is stable, free of hazards, minimizes hydrologic impacts, minimizes the release of substances that adversely impact other natural resources, and is maintenance free." This language should be inserted into the executive summary. In addition Rule 6132.3200 states that "No release from the permit to mine under part 6132.4800 shall be granted for those portions of the mining area that require postclosure maintenance until the necessity for maintenance ceases." Since maintenance would never cease under the project, the executive summary should indicate that the applicant would never be released from the permit to mine.	Text edited to reflect that the closure objective is to provide mechanical and non-mechanical treatment for as long as necessary to meet regulatory standards at evaluation locations in groundwater and surface water. Both mechanical and non-mechanical treatment will require periodic maintenance and monitoring activities. Modeling predicts that treatment activities will be a minimum 200 years at the Mine Site and a minimum of 500 years at the Plant Site. While long-term, these time frames for water treatment are not necessarily perpetual. The owning company would be held accountable to maintenance and monitoring required under permit and would not be released until all conditions have been met.	GLIFWC does not agree with the language in the co-lead disposition. Provide a link to the Perpetual care language in the appendix.
GLIFWC 27	GLIFWC	ES Executive Summary- NorthMet project effects on cultural and socioeconomic resources section	The NorthMet Project Proposed Action would create up to an estimated 500 full-time direct jobs during peak construction and 360 full-time direct jobs during operations. Estimates for full-time employment were provided by NorthMet. **It is essential that throughout the SDEIS authors need to repeatly state that direct employment estimates for both construction and during operations were provided by NorthMet.	Text edited. It should be noted that these employment estimates were provided by PolyMet.	ok

Executive Summary

Comment_No.	Agency	Section	Comment	Co-Lead Disposition	GLIFWC Response
GLIFWC 28	GLIFWC	ES Executive Summary- NorthMet project effects on cultural and socioeconomic resources section	"These direct jobs would generate additional indirect and induced employment, estimated to be 332 additional construction phase jobs and 631 additional operations phase jobs." Indirect and Induced Effect employment numbers are calculated by IMPLAN and may be temporary, part-time, full-time, long-term or short term jobs, as IMPLAN does not differentiate between these. **It is essential that throughout the SDEIS authors need to repeatly state that Indirect and Induced Effect employment numbers are calculated by IMPLAN and may be temporary, part-time, full-time, long-term or short term jobs. See GLIFWC socioeconomics attachment for additional information.	Text edited. It should be noted that indirect and induced effect employment numbers are calculated by IMPLAN and may be temporary, part-time, full-time, long-term or short term jobs.	ok
7/	GLIFWC	ES Executive Summary- NorthMet project effects on cultural and socioeconomic resources section	The Draft Environmental Impact Statement (DEIS) prepared in 2009 stated, "Due to the estimated 20-year operating life of the facility, it is estimated that approximately 55% of labor for the operations would be non-local and would relocated to the east range; 20% would commute daily or weekly from centeres such as Duluth; and the remaining labor would be local" DEIS (page 4.10-15). The Executive Summary needs to clearly identify the number of jobs projected to be filled by "local residents" in St. Louis County rather than the broad Arrowhead Region. See GLIFWC socioeconomics attachment for additional information.	The DEIS definition of "local" appears to be limited to the East Range, essentially the nearby towns and cities in St. Louis County alone. By comparison, the PSDEIS clearly states that "local" workers--those who would commute daily or weekly--would come from a very wide commute shed, given the willingness of workers in this region to commute relatively long distances. The definitions of "local" are very different; therefore, no change is needed.	ok

Chapter 1

Comment_No.	Agency	Section	Comment	Co-Lead Disposition	GLIFWC Response
GLIFWC 30	GLIFWC	1.1.2 Land Exchange	Map is misleading. The area labeled Mesabi Iron Range / Historic mining district encompases areas that have never been mined and are outside the geologic formations where iron mines have operated. It suggests that the NorthMet mine site is part of a mined area which is not correct. The GIS layer depicting all the mine features on the range (pits, tailings basins, etc) should be used instead.	Map is intended to show general area of the Mesabi Iron Range. Figure Key edited to now read, "General Mesabi Iron Range - Historic Mining"	GLIFWC staff disagree with the disposition. We maintain that the figure is misleading.
GLIFWC 34	GLIFWC	1.2.2 Cooperating Agencies	Please insert the following text for GLIFWC participation: GLIFWC staff did not participate in the development of the language in the SDEIS or the referenced technical documents.	Text edit made. New text reads "The Great Lakes Indian Fish and Wildlife Commission (GLIFWC) and the 1854 Treaty Authority have assisted the Bands in their roles as Cooperating Agencies"	ok
GLIFWC 31	GLIFWC	1.3 Purpose And Need	The first 4 bullets are the mining companies' purpose and need and not the purpose and need of the agencies involved. A title is needed making this clear. Question: This is a document from the lead agencies. Does the applicants purpose belong here?	The Co-lead Agencies developed this language for insertion into the SDEIS. As such, it is appropriately placed.	ok
GLIFWC 32	GLIFWC	1.7 Pollutants Of Interest	There is absolutely no scientific doubt that GHG in the atmosphere have, and will continue to change climate conditions. Text should be corrected.	Text not edited, use of "may" and "can" is intended to be consistent with the rest of this section.	GLIFWC staff disagree with the disposition. The text may be consistent with the section but it is inconsistent with accepted scientific knowledge.
GLIFWC 33	GLIFWC	1.7 Pollutants Of Interest	There is absolutely no scientific doubt that sulfate has, and will continue to negatively impact wild rice. There is absolutely no scientific doubt that sulfate has, and will continue to contribute to mercury methylation. Correct the text.	Text not edited, use of "may" and "can" is intended to be consistent with the rest of this section.	GLIFWC staff disagree with the disposition. The text may be consistent with the section but it is inconsistent with accepted scientific knowledge.

Chapter 3

Comment_No.	Agency	Section	Comment	Co-Lead Disposition	GLIFWC Response
GLIFWC 35	GLIFWC	3.1.1.3 Mine Operations Overview	Describes the NorthMet deposit as low-medium quality. We disagree with this characterization. The deposit had a low ore grade compared to most other ore bodies in the Great Lakes region. It should be characterized only as low quality.	It is ERM's professional judgment that the NorthMet Deposit should be classified as low-medium grade. Classification of the ore-body in simplified terms is relative and subjective and does not have any implications to the economic viability of the resource, nor does it influence the environmental evaluation presented in Chapter 5. Full description of the mineral resource may be found in PolyMet's 43-101 document. No changes to text.	We disagree. In GLIFWC's professional judgement the deposit should only be described as low quality.
GLIFWC 46	GLIFWC	3.2.2.4 Financial Assurance	EPA recommends that 10 to 25% of financial assurance be made available as cash. This should be added to the section. In addition, an explanation of how the state will financially assure a perpetual treatment project is required. Specifically, the state must financially assure in perpetuity: 2 RO water treatment plants, perpetual monitoring of water quality for the 2 tailings basins, west pit outflow, and groundwater points of compliance. Perpetual maintenance would be required at both tailings facilities for water quality, water capture, flow augmentation system, and geotechnical stability, the Cat 1 stockpile and the water level controls at the west pit.	Financial assurance costs, instruments, and duration will be determined in the MDNR Permit to Mine permitting process. Financial assurance can be required indefinitely and can include self-sustaining instruments such as trust funds.	The co-lead disposition is not realistic. Provide a link to the perpetual care language in the appendix.
GLIFWC 37	GLIFWC	3.1.2 Land Exchange Overview	Information in this paragraph is incorrect. As previously commented, federal lands are not within the historic mesabi range. Federal lands are not surrounded by private lands. Rather they are connected to other Superior National Forest lands on the south and east. Finally, the land exchange would unite surface and mineral rights for the mine site lands but not for the parcels that would enter the federal estate. Those surface and mineral ownerships would still be severed. The text should be clarified.	Edited sentences... "The federal lands are located adjacent to historic mining projects on the Mesabi Iron Range and are almost surrounded by privately held land used for mining and other industrial purposes; portions of the east and southwest areas of the federal lands are bordered by Superior National Forest lands." "in the area" to "on the federal lands"	ok
GLIFWC 40	GLIFWC	3.2.2.1.9 Water Management	Information on the length of time that the facility would need to operate should be included	This section is specific to the operational phase of mining. Long term management is discussed in section 3.2.2.1.10	ok

Chapter 3

Comment_No.	Agency	Section	Comment	Co-Lead Disposition	GLIFWC Response
GLIFWC 38	GLIFWC	3.2.2.1.7 Overburden And Waste Rock Management	Should state that Cat 1 stockpile will require some maintenance in perpetuity.	Table 3.2-7 states that from Year 20+ there would be maintenance. Maintenance activities would continue throughout reclamation and post-reclamation, for as long as necessary to meet regulatory standards.	GLIFWC believes the disposition is incomplete. Provide a link to perpetual care section in the appendix.
GLIFWC 39	GLIFWC	3.2.2.1.8 Engineered Water Controls	Throughout the section, information on post closure maintenance needs and length of time operation is needed should be included for all engineering controls.	This section is specific to the operational phase of mining. Long term management is discussed in section 3.2.2.1.10	ok
GLIFWC 42	GLIFWC	3.2.2.1.10 Reclamation And Long-term Closure Management	Last paragraph should explicitly state that erosion repair, and removal of woody species from the stockpile cover system would need to be perpetual. This would also include monitoring and inspections of the facility.	Maintenance activities would continue throughout reclamation and post-reclamation, for as long as necessary to meet regulatory requirements.	GLIFWC believes the disposition is incomplete. Provide a link to perpetual care section in the appendix.
GLIFWC 50	GLIFWC	3.2.2.1.10 Reclamation And Long-term Closure Management	Insert text stating that water quality modeling suggests water treatment would need to occur for over 500 years in order to meet water quality standards.	The Closure objective is to provide mechanical and non-mechanical treatment for as long as necessary to meet regulatory requirements at evaluation locations in groundwater and surface water. Both mechanical and non-mechanical treatment will require periodic maintenance and monitoring activities. Modeling predicts that treatment activities will be a minimum 200 years at the Mine Site. While long-term, this time frame for water treatment is not necessarily perpetual. Added text to section 3.2.2.1.10 to this effect.	GLIFWC does not agree with the language in the co-lead disposition. Provide a link to the Perpetual care language in the appendix.
GLIFWC 51	GLIFWC	3.2.2.2.4 Use During Operations	We disagree with the characterization that ore dust releases from rail cars is not a significant issue. See GLIFWC rail car attachment.	Air quality for the NorthMet Project is evaluated in Section 5.2.7. Due to the size of the ore rock being transported, the design of the railcars, and the short distance of transport from the Mine Site to the Plant Site, the ore fines are expected to be coarse in nature. Thus, no significant reactive airborne fugitive dust from the rail transport is expected	GLIFWC does not agree with the language in the co-lead disposition. Provide a link to the rail car section in the appendix.

Chapter 3

Comment_No.	Agency	Section	Comment	Co-Lead Disposition	GLIFWC Response
GLIFWC 36	GLIFWC	3.1.1.7 Project Closure Overview	This section states that post closure monitoring and maintenance would continue until features were "deemed environmentally acceptable in a self sustaining and stable condition" Water treatment and facility maintenance at the site are perpetual. Therefore this statement would never happen. It is misleading to suggest otherwise.	Text edited to reflect that the closure objective is to provide mechanical and non-mechanical treatment for as long as necessary to meet regulatory standards at evaluation locations in groundwater and surface water. Both mechanical and non-mechanical treatment will require periodic maintenance and monitoring activities. Modeling predicts that treatment activities will be a minimum 200 years at the Mine Site and a minimum of 500 years at the Plant Site. While long-term, these time frames for water treatment are not necessarily perpetual. The owning company would be held accountable to maintenance and monitoring required under permit and would not be released until all conditions have been met.	GLIFWC does not agree with the language in the co-lead disposition. Provide a link to the Perpetual care language in the appendix.
GLIFWC 53	GLIFWC	3.2.2.3.9 Transport Of Consumables And Products	There is no information provided on outgoing rail routes from the mine site. A map of these rail routes is requested.	The railway between the Mine Site and Plant Site is shown in Figure 3.2-4 and 3.2-20. Railway beyond the project area is outside of the scope of the SDEIS	GLIFWC disagrees. Regional transportation routes have been raised as issues in the past and there is the potential for environmental impacts along those routes based on impacts at other mine sites.
GLIFWC 54	GLIFWC	3.2.2.3.10 Engineered Water Controls	Section indicates that a water containment system exists on the south side. Please add that system to figure 3.2-27	Removed south side containment system from text.	ok
GLIFWC 55	GLIFWC	3.2.2.3.10 Engineered Water Controls - figure 3.2-28	Legend should be updated to describe the red and yellow lines on the outside of the berm.	The red and yellow lines do not add value to the figure and have been removed	ok

Chapter 3

Comment_No.	Agency	Section	Comment	Co-Lead Disposition	GLIFWC Response
GLIFWC 44	GLIFWC	3.2.2.3.12 Reclamation And Long-term Closure Management	It should be clearly statated that inspection and periodic water collection at the hydrometallurgical residue facility would need to be perpetual.	The Closure objective is to provide mechanical and non-mechanical treatment for as long as necessary to meet regulatory standards at evaluation locations in groundwater and surface water. Both mechanical and non-mechanical treatment will require periodic maintenance and monitoring activities. Modeling predicts that treatment activities will be a minimum 200 years at the Mine Site and a minimum of 500 years at the Plant Site. While long-term, these time frames for water treatment are not necessarily perpetual. Text has been added to section 3.2.2.3.12 to reflect this.	GLIFWC does not agree with the language in the co-lead disposition. Provide a link to the Perpetual care language in the appendix.
GLIFWC 45	GLIFWC	3.2.2.3.12 Reclamation And Long-term Closure Management - post-reclamation activities	A clear statement that perpetual water treatment, either active or passive, is required for the project to comply with water quality standards. In addition, the section should state that passive treatment is speculative.	The Closure objective is to provide mechanical and non-mechanical treatment for as long as necessary to meet regulatory standards at evaluation locations in groundwater and surface water. Both mechanical and non-mechanical treatment will require periodic maintenance and monitoring activities. Modeling predicts that treatment activities will be a minimum 200 years at the Mine Site and a minimum of 500 years at the Plant Site. While long-term, these time frames for water treatment are not necessarily perpetual. Text has been added to section 3.2.2.3.12 to reflect this.	GLIFWC does not agree with the language in the co-lead disposition. Provide a link to the Perpetual care language in the appendix.

Chapter 3

Comment_No.	Agency	Section	Comment	Co-Lead Disposition	GLIFWC Response
GLIFWC 56	GLIFWC	3.2.2.3.12 Reclamation And Long-term Closure Management	Include information about long term maintenance needs and lenghth of time that water treatment is needed.	The Closure objective is to provide mechanical and non-mechanical treatment for as long as necessary to meet regulatory standards at evaluation locations in groundwater and surface water. Both mechanical and non-mechanical treatment will require periodic maintenance and monitoring activities. Modeling predicts that treatment activities will be a minimum 200 years at the Mine Site and a minimum of 500 years at the Plant Site. While long-term, these time frames for water treatment are not necessarily perpetual. Text has been added to section 3.2.2.3.12 to reflect this.	GLIFWC does not agree with the language in the co-lead disposition. Provide a link to the Perpetual care language in the appendix.
GLIFWC 47	GLIFWC	3.2.2.4.3 Cessation Of Financial Assurance	The NorthMet project is a perpetual maintenance and water treatment project. This should be clearly stated in this section. Therefore, there is a significant financial assurance component that the applicant will never be able to recover. Finally, a clear statement that the state of Minnesota will ultimately be responsible for conducting any long term maintenance and/or cleanup because it is not realistic to assume that this mining company will exist past closure.	The Closure objective is to provide mechanical and non-mechanical treatment for as long as necessary to meet regulatory standards at evaluation locations in groundwater and surface water. Both mechanical and non-mechanical treatment will require periodic maintenance and monitoring activities. Modeling predicts that treatment activities will be a minimum 200 years at the Mine Site and a minimum of 500 years at the Plant Site. While long-term, these time frames for water treatment are not necessarily perpetual. Text has been added to section 3.2.2.3.12 to reflect this. Financial assurance can be required indefinitely and can include self-sustaining instruments such as trust funds.	GLIFWC does not agree with the language in the co-lead disposition. Provide a link to the Perpetual care language in the appendix.
GLIFWC 41	GLIFWC	3.2.2.1.10 Reclamation And Long-term Closure Management	Description of long term maintenance needs for the west pit lift station is needed.	The West Pit Lift station would be maintained as per needed in accordance with the reclamation plan, similarly as the WWTF would. Appropriate details would be provided for permitting	GLIFWC does not agree with the language in the co-lead disposition. Provide a link to the Perpetual care language in the appendix.

Chapter 3

Comment_No.	Agency	Section	Comment	Co-Lead Disposition	GLIFWC Response
GLIFWC 49	GLIFWC	3.2.2.1.10 Reclamation And Long-term Closure Management	Describe long term maintenance and monitoring needs for the stormwater ponds and outlet control structures next to the Dunka Rd.	The detailed maintenance and monitoring needs for outlet structures would be provided in the Reclamation Plan as required for permitting	GLIFWC does not agree with the language in the co-lead disposition. Provide a link to the Perpetual care language in the appendix.
GLIFWC 52	GLIFWC	3.2.2.1.10 Reclamation And Long-term Closure Management	A table describing in detail the long term maintenance, monitoring, and treatment needs is requested.	The following section provide more detail that what could be portrayed in a table. Please refer to the text.	GLIFWC does not agree with the language in the co-lead disposition. Provide a link to the Perpetual care language in the appendix.
GLIFWC 43	GLIFWC	3.2.2.3.10 Engineered Water Controls	How long would the tailings basin water collection and treatment system operate in post closure?	The Closure objective is to provide mechanical and non-mechanical treatment for as long as necessary to meet regulatory standards at evaluation locations in groundwater and surface water. Both mechanical and non-mechanical treatment will require periodic maintenance and monitoring activities. Modeling predicts that treatment activities will be a minimum 200 years at the Mine Site and a minimum of 500 years at the Plant Site. While long-term, these time frames for water treatment are not necessarily perpetual. Text has been added to section 3.2.2.3.12 to reflect this.	GLIFWC does not agree with the language in the co-lead disposition. Provide a link to the Perpetual care language in the appendix.

Chapter 3

Comment_No.	Agency	Section	Comment	Co-Lead Disposition	GLIFWC Response
GLIFWC 48	GLIFWC	3.2.3.3 Development Of The Northmet Project Proposed Action - table 3.2-16	"capture and treatment of virtually all groundwater…" is not realistic or correct. Change to capture and treatment of "most" groundwater…	Groundwater containment with slurry walls and permeable trenches has been routinely performed at mine and industrial sites over the last 50 years. There are hundreds of currently operating systems. When geologic conditions are favorable (particularly the presence of a low permeability basal unit that can be keyed into), it is typical to achieve greater than 90 percent groundwater capture. At the Mine and Plant Sites, the geologic conditions are favorable due to the presence of low permeability bedrock. Performance modeling of the containment systems performed by PolyMet and reviewed by the Co-Leads provides strong evidence that the capture efficiency will be greater than 90 percent. the bullet point has been updated to reflect this.	ok
GLIFWC 59	GLIFWC	3.2.3.4.1 Underground Mining Alternative	GLIFWC staff disagree with the lead agency position paper on the underground alternative. See GLIFWC underground mining attachment for more information (will be provided by July 3rd)	The Co-leads have eliminated the Underground Mining Alternative based on the rational provided in section 3.2.3.4.1.	GLIFWC does not agree with the language in the co-lead disposition. Provide a link to the underground mine alternative section in the appendix.
GLIFWC 60	GLIFWC	3.2.3.4.2 West Pit Backfill	GLIFWC staff disagree with the lead agency position paper on the west pit backfill alternative. See GLIFWC backfill attachment for more information (will be provided by July 3rd)	The Co-leads have eliminated the West Pit Backfill Alternative based on the rational provided in section 3.2.3.4.2.	GLIFWC does not agree with the language in the co-lead disposition. Provide a link to the west pit backfill section in the appendix.

Chapter 3

Comment_No.	Agency	Section	Comment	Co-Lead Disposition	GLIFWC Response
GLIFWC 57	GLIFWC	3.3.2.1 Federal Lands Proposed For Exchange	As previously commented, the mine site is not located within the historic mesabi iron range and the property is not surrounded by industrial lands. Correct the text.	Edited sentences... "The federal lands are located adjacent to historic mining projects on the Mesabi Iron Range and are almost surrounded by privately held land used for mining and other industrial purposes; portions of the east and southwest areas of the federal lands are bordered by Superior National Forest lands." "in the area" to "on the federal lands"	ok
GLIFWC 61	GLIFWC	3.3.2.1 Federal Lands Proposed For Exchange	As previously commented, the federal lands are not within the historic mining district and are not surrounded by private land used for mining	Edited sentences... "The federal lands are located adjacent to historic mining projects on the Mesabi Iron Range and are almost surrounded by privately held land used for mining and other industrial purposes; portions of the east and southwest areas of the federal lands are bordered by Superior National Forest lands." "in the area" to "on the federal lands"	ok
GLIFWC 58	GLIFWC	3.3.2.2 Non-federal Lands Proposed For Exchange	Section should indicate that all lands that would enter the federal estate have severed mineral and surface ownership.	Added sentence… "All of the non-federal lands except Tract 4 have severed mineral and surface ownership."	ok
GLIFWC 62	GLIFWC	3.3.2.2 Non-federal Lands Proposed For Exchange	Section should state that the lands entering the federal estate would still have severed surface and mineral ownership and therefore future mining cannot be ruled out.	Added sentence… "All of the non-federal lands except Tract 4 have severed mineral and surface ownership."	ok
GLIFWC 63	GLIFWC	3.3.3.3.6 Underground Mining Alternative	GLIFWC disagrees with the elimination of the underground alternative for further consideration in the SDEIS. The only reason for a land exchange is the fact that the applicant has chosen a surface mining operation. The development of an underground project that takes advantage of the entire mineraized zone should be analyzed. See GLUFWC underground mine attachment for more detail.	Feasibility analysis of an underground mining alternative was based on the mineralized zone as defined in accordance with National Instrument 43-101. The Underground Mining Alternative was eliminated from further analysis because it would not be economically viable and would not meet the purpose and need.	GLIFWC does not agree with the language in the co-lead disposition. Provide a link to the underground mine alternative section in the appendix.

Chapter 4.2

Comment_No.	Agency	Section	Comment	Co-Lead Disposition	GLIFWC Response
4.2.2 Water Resources					
GLIFWC 104	GLIFWC	4.2.2 Water Resources - Table 4.2.2-29	The values in this table for PM-12 are different than the values used in “Calibration of the Existing Natural Watershed at the Plant Site v4 MAR2012”, why? For example SO4 in Table 4.2.2-29 gives average So4 as 6.9 mg/L while “Calibration of the Existing Natural Watershed at the Plant Site v4 MAR2012” page 38 reports 4.34 mg/L. Manganese in Table 4.2.2-29 reports an average of 365 mg/L while “Calibration of the Existing Natural Watershed at the Plant Site v4 MAR2012” page 36 reports 158 mg/L. Why?	The values in Table 4.2.2-29 will be confirmed and updated as appropriate in the SDEIS.	Will the Goldsim model be recalibrated with the updated data in Table 4.2.2-29? If not, why?
GLIFWC 72	GLIFWC	4.2.2.3.2 Surface Water Resources - Embarras River WQ section	The first section is not correct. The river is on the draft 2012 303d list. See GLIFWC figure 3 in wild rice attachment. The section should also indicate that the wild rice standard is being exceeded in the Embarrass river because of effluent from the tailings basin and area 5 pits.	Text revised to clarify the current status of 303(d) listings.	ok
GLIFWC 68	GLIFWC	4.2.2.2.2 Surface Water	The XP-SWMM modeling is fatally flawed **because it is incapable of predicting even current baseflow conditions. If it is incapable of predicting current water quantity it will not accurately predict future water quantity conditions, a much more difficult task. It is therefore, not suitable for use in the SDEIS to predict future conditions**. See GLIFWC hydrology attachment.	We believe the XP-SWMM modeling is acceptable for use in the SDEIS. The 20 year old data is acceptable as there haven't been any significant changes within the watershed. We believe the assumptions used were reasonably conservative. Additional detail is provided in the water sections of the SDEIS, and further rationale is provided in the Water Data Packages.	GLIFWC disagrees with the co-lead disposition. The portion of the comment in bold has not been answered. Provide a link to the hydrology section in the appendix.
GLIFWC 69	GLIFWC	4.2.2.2.2 Surface Water	Section states that the old gauge represents current flows. We disagree. The hydrology of the Partridge river is incorrectly characterized because of the fatal flaws of XP-SWMM.	We believe the XP-SWMM modeling is acceptable for use in the SDEIS. The 20 year old data is acceptable as there haven't been any significant changes within the watershed. We believe the assumptions used were reasonably conservative. Additional detail is provided in the water sections of the SDEIS, and further rationale is provided in the Water Data Packages.	GLIFWC disagrees with the co-lead disposition. Provide a link to the hydrology section in the appendix.
GLIFWC 96	GLIFWC	4.2.2 Water Resources	Yes, as stated in the SDEIS text Northshore dewaters into partridge. So **simply subtracting the flow at the Northshore RR tracks from the flow measures further downstream will give the gain in groundwater between the RR tracks and downstream sites. Result at SW-003: 2.3 cfs, not the 0.51cfs predicted by XP-SWMM**. In additionaTable 4.2.2-9 values from XP-SWMM are obsolete values (see table 4.2.2-8).	We believe the XP-SWMM modeling is acceptable for use in the SDEIS. The 20 year old data is acceptable as there haven't been any significant changes within the watershed. We believe the assumptions used were reasonably conservative. Additional detail is provided in the water sections of the SDEIS, and further rationale is provided in the Water Data Packages. XP-SWMM values in Table 4.2.2-9 have been revised.	GLIFWC disagrees with the co-lead disposition. The portion of the comment in bold has not been answered. Provide a link to the hydrology section in the appendix.

Chapter 4.2

Comment_No.	Agency	Section	Comment	Co-Lead Disposition	GLIFWC Response
GLIFWC 100	GLIFWC	4.2.2 Water Resources	high SO4 water of Wyman Cr. is entering the rice waters of the Partridge river. Given that the Partridge is already 9.1 mg/L at SW-005 the addition of high sulfate water by Wyman Cr. almost certainly causes the Partridge R. to exceed 10 mg/L. Does this exceedance influence the Polymet project in any way?	No. Under Minnesota Rules chapter 7050 discharges, either direct or indirect, must not cause violation of water quality standards in the immediate receiving waters, but also must not cause exceedances in downstream waters that have more stringent water quality standards. No discharges are planned from the Mine Site during operations and reclamation. During long-term closure, West Pit water will be pumped to the Mine Site WWTF, the effluent from which will require an NPDES/SDS permit to discharge to the Partridge River. The WWTF, when it starts discharging to the PR, will be designed to meet an effluent target of <10 mg/L SO4 (RC)	ok
GLIFWC 101	GLIFWC	4.2.2 Water Resources	Tailings pond water quality was measured in 2001-2004 and has not been measured since 2004. The claim, used in the No-Action or Current Condition models that water level and quality at the basins has stabilized, can not be confirmed or refuted with such a limited & old data set. **Current data on water quality in the tailings pond must be collected to verify if the tailings basins are currently hydrologically stable.** It seems unlikely that the pond water quality would stay the same over the last 9 years given that the only water input to the system has been rainwater.	Additional water quality samples will be taken from the LTV tailings pond to confirm its water quality and the results included in the EIS.	Is water quality sampling of the tailings ponds being conducted this summer. If not when will sampling be conducted?
GLIFWC 102	GLIFWC	4.2.2 Water Resources - Legacy Groundwater Quality Issues	the title of these two paragraphs suggest that it is a discussion of general contamination, yet the text only addresses organics. The text must be expanded to discuss groundwater contamination of all types.	The discussion under Legacy Groundwater Quality Issues will be expanded to include other constituents.	ok
GLIFWC 64	GLIFWC	4.2.2.1.3 Wild Rice	There is no question that wild rice is affected by sulfate. The text should state that healthy and natural stands of wild rice are found in waters of 10 ppm sulfate or less. See GLIFWC wild rice attachment.	The text already states that 'Some research has indicated that natural wild rice thrives better in low sulfate waters.'. No text edit.	The text in the co-lead disposition is misleading. It implies that there is doubt about the negative effects of sulfate on rice by using the word "some". Provide a link to the wild rice section in the appendix.
GLIFWC 65	GLIFWC	4.2.2.1.3 Wild Rice	States that "current scientific understanding of its habitat requirements is limited". This is not correct, the habitat requirements are well known. Correct your work.	Text clarified.	ok

Chapter 4.2

Comment_No.	Agency	Section	Comment	Co-Lead Disposition	GLIFWC Response
GLIFWC 93	GLIFWC	4.2.2 Water Resources	"consequently, the 10 mg/L water quality standard for sulfate would not apply to this portion of the river (MPCA 2011b)." the "not" appears to be incorrect	Disagree. According to MPCA 2011a, the 10 mg/L water quality standard would not apply to this portion of the river.	GLIFWC does not agree with the MPCA determination for wild rice waters. Provide a link to the wild rice section of the appendix.
GLIFWC 94	GLIFWC	4.2.2 Water Resources	A 2010 field survey is mentioned. The pH and "salinity" data reported in Eggers 2011a, I believe to be data GLIFWC collected. No "salinity" measures were collected. The data appears to have been misunderstood. **Please contact GLIFWC concerning this data.**	Text revised to remove reference to salinity and be more consistent with Eggers 2011a.	GLIFWC collected the data. Please contact GLIFWC for proper interpretation of the data, as requested.
GLIFWC 98	GLIFWC	4.2.2 Water Resources - table 4.2.2-14	**SW-005 shows a mean value of 9.11 mg/l of SO4. an average of 9.11 indicates that at times the SO4 10mg/L standard is exceeded at SW-005.** The underlying data needs to be referenced and available.	The surface water quality data used to support the water quality modeling is in Barr 2013b (Technical Memorandum: Ongoing data collection for the NorthMet water quality modeling, aka Data Sufficiency Document, Version 3. February 25, 2013), as stated under the table.	ok
GLIFWC 99	GLIFWC	4.2.2 Water Resources - many data tables	Need sample size for the averages. otherwise the averages communicate very little information.	Tables 4.2.2-12, 4.2.2-14, 4.2.2-15, and 4.2.2-29 have been revised to include columns with detection and range data. The surface water quality data used to support the water quality modeling is in Barr 2013b (Technical Memorandum: Ongoing data collection for the NorthMet water quality modeling, aka Data Sufficiency Document, Version 3. February 25, 2013), as stated under the table.	ok
GLIFWC 103	GLIFWC	4.2.2 Water Resources - Table 4.2.2-29	Sulfate exceeds the 10mg/L standard for a substantial stretch of the Embarrass between Hwy 135 to Sabin Lake. Average SO4 at PM-13 is 31.8. Again sample size is needed in order to evaluate the information in the table. This reported average is very different than the modeled P50 (existing condition) value in figure 5.2.2-49, why?	Table 4.2.2-29 has been modified to include the number of samples for both locations. Original data is available in Barr 2013b. The calibrated water quality model PM-13 (Embarrass R. below all Mine Site loads) overestimates mean sulfate concentrations for existing conditions relative to measured values, apparently because the model does not incorporate removal of sulfate by chemical reduction processes (Barr 2012j, Section 2.2). The overall calibration of the No Action Model was approved by the Co-lead Agencies.	ok

Chapter 4.2

Comment_No.	Agency	Section	Comment	Co-Lead Disposition	GLIFWC Response
GLIFWC 105	GLIFWC	4.2.2 Water Resources - table 4.2.2-29	The existing water quality at PM-13 reported in this table is substantially different than the P50 values reported as (continuation of existing conditions) in chapter 5 (e.g. fig. 5.2.2-49) and substantially different from the P50 values reported as No-Action model in the modeling data package (Water Modeling Data Package Vol 2-Plant Site v9 MAR2013.pdf). This suggests that **the model is poorly calibrated and unlikely to accurately predict project impacts.**	The surface water quality model was calibrated to conditions in the Embarrass River at a location above where mining had effected water quality (i.e., location PM-12), and conditions at down-stream locations were then estimated by adding known loads (for existing conditions model) and/or possible new loads (for Proposed Action model). The predicted model range for monthly concentrations over the 200-year simulation in the Embarrass R. below all Plant Site Area loads (i.e., minimum P10 to maximum P90 concentrations at location PM-13) brackets average measured concentrations for most constituents reported in Table 4.2.2-49. The model does overestimate mean sulfate concentrations for existing conditions at PM-13 relative to measured values, apparently because the model does not incorporate removal of sulfate by chemical reduction in the river and wetlands (Barr 2012j, Section 2.2). The accuracy of this Embarrass River water-quality model, as calibrated to existing conditions, was approved by the Co-lead Agencies as adequate to support the NorthMet SDEIS.	GLIFWC disagrees with the co-lead disposition. Provide a link to the hydrology section in the appendix.

Chapter 4.2

Comment_No.	Agency	Section	Comment	Co-Lead Disposition	GLIFWC Response
GLIFWC 106	GLIFWC	4.2.2 Water Resources - table 4.2.2-1	The existing water quality in the Partridge reported in this table is substantially different than the P50 values reported as "continuation of existing conditions" in chapter 5 and substantially different from the P50 values reported as No-Action model in the modeling data package (e.g. Fig. K-06-24.2[SO4] and Fig. K-06-25.2 [Thallium], Water Modeling Data Package Vol 2-Plant Site v9 MAR2013.pdf . This suggests that **the model is poorly calibrated and unlikely to accurately predict project impacts.**	The surface water quality model was calibrated to conditions in the Embarrass River at a location above where mining had effected water quality (i.e., location PM-12), and conditions at down-stream locations were then estimated by adding known loads (for existing conditions model) and/or possible new loads (for Proposed Action model). The predicted model range for monthly concentrations over the 200-year simulation in the Embarrass R. below all Plant Site Area loads (i.e., minimum P10 to maximum P90 concentrations at location PM-13) brackets average measured concentrations for most constituents reported in Table 4.2.2-49. The model does overestimate mean sulfate concentrations for existing conditions at PM-13 relative to measured values, apparently because the model does not incorporate removal of sulfate by chemical reduction in the river and wetlands (Barr 2012j, Section 2.2). The accuracy of this Embarrass River water-quality model, as calibrated to existing conditions, was approved by the Co-lead Agencies as adequate to support the NorthMet SDEIS.	GLIFWC disagrees with the co-lead disposition. Provide a link to the hydrology section in the appendix.
GLIFWC 116	GLIFWC	4.2.2 Water Resources - Table 4.2.2-34	The means shown here for seeps at the toe of the basins are very different from the No-Action (continuation of existing conditions) values modeled in Water Modeling Data Package Vol 2-Plant Site v9 MAR2013.pdf. For example, Table 4.2.2-34 reports PM-10 (on the north toe) as having a mean Mn value of 100,192 mg/L, whereas Figure F-01-18.1 shows "continuation of existing conditions" as an annual maximum of 390 ug/L. at the north toe. **Aluminum is reported in Table 4.2.2-34 as a mean of 39.6 ug/L at PM-10 yet reported as a maximum for existing conditions at the north toe as 11 ug/L in Figure F-01-02.1.** These discrepancies between observed values at the north toe and the modeled existing conditions at the north toe suggests that the **Goldsim model is poorly calibrated and unlikely to accurately predict project impacts.**	The NorthMet Plant Site water-quality model used the composition of water in monitoring locations GW001, GW006, GW007, GW012, SD004, and SD026 as concentration targets for the GoldSim model (and PolyMet 2013L, Section 10.2.1 and Large Figure 5; see Figure 4.2.2-13 in this SDEIS). The overall calibration of the No Action Model was approved by the Co-lead Agencies.	GLIFWC disagrees with the co-lead disposition. Provide a link to the hydrology section in the appendix.
GLIFWC 66	GLIFWC	4.2.2.1.3 Wild Rice - Regulations section	we disagree with the MPCA's interpretation of the points of compliance. See GLIFWC wild rice attachment.	All information provided was considered when the MPCA made their recommendation.	GLIFWC does not agree with the MPCA determination for wild rice waters. Provide a link to the wild rice section of the appendix.

Chapter 4.2

Comment_No.	Agency	Section	Comment	Co-Lead Disposition	GLIFWC Response
GLIFWC 67	GLIFWC	4.2.2.2.1 Groundwater Resources	The 2010 field survey of wetlands focused on vegetation and plant lists. This information does not yield conclusive information on the effects that groundwater drawdown would have on a wetland. See GLIFWC wetland attachment.	No change to SDEIS text.	GLIFWC does not agree with the co-lead disposition. Provide a link to the wetland section in the appendix.
GLIFWC 70	GLIFWC	4.2.2.2.2 Surface Water	The section should state that Wyman creek has elevated sulfate at PM-5 which is likely a direct result of past mine impact. What is the effect of Wyman creek water on the wild rice standard compliance?	The fact that Wyman Creek drains an area previously mined by LTVSMC is discussed in the text preceding Table 4.2.2-15.	ok
GLIFWC 71	GLIFWC	4.2.2.3.1 Groundwater Resources	There is no question that historic contamination from the LTV tailings basin has been the most important factor in water quality in the area. Discussing natural processes and ignoring the tailings basin effluent in the discussion of existing water quality values is not appropriate.	Water quality affected by the LTV tailings is listed in Table 4.2.2-3. The baseline water quality sought wells that displayed minimal effect of LTV tailings seepage so that effects of the proposed action could be most easily compared to pre-mining conditions.	ok
GLIFWC 73	GLIFWC	4.2.2.3.2 Surface Water Resources	Uses an outdated point of compliance for the wild rice sulfate standard. Correct the text	The text will be consistent with the most recent MPCA recommendation.	ok
GLIFWC 74	GLIFWC	4.2.2.3.2 Surface Water Resources	same comment as above.	The text will be consistent with the most recent MPCA recommendation.	ok
GLIFWC 90	GLIFWC	4.2.2 Water Resources	“the portion of Upper Partridge River from river mile approximately 22 just upstream of the railroad bridge near Allen Junction, “ from where to where?	Text edited.	ok
GLIFWC 92	GLIFWC	4.2.2 Water Resources - Table 4.2.2-14	**The text states that** the values in Table 4.2.2-14 are referenced to (Barr 2008f) **i.e. “PolyMet averaged available ambient water quality data to document existing conditions (Barr 2008f) “ Barr 2008f is** RS74A but in that document “Table 5-3: Average baseline concentrations observed in the Partridge River” in that document shows different values. RS63 (Draft PolyMet Mining Baseline Surface Water Quality Information Report) shows individual values from 2004 but these are yet different. Where did the values in Table 4.2.2-13 come from?	Table 4.2.2-14 references Barr 2013b (Technical Memorandum: Ongoing data collection for the NorthMet water quality modeling, aka Data Sufficiency Document, Version 3. February 25, 2013), which is the cumulative repository for surface and groundwater quality data measured for the NorthMet Project. Table 4.2.2-13 cites as its source" MPCA, 2013a," http://www.pca.state.mn.us/index.php/water/index.html, which is the MPCA's web site to access water quality data.	Please clean up the text to clarify which is the source for the existing conditions.
GLIFWC 91	GLIFWC	4.2.2 Water Resources - table 4.2.2-12	sulfate is nearly exceeded by the mean at station SW-005, some readings exceed the standard. The rice standard applies there but no numeric rice standard is shown in the table	Agree. Text is revised	ok

Chapter 4.2

Comment_No.	Agency	Section	Comment	Co-Lead Disposition	GLIFWC Response
GLIFWC 95	GLIFWC	4.2.2 Water Resources	Yes, there is inadequate flow data for the upper Partridge. however there has been a gage on the upper Partridge at the Dunka Rd. (http://www.dnr.state.mn.us/waters/csg/site_report.html?mode=get_site_report&site=03155002) for over 2 years now. The spot flow measurements and data from that gage help clarify flow in the Partridge. **Those measures show substantially more baseflow than that predicted by XP-SWIMM. The recent data needs to be used and the models (SP-SWIMM, Modflow & Goldsim) need to be calibrated** to the more accurate flow data now available. (see GLIFWC Hydrology attachment for more information)	The difference in the base flows are very small (indistinguishable from a stage standpoint). We believe the assumptions used were reasonably conservative in terms of water quantity.	GLIFWC believes that a difference in baseflow of 200% to 300% is not "small". Provide a link to the hydrology section in the appendix.
GLIFWC 97	GLIFWC	4.2.2 Water Resources	Yes, there is uncertainty in the Northshore discharges. The DNR must require better reporting or else install a gage near Northshore's discharge. **The lack of adequate reporting of discharges and flows in the upper Partridge prevents the adequate evaluation of upper Partridge hydrology.**	Northshore is meeting the statutory requirements.	Inadequate data for this project has been a chronic problem. In particular our, and others' repeated requests for flow measurement on the Partridge River has been ignored. Why is the EIS being written with <u>no</u> data collected by Polymet on flows on the upper portion of the river?
4.2.3 Wetlands					
GLIFWC 75	GLIFWC	4.2.3 Wetlands - table 4.2.3-1	Text discussing limitations of the classification system should be provided. In particular, the issue of "lumping" different bog wetland types together in the Eggers and Reed system overlooks the range of connectivity that bog wetlands have with the aquifer. This oversimplification leads to masking of the effects of drawdown on bog wetlands. See GLIFWC wetland attachment.	Footnote added: All wetland classification systems have some limitations; however, wetlands identified as open bogs or coniferous bogs under the Eggers and Reed (1997) classification system were further subcategorized as either ombrotrophic (hydrology and mineral inputs entirely from direct precipitation) or somewhat minerotrophic (some degree of mineral inputs from groundwater and/or surface water runoff) (Eggers 2011a; PolyMet 2013b). Please refer to Section 4.2.3.1.2 and Section 5.2.3 for more information.	The co-lead disposition is incomplete. Provide a link to the wetland section in the appendix.
GLIFWC 76	GLIFWC	4.2.3.1.2 Hydrology Wetland Vegetation And Community Types	We disagree with the first sentence. The effect of construction, operations, reflooding and subsequent dewatering of the Northshore pits have never been investigated. Therefore the conclusion in the first sentence is not supportable.	Vegetation types at the site are indicative of pre-settlement conditions and lack hydrologic disturbance, the wetlands at mine site are stable. Following sentence was added: The vegetation types located at the Mine Site are indicative of pre-settlement conditions and lack hydrologic disturbance.	GLIFWC disagrees with the co-lead disposition. Vegetation is not a robust indicator of groundwater hydrology.

Chapter 4.2

Comment_No.	Agency	Section	Comment	Co-Lead Disposition	GLIFWC Response
GLIFWC 77	GLIFWC	4.2.3.1.2 Hydrology Wetland Vegetation And Community Types	There is no hydrologic data that shows that wetlands are perched. The lead agencies and the applicant have resisted suggestions by tribal agencies that the connectivity between wetland hydrology and surficial aquifer be assessed.	ERM, USACE, and Barr held a conference call to talk about the data. ERM also reviewed the source documents and added additional text on the connectivity question.	There is not enough information for us to remove our comment.
GLIFWC 78	GLIFWC	4.2.3.1.2 Hydrology Wetland Vegetation And Community Types	The "stability" of the wetlands not affected by the Northshore pits may be due to the factors listed. However the main reason for the stability is the absence of major hydrologic stressors - such as mine pits.	We disagree as groundwater would need to flow uphill for Northshore Pits to impact the surficial aquifer. Furthermore, this section is on existing conditions and the potential impact from NM project to wetlands is discuss in Chapter5.	Information developed by the MNDNR mining hydrologist show that impacts from mine pits affect can affect surficial aquifer by pirating water that would otherwise enter an unimpacted system and flow downgradient. Groundwater would not need to flow uphill for Northshore Pits to impact the surficial aquifer. Please consult a qualified hydrologist before providing further response.
GLIFWC 79	GLIFWC	4.2.3.1.2 Hydrology Wetland Vegetation And Community Types	The last sentence is not necessarily true and is an unsupported assumption. While groundwater may not be an important part of the hydrology at the surface of some wetlands at this time, that could change once stressors are introduced into the system.	Text added to refer reader to chapter 5.2.3	GLIFWC disagrees with the co-lead disposition. Provide a link to the wetland section in the appendix.
GLIFWC 80	GLIFWC	4.2.3.1.2 Hydrology Wetland Vegetation And Community Types	We disagree with the conclusion in the last sentence. There has been no data collected in these wetlands that looks at the connectivity of the surficial aquifer to the water at the surface. It is not defensible to assume that all ombotrophic wetlands at the site are perched and/or would remain perched under mine induced drawdown conditions.	See comment GLIFWC 77 According to Eggers 2011a memo, ombrotrphic peatlands (hydrology entirely from direct precipitation) would likely not be impacted by groundwater drawdown associated with mining operations. No text edit.	GLIFWC disagrees with the co-lead disposition. Provide a link to the wetland section in the appendix.

Chapter 4.2

Comment_No.	Agency	Section	Comment	Co-Lead Disposition	GLIFWC Response
GLIFWC 81	GLIFWC	4.2.3.1.2 Hydrology Wetland Vegetation And Community Types	The first sentence is not supported. As indicated in the paragraph, the pump test did show some connectivity. Furthermore, a 30 day pump test does not produce the same degree of drawdown pressure as a 20 year mine project with 600 feet deep pits. Finally, the effects are likely to differ from one wetland to another. The sweeping conclusions in the bullet should be removed.	Edit bullet point… "• There is a general lack of connectivity between the shallow water table in the wetlands and the deeper bedrock aquifer. The depth of soil and till overlying the bedrock ranges up to 33 ft, with bedrock outcrops present that alter local groundwater flow paths. A pumping and isotope test conducted in 2006 indicated that the majority of the groundwater pumped during a 30-day pump test from a 610-ft-deep well drilled into the Virginia Formation was derived from aquifer recharge rather than surface water seepage from surface water features such as the Northshore Pit or wetlands. The variability of the bedrock and soil surface, along with the location of the surface water divide, creates localized, short, surficial groundwater flow paths within the watersheds on the Mine Site." Also see information provided in GLIFWC 77 that was added to beginning of section.	There is not enough information for us to remove our comment.
GLIFWC 82	GLIFWC	4.2.3.1.2 Hydrology Wetland Vegetation And Community Types	The discussion in these bullets represent observations of current conditions in wetlands that are not under hydrologic stress from mine induced drawdown.Once dewatering of the aquifer occurs, the situation is likely different. The text should be clarified.	This is existing conditions being discussed and not the potential effects of the project. No text edits.	ok
GLIFWC 83	GLIFWC	4.2.3.1.2 Hydrology Wetland Vegetation And Community Types	It should be noted in the text that according to scientific literature, ombotrophic wetlands can be affected by groundwater drawdown. See GLIFWC wetlands attachment.	Following sentence was added: Wetlands can be either groundwater or precipitation fed.	ok
4.2.6 Aquatic Species					
GLIFWC 84	GLIFWC	4.2.6.4 Mercury Concentrations In Fish	The discussion of 303d listing is not correct because the Embarrass River is on the 2012 303d list. See GLIFWC map of 303d waters in the wild rice attachment (fugure 3). Sulfate has a link to mercury methylation which is directly related to mercury contamination in fish. This should be noted here.	Text revised to clarify the current status of 303(d) listings. The Embarrass River is on the 303d list as impaired for Fishes Bioassessment, a category not related to mercury.	ok. However it should be noted that the Embarrass river is expected to be impaired for sulfate in the next draft list. Language regarding changes to 303d lists should be added.
4.2.8 Noise and Vibration					

Chapter 4.2

Comment_No.	Agency	Section	Comment	Co-Lead Disposition	GLIFWC Response
GLIFWC 85	GLIFWC	4.2.8.2 Mine Site	As with the 2009 DEIS, this document relies on assessing noise impacts on a few receptors instread of discussing the overall area that would be affected. A discussion of noise impacts to all publicly accessible areas is the Superior National Forest is needed. See GLIFWC noise attachment.	A discussion of noise impacts to all publicly accessible areas in the Superior National Forest has been included. As indicated above, the USFS has provided shapefiles for all recreational sites within the project vicinity (family camp grounds, camp sites, boating, fishing, swimming, and family picnic areas). In addition to the residential areas, BWCAW, and wildlife corridors already discussed in the SDEIS, we have also included recreational sites, trails, and closest State wildlife waters (used by tribal members for harvesting purposes) in all the noise and vibration contour maps. A discussion of noise impacts to all publicly accessible areas in the SNF has been included in the text in Section 4.2.8.2. Though not depicted on the noise and vibration figures due to sensitivity regarding cultural resources and locations, a discussion of the nearest archaeological sites (e.g., Spring Lake Sugarbush and Mesabe Widjiu [Laurentian Divide]) within the Project vicinity has been included in the text.	GLIFWC has concerns about the analysis. Provide a link to the cumulative effect section in the appendix.
4.2.9 Cultural Resources					
GLIFWC 86	GLIFWC	4.2.9.2.3 Area Of Potential Effects	Text asserts that compliance with standards suggests there would be no impacts to vegetation or soils. This assumption is incorrect. Significant effects and changes fron unimpacted conditions can occur without violation of a standard.	No change. The assumption is based on meeting ambient air quality standards.	GLIFWC stands by the comment.
GLIFWC 87	GLIFWC	4.2.9.2.3 Area Of Potential Effects	The discussion on water quality standards is not complete. The project may not exceed any evaluation criteria but that assumes successful implementation of perpetual water treatment and perpetual maintenance of the features that are left behind (hydromet and flotation tailings basins, cat 1 stockpile). This information should be included anytime the SDEIS makes the claim that all evaluation criteria are met. In addition, evaluation criteria are different from water quality standards. The PSDEIS indicates that water quality standards will not be met for several constituents.	Refer to chapter 5.2 for the environmental analysis of effects of the NorthMet Project Proposed Action.	GLIFWC disagrees with the co-lead disposition. Provide a link to the perpetual maintenance section in the appendix.
GLIFWC 88	GLIFWC	4.2.9.2.3 Area Of Potential Effects	We disagree with the conclusion that there would be no impacts due to groundwater drawdowns. See GLIFWC wetland attachment.	Refer to chapter 5.2 for the environmental analysis of effects of the NorthMet Project Proposed Action.	GLIFWC disagrees with the co-lead disposition. Provide a link to the hydrology section in the appendix.
GLIFWC 89	GLIFWC	4.2.9.2.3 Area Of Potential Effects	The visual area of potential effect should be the viewshed of the existing tailings basin. See GLIFWC map.	Text has been revised for clarity.	There is not enough information for us to remove our comment.

Chapter 4.2

Comment_No.	Agency	Section	Comment	Co-Lead Disposition	GLIFWC Response
4.2.10 Socioeconomics					
GLIFWC 107	GLIFWC	4.2.10 Socioeconomics - "The study area for socioeconomics extends beyond the area of direct potential project effects to include all of Cook, Lake, and St. Louis counties (see Figure 4.2.10-1)."	IMPLAN modeling played a key role in the SDEIS's socio-economic accessment. IMPLAN modeling and the employment figures derived from the model (i.e. direct, indirect and induced) were for St. Louis County (i.e. NorthMet Economic Impact 2011 Update: Economic Impact of PolyMet's NorthMet Project on St. Louis County, Minnesota Revised April 2012 for PolMet Mining Inc.). The socio-economic study area (i.e. 3 counties) is not consistent with IMPLAN modeling (one county). See GLIFWC socioeconomics attachment for additional information.	Section 5.2.10.1.3 explains why the IMPLAN model focuses on St. Louis County, and how this is consistent with the remainder of the Socioeconomic section. No text edit.	We disagree. The comment stands.
GLIFWC 108	GLIFWC	4.2.10 Socioeconomics - Jobs Held by residents section, Table 4.2.10-9 Employment Status of Study Area Communities, 2009	This table illustrates unemployment rates in 2009 during the worste of the recession. Tables should be updated with unemployment figures for the Counties in 2010, 2011,and 2012 to ascertain impacts of business cycles on regional employment. See GLIFWC socioeconomics attachment for additional information.	No change. Will revisit updating all data (including IMPLAN) for the Final SEIS.	We disagree. The comment stands.
GLIFWC 109	GLIFWC	4.2.10 Socioeconomics - Education Section	A table is needed to provide number of graduates from Mesabi Range Community and Technical College (Virginia and Eveleth); Vermilion Community College (Ely); Hibbing Community College; Fond du Lac Tribal and Community College (Cloquet); and Lake Superior College (Duluth) for the following job categories: 1)Management, 2) Mine Operations - Contract supervision, operators, maintenance, 3) Mine Technical - Geology, grade control, planning, 4) Railroad Operations, 5) Plant Operations, 6) Sample Preparation and analytical laboratory, and 7) Finance, purhchasing, marketing, environmental, HR. See GLIFWC socioeconomics attachment for additional information.	Sufficient assumptions have been made about availability of the workforce. No change.	We disagree. The comment stands.

Chapter 4.2

Comment_No.	Agency	Section	Comment	Co-Lead Disposition	GLIFWC Response
GLIFWC 110	GLIFWC	4.2.10.1.6 Subsistence	Subsistence section failed to acknowledge the large number of species that could be harvested off-reservation by tribes. RESOURCES USED - As of 1837 and 1842, the Chippewa exploited virtually every resource in the ceded territory. Among the mammals the Chippewa hunted at treaty time were white-tailed deer, black bear, muskrat, beaver, marten, mink, fisher, snowshoe hare, cottontail rabbit, badger, porcupine, moose, woodchuck, squirrel, raccoon, otter, lynx, fox, wolf, elk, and bison. Among the birds the Chippewa hunted were ducks, geese, songbirds, various types of grouse, turkeys, hawks, eagles, owls, and partridges. Among the fish the Chippewa harvested were, in Lake Superior, whitefish, herring, chubs, lake trout and turbot; and, in-shore, suckers, walleye, pike, sturgeon, muskie, and perch. LAC COURTE OREILLES CHIPPEWA IND. v. STATE OF WIS. NO. 74-C-313. 653 F.Supp. 1420 (1987). See GLIFWC socioeconomics attachment for additional information.	Species list added to Cultural Resources section (4.2.9), and referenced in Section 4.2.10.1.6. Reference to Section 4.2.9 added.	ok

Chapter 4.2

Comment_No.	Agency	Section	Comment	Co-Lead Disposition	GLIFWC Response
GLIFWC 111	GLIFWC	4.2.10.1.6 Subsistence	Subsistence section failed to acknowledge the large number of species that could be harvested off-reservation by tribes. RESOURCES USED - The Chippewa also harvested a large number of plants and plant materials, including: box elder, sugar maple, arum-leaved arrow-head, smooth sumac, stag-horn sumac, wild ginger, common milkweed, yellow birch, hazelnut, beaked hazelnut, nannyberry, climbing bitter-sweet, large-leaved aster, Philadelphia fleabane, dandelion, panicled dogwood, large toothwort, cucumber, Ojibwe squash, large pie pumpkin, gourds, field horsetail, bog rosemary, leather leaf, wintergreen, Labrador tea, cranberry, blueberry, beech, white oak, bur oak, red oak, black oak, corn, wild rice, Virginia waterleaf, shell bark hickory, butternut, wild mint, catnip, hog peanut, creamy vetchling, navy bean, lima bean, cranberry pole bean, lichens, wild onion, wild leek, false spikenard, sweet white water lily, yellow lotus, red ash, white pine, hemlock, brake, marsh marigold, smooth juneberry, red haw apple, wild strawberry, wild plum, pin cherry, sand cherry, wild cherry, choke cherry, highbush blackberry, red raspberry, large-toothed aspen, prickly gooseberry. LAC COURTE OREILLES CHIPPEWA IND. v. STATE OF WIS. NO. 74-C-313. 653 F.Supp. 1420 (1987). See GLIFWC socioeconomics attachment for additional information.	Species list added to Cultural Resources section (4.2.9), and referenced in Section 4.2.10.1.6. Reference to Section 4.2.9 added.	ok

Chapter 4.2

Comment_No.	Agency	Section	Comment	Co-Lead Disposition	GLIFWC Response
GLIFWC 112	GLIFWC	4.2.10.1.6 Subsistence	Subsistence section failed to acknowledge the large number of species that could be harvested off-reservation by tribes. RESOURCES USED -wild black currant, wild red currant, smooth gooseberry, Ojibwe potato, hop, Virginia creeper, river-bank grape, red maple, mountain maple, spreading dog-bane, paper birch, low birch, downy arrowwood, woolly yarrow, white sage, alternate-leaved dogwood, wool grass, great bulrush, scouring rush, sweet grass, Dudley's rush, marsh vetchling, sweet fern, black ash, balsam fir, tamarack, black spruce, jack pine, Norway pine, arbor vitae (white cedar), hawthorn, shining willow, sphagnum moss, basswood, cat-tail, wood nettle, slippery elm, and Lyall's nettle, poison ivy, winterberry, mountain holly, sweet flag, Indian turnip, wild sarsaparilla, ginseng, spotted touch-me-not, blue cohosh, speckled elder, hound's tongue, marsh bellflower, harebell, bush honeysuckle, red elderberry, snowberry, highbush cranberry, white campion, yarrow, pearly everlasting. LAC COURTE OREILLES CHIPPEWA IND. v. STATE OF WIS. NO. 74-C-313. 653 F.Supp. 1420 (1987)	Species list added to Cultural Resources section (4.2.9), and referenced in Section 4.2.10.1.6. Reference to Section 4.2.9 added.	ok
GLIFWC 113	GLIFWC	4.2.10.1.6 Subsistence	Subsistence section failed to acknowledge the large number of species that could be harvested off-reservation by tribes. RESOURCES USED -lesser cat's foot, common burdock, ox-eye daisy, Canada thistle, common thistle, daisy fleabane, Joe-Pye weed, tall blue lettuce, white lettuce, black-eyed Susan, golden ragwort, entire-leaved groundsel, Indian cup plant, fragrant golden-rod, tansy, cocklebur, bunch berry, tower mustard, marsh cress, tansy-mustard, squash, wild balsam-apple, hare's tail, wood horsetail, prince's pine, flowering spurge, golden corydalis, giant puffball, wild geranium, rattlesnake grass, blue flag, wild bergamot, heal-all, marsh skullcap, white sweet clover, reindeer moss, northern clintonia, Canada mayflower. LAC COURTE OREILLES CHIPPEWA IND. v. STATE OF WIS. NO. 74-C-313. 653 F.Supp. 1420 (1987) See GLIFWC socioeconomics attachment for additional information.	Species list added to Cultural Resources section (4.2.9), and referenced in Section 4.2.10.1.6. Reference to Section 4.2.9 added.	ok

Chapter 4.2

Comment_No.	Agency	Section	Comment	Co-Lead Disposition	GLIFWC Response
GLIFWC 114	GLIFWC	4.2.10.1.6 Subsistence	Subsistence section failed to acknowledge the large number of species that could be harvested off-reservation by tribes. RESOURCES USED -small Solomon's seal, star-flowered Solomon's seal, carrion flower, twisted stalk, large flowered bellwort, ground pine, Canada moonseed, heart-leaved umbrella-wort, yellow water lily, great willow-herb, evening primrose, Virginia grape fern, yellow ladies' slipper, rein orchis, adder's mouth, bloodroot, white spruce, common plantain, Carey's persicaria, swamp persicaria, curled dock, shield fern, female fern, sensitive fern, red baneberry, Canada anemone. LAC COURTE OREILLES CHIPPEWA IND. v. STATE OF WIS. NO. 74-C-313. 653 F.Supp. 1420 (1987). See GLIFWC socioeconomics attachment for additional information.	Species list added to Cultural Resources section (4.2.9), and referenced in Section 4.2.10.1.6	ok
GLIFWC 115	GLIFWC	4.2.10.1.6 Subsistence	Subsistence section failed to acknowledge the large number of species that could be harvested off-reservation by tribes. RESOURCES USED - thimble-weed, wild columbine, gold thread, bristly crowfoot, cursed crowfoot, purple meadow rue, agrimony, large-leaved aven, rough cinquefoil, marsh five-finger, smooth rose, high bush blackberry, meadow-sweet, steeple bush, goose grass, small cleaver, small bedstraw, prickly ash, balsam poplar, large toothed aspen, quaking aspen, crack willow, bog willow, pitcher-plant, butter and eggs, cow wheat, wood betony, mullein, moosewood, musquash root, cow parsnip, sweet cicely, wild parsnip, black snakeroot, Canada violet, American dog violet, speckled alder, sweet gale, goldthread, bluewood aster, horseweed, Canada hawkweed, fragrant goldenrod, shin leaf, sessile-leaved bellwort, slender ladies' tresses, and starflower. The Chippewa harvested other miscellaneous resources, such as turtles and turtle eggs.COURTE OREILLES CHIPPEWA IND. v. STATE OF WIS. NO. 74-C-313. 653 F.Supp. 1420 (1987). See GLIFWC socioeconomics attachment for additional information.	Species list added to Cultural Resources section (4.2.9), and referenced in Section 4.2.10.1.6. Reference to Section 4.2.9 added.	ok

Chapter 5.2

Comment_No.	Agency	Section	Comment	Co-Lead Disposition	GLIFWC Response
5.2.2 Water Resources					
GLIFWC 195	GLIFWC	5.2.2.3.4 Mercury	There is a general lack of understanding of mercury dynamics in the St. Louis River Watershed. See the supplemental document "Great Lakes Indian Fish and Wildlife Commission (GLIFWC) Comments Related to Mercury" [Comment 1] for details.	The Co-leads agree that the mercury dynamics are complex; however, the analysis as presented indicated that there was minimal potential for a downstream increase in mercury loading.	GLIFWC disagrees with the co-lead disposition. Provide a link to the mercury section in the appendix.
GLIFWC 197	GLIFWC	5.2.2.3.4 Mercury - Throughout the section	The conclusion that mercury will not increase in the environment or exceed applicable environmental evaluation criteria is based on several assumptions. One such assumption is that mercury methylation will not increase because the amount of sulfate being released to the environment will actually be reduced by the project. This assumption is not justified. See the supplemental document "Great Lakes Indian Fish and Wildlife Commission (GLIFWC) Comments Related to Mercury" [Comment 3] for details.	Text will be edited to remove this statement. Similar sentences will also be removed.	ok
GLIFWC 198	GLIFWC	5.2.2.3.4 Mercury	The conclusion that mercury will not increase in the environment or exceed applicable environmental evaluation criteria is based on several assumptions. One such assumption is that the Nothmet project would have minor effects on flows in the Partrige and Embarrass Rivers or their tributaries and is thus not expected to result in increases in flow fluctuations that promote mercury methylation. This assumption is not justified. See the supplemental document "Great Lakes Indian Fish and Wildlife Commission (GLIFWC) Comments Related to Mercury" [Comment 4] for details.	The modeling does not suggest that flow fluctuations should be any greater than existing conditions.	GLIFWC disagrees with the co-lead disposition. Provide a link to the hydrology section in the appendix.
GLIFWC 200	GLIFWC	5.2.2.3.4 Mercury - Throughout the section	There is a potential for the overflow from the West Pit (after year 40) to exceed the Great Lakes Initiative (GLI) standard for mercury of 1.3 ng/L. This has not been considered when concluding the Proposed Action would not exceed applicable environmental evaluation criteria. See the supplemental document "Great Lakes Indian Fish and Wildlife Commission (GLIFWC) Comments Related to Mercury" [Comment 6] for details.	Both an analog approach and a mass balance were conducted for evaluating the potential for the West Pit lake water quality to exceed the GLI standard for mercury of 1.3 ng/L. Both analyses concluded the potential for an exceedance was unlikely. Further, West Pit overflow water is first treated at the WWTF before discharge, which would further reduce mercury concentrations in the effluent.	Comment stands. Provide a link to the mercury section in the appendix.

Chapter 5.2

Comment_No.	Agency	Section	Comment	Co-Lead Disposition	GLIFWC Response
	GLIFWC	5.2.2	The GOLDSIM model is not able to reproduce the existing water quality conditions that are observed at the site. This indicates that the model is poorly calibrated to existing conditions. Therefore, it is doubtful that GOLDSIM will be able to accurately predict future water quality which is a much more difficult task. Provide a link to the hydrology section.		Provide a link to the hydrology section in the appendix
GLIFWC 173	GLIFWC	5.2.2.3.5 Proposed And Recommended Mitigation Measures	The section on proposed action design changes and fixed engineering controls are no longer mitigation measures as they are now part of the proposed project. These chages have already been described in other sections of the PSDEIS. It appears that the list of mitigations is being padded. These sections should be removed.	This section acknowledges measures taken to avoid, minimize, or mitigate impacts to water resources. Just because a measure is included as part of the proposed project does not mean it does not serve to mitigate impacts.	ok
GLIFWC 174	GLIFWC	5.2.2.3.5 Proposed And Recommended Mitigation Measures	The notion of fine material being segregated in the center of the rail cars is not credible. See GLIFWC rail car attachment.	Discussion of fine material being segregated in the center of rail cars has been removed.	While that language has been removed, the overall conclusion regarding rail cars remains. Provide a link to the rail car information in the appendix.
GLIFWC 175	GLIFWC	5.2.2.3.5 Proposed And Recommended Mitigation Measures	Because the hydrology of surface and groundwater for the Partridge River is poorly understood, this section should give information on the maximum capacity for the WWTF. GLIFWC staff believe that this facility will have to treat significantly greater ammounts of water than the applicant proposes based on field baseflow data.	As stated on page 5.2.2-109, "The WWTF equalization basins are designed for the spring snowmelt when the Mine Sit would be at its maximum area. In the event of an extreme event (e.g., 100-year storm), excess water would remain in the mine pits, which essentially have unlimited storage capacity, with mine operations in the pits temporarily shut down (see Mine Site Water Management Plan)." The WWTF is being designed such that additional capacity may be added if required as per the adaptive water management plan	ok

Chapter 5.2

Comment_No.	Agency	Section	Comment	Co-Lead Disposition	GLIFWC Response
GLIFWC 176	GLIFWC	5.2.2.3.5 Proposed And Recommended Mitigation Measures	Says that the Category 1 stockpile cover design could be updated but it does not say how. The rest of the text is simply a restatement of the proposed project.	Text added. Design options, which would need to be approved by the MPCA and MDNR, include: increased or decreased thickness of the geomembrane material to modify the potential for defects to be created during installation and to modify the life of the geomembrane; increased or decreased soil cover thickness above the geomembrane material to modify water storage capacity; increased or decreased soil hydraulic conductivity of the granular drainage layer above the geomembrane to modify lateral drainage capacity; increased or decreased uninterrupted slope length to modify lateral drainage capacity; modified soil type and/or thickness below the geomembrane to modify leakage rate through potential geomembrane defects; and/or including a geosynthetic clay liner below the geomembrane to modify leakage rate through potential geomembrane defects. After installation of the cover system, post-installation adjustments, such as modifying vegetation density and erosion of the cover system, could be made if approved by the MPCA and MDNR (PolyMet 2013g).	ok
GLIFWC 177	GLIFWC	5.2.2.3.5 Proposed And Recommended Mitigation Measures	This is a restatement of the bentonite cover that is part of the proposed project. This is not a mitigation measure. How exactly can the cover system be modified? What part of the cover design is adaptive?	Text added to clarify. Prior to installation, the design of the pond bottom cover system could be adjusted to modify performance. Design options include: increasing or decreasing the thickness of the bentonite amendment, and/or increasing the percent of bentonite, and/or a combination of increasing/decreasing the thickness and increasing/decreasing the percent bentonite. After installation, the design of the installed pond bottom cover system could also be adjusted to modify performance by these same methods. In addition, the bentonite amended layer could be excavated from portions of the pond bottom. Any design modifications would need to be approved by the MPCA and MDNR (PolyMet 2013g).	ok
GLIFWC 178	GLIFWC	5.2.2.3.5 Proposed And Recommended Mitigation Measures	Describe the long term maintenance needs for PRB's including replacement frequency (expected effective timeperiod)	The Proposed Action relies on mechanical treatment to achieve water quality objectives. Non-mechanical treatment (including PRBs) is described as a goal, but is not specifically part of the Proposed Action. It is beyond the scope of the SEIS to describe non-mechanical systems in detail. For interested readers, information on non-mechanical systems is referenced in the SDEIS (PolyMet, 2013g).	GLIFWC staff disagree with the co-lead disposition. Provide a link to the perpetual maintenance section in the appendix.

Chapter 5.2

Comment_No.	Agency	Section	Comment	Co-Lead Disposition	GLIFWC Response
GLIFWC 179	GLIFWC	5.2.2.3.5 Proposed And Recommended Mitigation Measures	As previously commented, other sections of the PSDEIS state that the applicant is not seeking a seasonal application of the wild rice standard. Yet, the west pit overflow non mechanical treatment system relies on a seasonal discharge to comply with the standard. This non-mechanical treatment option should be eliminated from the project as it does not meet the stated goals of compliance with water quality standards.	The Proposed Action relies on mechanical treatment to achieve water quality objectives. Non-mechanical treatment (including PRBs) is described as a goal, but is not specifically part of the Proposed Action. It is beyond the scope of the SEIS to describe non-mechanical systems in detail. For interested readers, information on non-mechanical systems is referenced in the SDEIS (PolyMet, 2013g).	GLIFWC staff disagree with the co-lead disposition. Provide a link to the perpetual maintenance section in the appendix.
GLIFWC 202	GLIFWC	5.2.2.3.6 Monitoring - Throughout the section	It is not apparent whether mercury monitoring is included within the water quality monitoring of the Mine Site or Plant Site. If it is, this should be specified. If it is not, it should be added to the monitoring activities.	Water quality monitoring would be finalized during permitting, but in general, mercury monitoring would be included within the water quality monitoring.	ok
GLIFWC 180	GLIFWC	5.2.2.4 Northmet Project No Action Alternative	This section describes the flaw in the PSDEIS of assuming that the no action alternative is equivalent to existing conditions. We agree that they are not the same thing. A true no action alternative should be modeled as required by NEPA. See GLIFWC hydrology attachment for more information.	Description of the No Action Alternative will be clarified.	There is not enough information for us to remove the comment. Provide a link to the hydrology section of the appendix.
GLIFWC 117	GLIFWC	5.2.2 Water Resources	As previously commented, the mine site is not located within the historic iron/taconite mining district. It is in a separate geology alltogether in an mostly undisturbed area knows an the 100 mile swamp. Correct the text.	Text edited.	ok
GLIFWC 118	GLIFWC	5.2.2 Water Resources	The negative effects of sulfate on wild rice are well understood and scientifically documented. Edit the text as outlined in the GLIFWC wild rice attachment.	All information provided was considered when the MPCA made its recommendation. The text already states that 'Some research has indicated that natural wild rice thrives better in low sulfate waters.'. No text edit.	GLIFWC staff disagree with the co-lead disposition. Provide a link to the wild rice section in the appendix.
GLIFWC 119	GLIFWC	5.2.2 Water Resources	There is a discussion comparing the NorthMet project to other sulfide mines. The goal appears to be the minimization of impact discussion prior to any information presented on the impact analysis itself. If this type of information is to be presented, additional discussion about the water quality contamination that these other mines have caused, their location and ore grade is necessary.	No change to SDEIS text.	Comment stands.
GLIFWC 120	GLIFWC	5.2.2 Water Resources	why is the term wild rice bed in quotes? Remove the quotes.	Quotes removed.	ok

Chapter 5.2

Comment_No.	Agency	Section	Comment	Co-Lead Disposition	GLIFWC Response
GLIFWC 121	GLIFWC	5.2.2 Water Resources	The discussion on water treatment should state that both active and passive treatment systems would need to operate successfully in perpetuity.	Text edited to reflect that the Closure objective is to provide mechanical and non-mechanical treatment for as long as necessary to meet regulatory standards at evaluation locations in groundwater and surface water. Both mechanical and non-mechanical treatment will require periodic maintenance and monitoring activities. Modeling predicts that treatment activities will be a minimum 200 years at the Mine Site and a minimum of 500 years at the Plant Site. While long-term, these time frames for water treatment are not necessarily perpetual. The owning company would be held accountable to maintenance and monitoring required under permit and would not be released until all conditions have been met.	GLIFWC does not agree with the language in the co-lead disposition. Provide a link to the Perpetual care language in the appendix.
GLIFWC 122	GLIFWC	5.2.2 Water Resources	The discussion of model results and compliance with evaluation criteria assumes perpetual water treatment and perpetual maintenance of the facilities. This should be clearly stated. Also, evaluation criteria are different from standards. The PSDEIS does say that standards would be exceeded for several constituents.	Text edited. As described in the SDEIS, the evaluation criteria do use the standards, but interpret the standards from a probabilistic perspective. The P90 approach is a reasonable method for applying the results of probabilistic modeling for EIS impact assessment. In this context, it is not appropriate to say that "a constituent will exceed a water quality standard". It is more accurate to say that "there is at least a 90 percent probability that a constituent will not exceed a standard (or up to a 10 percent probability that it will)". These quoted statements are very different.	GLIFWC does not agree with the language in the co-lead disposition. Provide a link to the Perpetual care language in the appendix.
GLIFWC 196	GLIFWC	5.2.2 Water Resources	The conclusion that mercury will not increase in the environment or exceed applicable environmental evaluation criteria is based on several assumptions. One such assumption is that the tailings basin will function as a mercury sink. This assumption is not justified. See the supplemental document "Great Lakes Indian Fish and Wildlife Commission (GLIFWC) Comments Related to Mercury" [Comment 2] for details.	Co-leads disagree. Tailings Basins in general are a sink for mercury.	GLIFWC does not agree with the language in the co-lead disposition. Provide a link to the mercury section in the appendix.
GLIFWC 221	GLIFWC	5.2.2 Water Resources	The No-Action, P50 model (continuation of current conditions) for As shows annual maximum values (~0.5 ug/L), substantially less than those shown as mean existing water quality in Table 4.2.2-18 (mean As is 0.78 to 1.4 ug/L depending on the data set).	Baseline data is presented in Table 4.2.2-18 which is different to what was modeled for the Continuation of Existing Conditions Scenario.	"Continuation of Existing Conditions" is supposed to represent a model of existing conditions. If baseline for Colby Lake in Table 4.2.2-18 is not existing conditions then what is it?

Chapter 5.2

Comment_No.	Agency	Section	Comment	Co-Lead Disposition	GLIFWC Response
GLIFWC 222	GLIFWC	5.2.2 Water Resources	the travel times to the Partridge River depend on the basic hydrology of the mine site. As we comment elsewhere, the baseflow assumed for the Partridge is not supported by data from the Dunka Rd. gage. Incorporating the higher baseflow indicated by the gage data into modeling assumptions and calibration would result in a more conductive site and therefore, faster transport times.	Groundwater travel times are related to river baseflow estimates. We believe the baseflow estimates are reasonable. Higher baseflows would likely result in a more conductive site and faster transport times, but this would not necessarily result in higher solute concentrations in either groundwater or surface water; in fact we believe higher baseflows would result likely result in lower concentrations. The GoldSim model duration was 200 years, which was sufficient to capture the peak concentration of all solutes along all surficial groundwater flow paths; therefore, the GoldSim model does not need faster transport times to capture peak solute concentrations.	A more conductive site would, as you agree, result in faster transport times but would also result in great loss of groundwater to pit dewatering. The interaction between site conductivity and contaminate transport is not a simple relationship that can fully captures by a “belief” on your part.
GLIFWC 223	GLIFWC	5.2.2 Water Resources	The evaluation point at the toe of the basins is omitted from the table. Without that information it is impossible to evaluate the need for and the effectiveness of the seep capture system. Given that the seep capture system can not be operated indefinitely, it is important to report the character of the water that will be exiting the basins. A figure showing the water character at the toe of the basins should be added. Figures from Water Modeling Data Package Vol 2-Plant Site v9 MAR2013.pdf such as Figure F-01-04.1 or Figure F-01-18.1 or Figure F-01-24.1 would be suitable.	Although we agree that the evaluation locations at the toe of the tailings basin are valuable in terms of ongoing monitoring and early warning of potential water quality issues, we do not see any real benefit to including these additional evaluation locations in the SDEIS as the GoldSim model was run for sufficient durations that the peak of seepage from all contamination sources reaches the evaluation locations currently included in the SDEIS.	Given dilution of contamination between the basin and the reported evaluation points, the modeled peak is not the same as the concentration at the toe of the basin. Toe of basin concentrations should be reported.
GLIFWC 123	GLIFWC	5.2.2.1.1 Groundwater	The conclusion that there are no significant hydrologic affects of the project cannot be supported. It is based on fatally flawed modelling in XP-SWMM using antiquated data from far downstream. See GLIFWC hydrology attachment.	We believe the XP-SWMM modeling is acceptable for use in the SDEIS. The 20 year old data is acceptable as there haven't been any significant changes within the watershed. We believe the assumptions used were reasonably conservative. Additional detail is provided in the water sections of the SDEIS, and further rationale is provided in the Water Data Packages.	GLIFWC does not agree with the co-lead disposition. Provide a link to the hydrology section in the appendix.

Chapter 5.2

Comment_No.	Agency	Section	Comment	Co-Lead Disposition	GLIFWC Response
GLIFWC 124	GLIFWC	5.2.2.1.1 Groundwater	The discussion of groundwater evaluation criteria is incomplete. The evaluation point at the Dunka road needs to be discussed and all results displayed in a table. This is because there are 2 alternatives for the land exchange and a preferred alternative is not yet chosen. This section, and all other sections of chapter 5 must not assume a property boundary in the text. Finally, figure 5.2.2-4 apprears to depict the Dunka Rd. evaluation point. the text should also.	Although we agree that the evaluation locations along Dunka Road are valuable in terms of ongoing monitoring and early warning of potential water quality issues, we do not see any real benefit to including these additional evaluation locations in the SDEIS as the GoldSim model was run for sufficient durations that it captures the peak solute concentrations along all flow paths at the evaluation locations currently included in the SDEIS.	The Dunka road should be included because Alternative B of the land exchange would use that evaluation point as the point of compliance should that alternative be chosen.
GLIFWC 125	GLIFWC	5.2.2.1.1 Groundwater- figure 5.2.2-4	The location of the groundwater evaluation point for the ore surge pile flowpath should be moved to the section of the property boundary closest to the pile itself. Does the modeling use this incorrect evaluation point?	The evaluation point for the OSP is the Partridge River because the river is located slightly further upgradient (northwest) than the mine property boundary. The distance from the OSP to the evaluation point is about 1100 meters which is consistent with Figure 5.2.2-4.	We suggest you look at the figure again. The river is <u>not</u> closer than the property boundary to the OSP source. NOTE - Map corrected in later version.
GLIFWC 126	GLIFWC	5.2.2.1.2 Surface Waters - Hydrologic Alterations	The evaluation criteria values for the project are taken from XP_SWMM modeling That model is fatally flawed and produces results that conflict with measured data. The results cannot be used. See GLIFWC hydrology attachment	We believe the XP-SWMM modeling is acceptable for use in the SDEIS. The 20 year old data is acceptable as there haven't been any significant changes within the watershed. We believe the assumptions used were reasonably conservative. Additional detail is provided in the water sections of the SDEIS, and further rationale is provided in the Water Data Packages.	GLIFWC does not agree with the co-lead disposition. Provide a link to the hydrology section in the appendix.
GLIFWC 127	GLIFWC	5.2.2.1.2 Surface Waters	GLIFWC disagrees with MPCA interpretation of areas of wild rice production. See GLIFWC wild rice attachment.	The SDEIS uses MPCA's draft determination regarding the locations of water used for the production of wild rice.	GLIFWC does not agree with the MPCA determination of points of compliance. Provide a link to the wild rice section in the appendix.
GLIFWC 128	GLIFWC	5.2.2.1.2 Surface Waters	GLIFWC disagrees with MPCA seasonal application of the wild rice standard. See GLIFWC wild rice attachment.	The SDEIS uses MPCA's draft determination regarding the seasonal application of the wild rice standard.	GLIFWC does not agree with the MPCA seasonal application of the wild rice sulfate standard. Provide a link to the wild rice section in the appendix.
GLIFWC 129	GLIFWC	5.2.2.1.2 Surface Waters	Section states that PolyMet is not seeking application of a seasonal wild rice standard. This is in conflict with other sections of the PSDEIS. See GLIFWC wild rice attachment.	All information provided was considered when the MPCA made their recommendation. Should the application of the standard change, it will be addressed at that time.	GLIFWC does not agree with the MPCA determination of points of compliance. Provide a link to the wild rice section in the appendix.
GLIFWC 194	GLIFWC	5.2.2.1.2 Surface Waters	There is a general lack of understanding of mercury dynamics in the St. Louis River Watershed. See the supplemental document "Great Lakes Indian Fish and Wildlife Commission (GLIFWC) Comments Related to Mercury" [Comment 1] for details.	The Co-leads agree that the mercury dynamics are complex; however, the analysis as presented indicated that there was minimal potential for a downstream increase in mercury loading.	GLIFWC does not agree with the co-lead disposition. Provide a link to the mercury section in the appendix.

Chapter 5.2

Comment_No.	Agency	Section	Comment	Co-Lead Disposition	GLIFWC Response
GLIFWC 130	GLIFWC	5.2.2.2.3 Water Quality Modeling (goldsim)	There is a comparison of sulfur content with other mines. Fundamentally, it does not matter if S levels are lower or higher compared to other mines. NorthMet would be located in a wet environment with complex hydrology where other mines are located in arid or arctic environments with little hydrologic connectivity. All mines are different and this language makes the attempt to minimize the risks of this particular mine. Remove the language.	Caveat added to discussion.	There is not enough information for us to remove the comment.
GLIFWC 131	GLIFWC	5.2.2.2.3 Water Quality Modeling (goldsim)	XP-SWMM model is fatally flawed and should not be used in impact assessment. See GLIFWC hydrology attachment	The difference in the baseflows are very small (indistinguishable from a stage standpoint). We believe the XP-SWMM modeling is acceptable for use in the SDEIS. The 20 year old data is acceptable as there haven't been any significant changes within the watershed. We believe the assumptions used were reasonably conservative. Additional detail is provided in the water sections of the SDEIS, and further rationale is provided in the Water Data Packages.	GLIFWC does not agree with the co-lead disposition. Provide a link to the hydrology section in the appendix.
GLIFWC 132	GLIFWC	5.2.2.2.3 Water Quality Modeling (goldsim)	There is a statement that the no action alternative is a continuation of existing conditions. GLIFWC staff fundamentally disagree with this approach. This flawed assumtion leads to errors in water quality model outputs. NEPA requires an analysis of the no action alternative so that the effects of the proposed action can be understood in a larger context. See GLIFWC hydrology attachment.	We believe the assumptions used were reasonably conservative. The description of the No Action Alternative and Continuation of Existing Conditions will be further clarified in the SDEIS.	GLIFWC does not agree with the co-lead disposition. Provide a link to the hydrology section in the appendix.
GLIFWC 133	GLIFWC	5.2.2.3.1 Northmet Project Proposed Action Water Budget Overview - figure 5.2.2-15	This map, or a new map are needed with the location of the west pit level control structure, the outfall location, and the potential location of facilities described in the AWMP.	Figure 5.2.2-15 will be edited to include the west pit level control structure & the outfall location.	ok
GLIFWC 134	GLIFWC	5.2.2.3.1 Northmet Project Proposed Action Water Budget Overview	Section states that figure 5.2.2-15 has the location of a wetland and outlet control structure OS-5. It does not. Figure should also include the tributary channel that would connect the outfall to the Partridge River.	Figure 5.2.2-15 will be edited to include the west pit level control structure & the outfall location.	ok

Chapter 5.2

Comment_No.	Agency	Section	Comment	Co-Lead Disposition	GLIFWC Response
GLIFWC 135	GLIFWC	5.2.2.3.1 Northmet Project Proposed Action Water Budget Overview	Discussion on the hydromet tailings facility should clearly state that the periodic pumping and water collection activities would be perpetual.	The Closure objective is to provide water management activities at the hydrometallurgical facility for as long as necessary to meet regulatory standards at evaluation locations in groundwater and surface water. While described as long-term, the time frame for these activities is not necessarily "perpetual". Chapter 3 describes closure of the Hydrometallurgical Residue Facility. Once the facility is drained and reclaimed (covered), no further pumping would be required. As such, there would not be periodic or perpetual pumping of water from the Hydrometallurgical Residue Facility post closure.	GLIFWC does not agree with the language in the co-lead disposition. Provide a link to the Perpetual care language in the appendix.
GLIFWC 136	GLIFWC	5.2.2.3.1 Northmet Project Proposed Action Water Budget Overview - Mine Site section	The section should clearly state for how long water collection and treatment of Category 1 stockpile seepage would be needed. It should also state that the length of time the WWTP would operate in order to comply with water quality standards is perpetual	Text edited to reflect that the Closure objective is to provide mechanical and non-mechanical treatment for as long as necessary to meet regulatory standards at evaluation locations in groundwater and surface water. Both mechanical and non-mechanical treatment will require periodic maintenance and monitoring activities. Modeling predicts that treatment activities will be a minimum 200 years at the Mine Site and a minimum of 500 years at the Plant Site. While long-term, these time frames for water treatment are not necessarily perpetual. The owning company would be held accountable to maintenance and monitoring required under permit and would not be released until all conditions have been met.	GLIFWC does not agree with the language in the co-lead disposition. Provide a link to the Perpetual care language in the appendix.
GLIFWC 137	GLIFWC	5.2.2.3.1 Northmet Project Proposed Action Water Budget Overview	States that the goal is to transition to non mechanical water treatment. The fact that all water treatment (mechanical and/or non mechanical) would need to occur in perpetuity. It should also clearly state that a transition to non mechanical treatment may not be possible.	Text edited (see GLIFWC 136: maintenance and monitoring long term required)	GLIFWC does not agree with the language in the co-lead disposition. Provide a link to the Perpetual care language in the appendix.
GLIFWC 138	GLIFWC	5.2.2.3.1 Northmet Project Proposed Action Water Budget Overview	First paragraph should state that treatment and capture of water needs are perpetual.	Text edited (see GLIFWC 136: maintenance and monitoring long term required)	GLIFWC does not agree with the language in the co-lead disposition. Provide a link to the Perpetual care language in the appendix.

Chapter 5.2

Comment_No.	Agency	Section	Comment	Co-Lead Disposition	GLIFWC Response
GLIFWC 139	GLIFWC	5.2.2.3.1 Northmet Project Proposed Action Water Budget Overview	States that long term closure activities will continue until the various facility features are deemed environmentally acceptable, in a self sustaining and stable condition. This is a misleading statement because the maintenance and water treatment needs are perpetual. A stable and self sustaining site will never occur.	Text edited to reflect that the Closure objective is to provide mechanical and non-mechanical treatment for as long as necessary to meet regulatory standards at evaluation locations in groundwater and surface water. Both mechanical and non-mechanical treatment will require periodic maintenance and monitoring activities. Modeling predicts that treatment activities will be a minimum 200 years at the Mine Site and a minimum of 500 years at the Plant Site. While long-term, these time frames for water treatment are not necessarily perpetual. The owning company would be held accountable to maintenance and monitoring required under permit and would not be released until all conditions have been met.	GLIFWC does not agree with the language in the co-lead disposition. Provide a link to the Perpetual care language in the appendix.
GLIFWC 140	GLIFWC	5.2.2.3.1 Northmet Project Proposed Action Water Budget Overview	Non mechanical treatment options would still require maintenance and monitoring in perpetuity to ensure effectiveness.	Text edited to reflect that the Closure objective is to provide mechanical and non-mechanical treatment for as long as necessary to meet regulatory standards at evaluation locations in groundwater and surface water. Both mechanical and non-mechanical treatment will require periodic maintenance and monitoring activities. Modeling predicts that treatment activities will be a minimum 200 years at the Mine Site and a minimum of 500 years at the Plant Site. While long-term, these time frames for water treatment are not necessarily perpetual. The owning company would be held accountable to maintenance and monitoring required under permit and would not be released until all conditions have been met.	GLIFWC does not agree with the language in the co-lead disposition. Provide a link to the Perpetual care language in the appendix.
GLIFWC 199	GLIFWC	5.2.2.3.1 Northmet Project Proposed Action Water Budget Overview	There is no discussion of the impacts on mercury from the construction of wetlands over the East Pit and at the permiter of the tailings basin during reclamation. See the supplemental document "Great Lakes Indian Fish and Wildlife Commission (GLIFWC) Comments Related to Mercury" [Comment 5] for details.	These wetlands are not expected to be sources of mercury nor have elevated mercury concentrations. The water used to augment flows north of the tailings storage facility would have significantly lower sulfate concentrations than current conditions. Therefore we do not expect these wetlands to function as any more of a source of methyl mercury than the current wetlands found in these locations.	The answer addresses only one part of the comment. There are other factors besides sulfate that generate methylmercury in a wetland. Wetlands in general, wether they are high in sulfate or not have the potential to generate methylmercury. Please add a link to the mercury section of the appendix.
GLIFWC 141	GLIFWC	5.2.2.3.2 Partridge River Watershed	The entire section is fatally flawed because it relies on the Canisteo Pit analog method. GLIFWC staff have objected to the use of this method since it was proposed (See GLIFWC wetland attachment).This analog approach is not scientifically defensible.	The analog approach is considered a reasonable method for evaluating the extent of pit drawdown considering the heterogeneous nature of glacial till and the underlying low-permeability bedrock. Even when the pit water level is well below the top of bedrock, the low-permeability bedrock limits the amount of surficial groundwater that can drain downward into the pit and there is sufficient recharge to the surficial unit to generally maintain water levels.	GLIFWC does not agree with the co-lead disposition. Provide a link to the wetland section in the appendix.

Chapter 5.2

Comment_No.	Agency	Section	Comment	Co-Lead Disposition	GLIFWC Response
GLIFWC 142	GLIFWC	5.2.2.3.2 Partridge River Watershed - table 5.2.2-18	Chemical mechanisms column for the west pit should include water level fluctuations in the pit with wetting and drying of pit walls. This fluctuation is likely if a non-mechanical treatment option is used in order to meet the MPCA seasonal wild rice standard.	This factor will be addressed in future analysis of the passive system.	If the passive systems are not to be analized at all, they should be removed from the SDEIS.
GLIFWC 143	GLIFWC	5.2.2.3.2 Partridge River Watershed	Placing peat and unsaturated overburden in an unlined area would create a significant pulse of mercury. This mercury release does not seem to be accounted for in the mercury sections. The mercury, once released would travel the groundwater flow path and constitute an untreated discharge into the Partridge River. This is a particular concern because of the applicants failure to model mercury.	Surface runoff from the Overburden Storage and Laydown Area is considered "Process Water," and would be captured in an unlined pond (Pond PW-OSLA) and monitored for quality, including mercury. If the Overburden Storage and Laydown Area water was of sufficient quality, it would be pumped to the CPS and discharged to the East Pit or the Tailings Basin. If water in Pond PW-OSLA required treatment, it would be pumped to the WWTF for treatment prior to delivery to the CPS. The potential release of mercury from the decomposition of overburden materials is included in the mercury mass balance (Section 5.2.2.3.4).	ok
GLIFWC 144	GLIFWC	5.2.2.3.2 Partridge River Watershed	The no action alternative is not the same as existing conditions. An accurate no action alternative needs to be modeled in order to compare impacts under NEPA.	The SDEIS text regarding the No Action Alternative and "Continuation of Existing Conditions" will be clarified.	GLIFWC does not agree with the co-lead disposition. Provide a link to the hydrology section in the appendix.
GLIFWC 145	GLIFWC	5.2.2.3.2 Partridge River Watershed	All statements indicating that evaluation criteria would be met must include the caveat that perpetual water capture and treatment must be done to make that happen. We disagree that all water quality standards would be met. Water quality will be exceeded for several constituents.	Text edited. As described in the SDEIS, the evaluation criteria do use the standards, but interpret the standards from a probabilistic perspective. The P90 approach is a reasonable method for applying the results of probabilistic modeling for EIS impact assessment. In this context, it is not appropriate to say that "a constituent will exceed a water quality standard". It is more accurate to say that "there is at least a 90 percent probability that a constituent will not exceed a standard (or up to a 10 percent probability that it will)". These quoted statements are very different.	GLIFWC does not agree with the language in the co-lead disposition. Provide a link to the Perpetual care language in the appendix.
GLIFWC 146	GLIFWC	5.2.2.3.2 Partridge River Watershed	Title is not correct because there is no property boundary yet. In addition, the table should provide the 90th percentile concentration values for both land exchange alternatives.	Table title will be revised. In this section. the SDEIS is evaluating the Proposed Action. See Section 5.3.2 for a discussion of the land exchange alternative.	ok

Chapter 5.2

Comment_No.	Agency	Section	Comment	Co-Lead Disposition	GLIFWC Response
GLIFWC 147	GLIFWC	5.2.2.3.2 Partridge River Watershed	The first paragraph is not correct. The Copper Nickel study from 1979 states "Highly saline groundwater has been encountered in some bedrock areas in the study area…The source and spatial distribution of this water in the Study Area is unknown. The Superior National Forest technical memorandum No. 4 Brackish Groundwater within the SNF states that In 1976, brackish waters were encountered at the AMAX site which is in the same geology as the NorthMet project. In 2012 elevated chloride levels were found at mineral exploration drill locations near the South Kawishiwi River. The text should be corrected in light of available data from the SNF.	We disagree - applicable data is discussed.	Comment stands.
GLIFWC 148	GLIFWC	5.2.2.3.2 Partridge River Watershed	XP-SWMM model is fatally flawed and should not be used in imoact assessment. See GLIFWC hydrology attachment.	We believe the XP-SWMM modeling is acceptable for use in the SDEIS. The 20 year old data is acceptable as there haven't been any significant changes within the watershed. We believe the assumptions used were reasonably conservative. Additional detail is provided in the water sections of the SDEIS, and further rationale is provided in the Water Data Packages.	GLIFWC does not agree with the co-lead disposition. Provide a link to the hydrology section in the appendix.
GLIFWC 149	GLIFWC	5.2.2.3.2 Partridge River Watershed	Pit seepage is a long term untreated discharge. The section should clearly state this.	The following edit has been made to the text: These untreated pit discharges to groundwater in the West Pit Surficial Flow Path and the East Pit Category 2/3 Surficial Flowpath would occur in perpetuity. Groundwater in these flowpaths would flow down gradient and eventually discharge to the Partridge River.	ok
GLIFWC 150	GLIFWC	5.2.2.3.2 Partridge River Watershed	The discussion in the fourth bullet states that sulfate exceedances would be "exclusively limited to the low flow winter months" This explanation is only relevant if the applicant is seeking a seasonal application of the sulfate standard. Other sections of the PSDEIS have stated that they are not. This conflict should be resolved.	PolyMet Is not seeking seasonal application for the Proposed Project. Any future request for a seasonal application would require MPCA approval.	GLIFWC does not agree with the co-lead disposition. Provide a link to the wild rice section in the appendix.
GLIFWC 151	GLIFWC	5.2.2.3.2 Partridge River Watershed	The entire discussion of sulfate being exceeded during low flows is colored by the fact that there is very little undferstanding of hydrology in the upper Partridge River. The XP-SWMM model used to interpolate flow data is fatally flawed and does not produce reliable data. The net effect is that the PSDEIS cannot reliably state wether the sulfate standard will be met or not.	We believe the XP-SWMM modeling is acceptable for use in the SDEIS. The 20 year old data is acceptable as there haven't been any significant changes within the watershed. We believe the assumptions used were reasonably conservative. Additional detail is provided in the water sections of the SDEIS, and further rationale is provided in the Water Data Packages.	GLIFWC does not agree with the co-lead disposition. Provide a link to the hydrology section in the appendix.

Chapter 5.2

Comment_No.	Agency	Section	Comment	Co-Lead Disposition	GLIFWC Response
GLIFWC 152	GLIFWC	5.2.2.3.2 Partridge River Watershed	The last bullet states that the no action alternative is assumed to be the same as existing conditions. This is not correct as it ignores the intermittent dewatering of the Northshore pits. A realistic no action alternative needs to be modeled.	The description of the No Action Alternative and Continuation of Existing Conditions will be further clarified in the SDEIS.	GLIFWC does not agree with the co-lead disposition. Provide a link to the hydrology section in the appendix.
GLIFWC 153	GLIFWC	5.2.2.3.2 Partridge River Watershed	The conclusion that sulfate concentrations at 200 years would be less than 10 mg/l may not be supportable by modeling. It assumes that the no action alternative is the same as existing conditions and that is not the case.	The GoldSim model results do suggest that sulfate concentrations in the Partridge River at SW-005 would be less than 10 mg/L.	GLIFWC does not agree with the co-lead disposition. Provide a link to the hydrology section in the appendix.
GLIFWC 154	GLIFWC	5.2.2.3.2 Partridge River Watershed	The discussion relies on dilution to meet the sulfate standard. Because hydrology at the mine site is not understood, there is no basis to make this claim.	We believe the XP-SWMM modeling is acceptable for use in the SDEIS. The 20 year old data is acceptable as there haven't been any significant changes within the watershed. We believe the assumptions used were reasonably conservative. Additional detail is provided in the water sections of the SDEIS, and further rationale is provided in the Water Data Packages.	GLIFWC does not agree with the co-lead disposition. Provide a link to the hydrology section in the appendix.
GLIFWC 155	GLIFWC	5.2.2.3.2 Partridge River Watershed	The first paragraph describes a situation where the wild rice sulfate standard "would be exceeded anyway". This is an acknowledgement that the standard is, at least at some times, bein exceeded through cumulative impacts of other operations. If this is the case, the Clean Water Act does not allow Polymet to contribute any load to that exceedance regadless of dilution.	The Co-leads recognize this is a major difference of opinion.	Provide a link to the hydrology section in the appendix.
GLIFWC 156	GLIFWC	5.2.2.3.2 Partridge River Watershed	GLIFWC staff disagree that effective mitigation for sulfate exceedences are identified. There is conjecture about the dilutive effects of treated waste water but no modeling or analysis to demonstrate that effect.	The text has been edited to include possible contingency measures that could be implemented. Given that the identified contingency measures are based on engineered facilities that can be pilot tested, there is reasonable likelihood that contingency measures could be implemented (if needed) to prevent exceedance of the 10 mg/L sulfate standard in Partridge River surface water.	GLIFWC does not agree with the co-lead disposition. The purpose of the analysis was to demonstrate that the project would not exceed standards. The disposition is an assumption and not a demonstration.
GLIFWC 157	GLIFWC	5.2.2.3.2 Partridge River Watershed	GLIFWC staff disagree with the characterization of dust from the rail corridor as minor. See GLIWC rail car attachment.	This section acknowledges the dust issue and refers the reader to section 5.2.3.2.2. There is no other discussion or characterization of dust in this section. Discussion of fine material being segregated in the center of rail cars has been removed.	GLIFWC does not agree with the co-lead disposition. Provide a link to the rail car section in the appendix.

Chapter 5.2

Comment_No.	Agency	Section	Comment	Co-Lead Disposition	GLIFWC Response
GLIFWC 158	GLIFWC	5.2.2.3.2 Partridge River Watershed	As previously stated, XP_SWMM is fatally flawed and therefore flow information cannot be used to show that standards are met through dilution. Therefore, the conclusions on arsenic in Colby lake cannot be supported.	We believe the XP-SWMM modeling is acceptable for use in the SDEIS. The 20 year old data is acceptable as there haven't been any significant changes within the watershed. We believe the assumptions used were reasonably conservative. Additional detail is provided in the water sections of the SDEIS, and further rationale is provided in the Water Data Packages.	GLIFWC does not agree with the co-lead disposition. Provide a link to the hydrology section in the appendix.
GLIFWC 159	GLIFWC	5.2.2.3.2 Partridge River Watershed	perpetual water treatment would be needed in to avoid violating standards in Colby Lake.	No change to SDEIS text.	GLIFWC does not agree with the co-lead disposition. Provide a link to the perpetual maintanance section in the appendix.
GLIFWC 160	GLIFWC	5.2.2.3.2 Partridge River Watershed	The last paragraph correctly discusses perpetual treatment needs. The improvements in water quality in the west pit are speculative and do not change the fact that perpetual treatment is necessary. Therefore the paragraph should indicate that while non-mechanical treatment options may be possible at some point in time, that non-mechanical treatment would also have to be perpetual for standards to be met.	Water quality changes in the pits are not speculative, but are predicted based on flow/chemical modeling with reasonable assumptions. Text clarified.	ok
GLIFWC 161	GLIFWC	5.2.2.3.2 Partridge River Watershed - Figures 5.2.2-37 through 5.2.2-39	Need to indicate the appropriate water quality standard	The West Pit is not considered an evaluation location so a water quality standard does not apply. Water quality standards would apply to the WWTF (which treats the West Pit overflow) discharge.	ok. We understand that there will be a polluted pit lake and water quality standards will not apply until water leaves the lake.
GLIFWC 162	GLIFWC	5.2.2.3.2 Partridge River Watershed	States that water quality in the permanent mine features left behind is expected to improve over time. This is misleading because the model was not run long enough to predict when that would be. It is clear that, using sulfate as an example, the west pit would be a perpetual source with the potential of contaminating downstream beds in perpetuity.	The flow/chemical modeling does predict that water quality will improve over the modeled time frame of 200 years. Text has been modified.	ok
GLIFWC 163	GLIFWC	5.2.2.3.2 Partridge River Watershed	Why was water quality modeling terminated after 200 years?	Before 200 years, the maximum chemical loading in affected groundwater is predicted to reach the Partridge River.	But the plume in bedrock is not.

Chapter 5.2

Comment_No.	Agency	Section	Comment	Co-Lead Disposition	GLIFWC Response
GLIFWC 201	GLIFWC	5.2.2.3.2 Partridge River Watershed	There is no consideration of the likely mercury pulse to the Partridge River resulting from placement of the stripped peat and unsaturated overburden into the unlined Overburden Storage and Laydown Area. See the supplemental document "Great Lakes Indian Fish and Wildlife Commission (GLIFWC) Comments Related to Mercury" [Comment 7] for details.	Surface runoff from the Overburden Storage and Laydown Area is considered "Process Water," and would be captured in an unlined pond (Pond PW-OSLA) and monitored for quality. If the Overburden Storage and Laydown Area water was of sufficient quality, it would be pumped to the CPS and discharged to the East Pit or the Tailings Basin. If water in Pond PW-OSLA required treatment, it would be pumped to the WWTF for treatment prior to delivery to the CPS.	ok
GLIFWC 164	GLIFWC	5.2.2.3.3 Embarrass River Watershed	States that the seepage capture system is not expected to have an effect on groundwater downgradient of wetlands because ponded water at the surface is expected to infiltrate and replace groundwater. This is a circular argument. The ponded water downgradient of the tailings basin is mostly tailings basin water that has been seeping over decades saturating the aquifer and flooding wetlands. The seepage capture system would reduce that water source and that capture system is likely perpetual. It is not reasonable to assume that the ponded water will be able to replace groundwater captured by the containment system in perpetuity because the tailings basin is the water source for both the ponds and the groundwater. What are the impacts to groundwater levels and wetlands outside the containment system once the pond water at the surface runs out?	The text has been changed to reflect the decrease in groundwater seepage would not be expected to have a significant effect on groundwater down gradient of the groundwater containment system because there would be sufficient natural recharge to maintain saturation in the surficial (unconsolidated) unit.	ok
GLIFWC 165	GLIFWC	5.2.2.3.3 Embarrass River Watershed	How long would the groundwater capture system need to operate? How long would the WWTP need to operate?	Modeling predicts that groundwater capture and mechanical (WWTP) or non-mechanical water treatment would need to occur for a minimum of 500 years. Capture and treatment would continue after that time until water quality monitoring at groundwater and surface water evaluation locations indicate that these measures are no longer needed.	GLIFWC does not agree with the co-lead disposition. Provide a link to the perpetual maintanance section in the appendix.
GLIFWC 166	GLIFWC	5.2.2.3.3 Embarrass River Watershed - Figure 5.2.2-40	Figure is misleading. Edit the figure to indicate that the long term does not end at year 45 but rather extends into perpetuity.	The figure will be edited.	There is not enough information for us to remove our comment.

Chapter 5.2

Comment_No.	Agency	Section	Comment	Co-Lead Disposition	GLIFWC Response
GLIFWC 167	GLIFWC	5.2.2.3.3 Embarrass River Watershed	The no action alternative is not the same as existing conditions. This assumption ignores ongoing VIC work and the Cliffs Erie consent decree that would improve water quality over time. It also ignores the fact that rain will fall on the tailings basin, percolate through the tailings and flush constituents. Over time this effect will reduce the source term of the facility. An accurate no naction alternative needs to be modeled in order to compare impacts under NEPA. See GLIFWC attachment.	Description of the No Action Alternative will be clarified.	There is not enough information for us to remove our comment. Please add a link to the hydrology section in the appendix
GLIFWC 168	GLIFWC	5.2.2.3.3 Embarrass River Watershed	The discussion on TDS is not correct. The no action alternative is not the same as existing conditions. It does not matter that the exceedances from the tailings basin were caused by historic operations. PolyMet assumes responsibility for those exceedances if the project goes forward.	Description of the No Action Alternative will be clarified.	There is not enough information for us to remove our comment. Please add a link to the hydrology section in the appendix
GLIFWC 169	GLIFWC	5.2.2.3.3 Embarrass River Watershed	With respect to the TDS exceedances. How long before the model shows that groundwater criteria are met? And how does that differ from information in the consent decree?	The NorthMet Proposed Project water quality model indicates that the 90th percentile value for TDS in the Plant Site groundwater would drop below the 500-mg/l groundwater evaluation criteria at ~55 years after start of mining, as illustrated in Figure 5.2.2-44. Because the No Action condition for the LTVSMC Tailings Basin is represented in the GoldSim model without implementation of any mitigation measures, model predictions do not show a reduction in Plant Site groundwater TDS under the No Action conditions, also illustrated in Figure 5.2.2-44.	GLIFWC does not agree with the co-lead disposition. Provide a link to the hydrology section in the appendix.
GLIFWC 170	GLIFWC	5.2.2.3.3 Embarrass River Watershed	Flow in the tributary streams will change as effluent from the tailings basin changes over time under a no action scenario. The assumption that existing conditions is the same as the no action scenario is not supported. A no action alternative should be modeled.	The description of the No Action Alternative and Continuation of Existing Conditions will be further clarified in the SDEIS.	There is not enough information for us to remove our comment. Please add a link to the hydrology section in the appendix

Chapter 5.2

Comment_No.	Agency	Section	Comment	Co-Lead Disposition	GLIFWC Response
GLIFWC 171	GLIFWC	5.2.2.3.3 Embarrass River Watershed	The section should indicate that the assumption of meeting evaluation criteria depends on perpetual water capture, water treatment, and tailings facility maintenance. We disagree that water quality standards would be met. The PSDEIS states that standards would be exceeded for several constituents.	Text edited. As described in the SDEIS, the evaluation criteria do use the standards, but interpret the standards from a probabilistic perspective. The P90 approach is a reasonable method for applying the results of probabilistic modeling for EIS impact assessment. In this context, it is not appropriate to say that "a constituent will exceed a water quality standard". It is more accurate to say that "there is at least a 90 percent probability that a constituent will not exceed a standard (or up to a 10 percent probability that it will)". These quoted statements are very different.	GLIFWC does not agree with the co-lead disposition. Provide a link to the perpetual maintenance section in the appendix.
GLIFWC 172	GLIFWC	5.2.2.3.3 Embarrass River Watershed	As previously commented, the no action alternative is not the same as existing conditions.	The description of the No Action Alternative and Continuation of Existing Conditions will be further clarified in the SDEIS.	There is not enough information for us to remove our comment. Please add a link to the hydrology section in the appendix
5.2.3 Wetlands					
GLIFWC 182	GLIFWC	5.2.3.1.2 Potential Indirect Wetland Effects Methodology And Evaluation Criteria	The indirect impact analysis is fatally flawed. The analog approach is not scientifically defensible and further, it uses cherry picked data to reach conclusions. See GLIFWC wetland analysis attachment.	Per the Final Wetlands IAP Summary Memo, the Co-lead Agency position was that the assessment of potential indirect wetland impacts at the mine site should be conducted based upon an interpretation of the general analog guidelines regarding groundwater drawdown analog information provided by the Water Resources IAP Workgroup in accordance with the guidance provided in the attachment to this summary memo. The Co-lead Agencies believe that even with additional groundwater data collection and additional groundwater modeling, there would still be a high level of uncertainty regarding groundwater model outputs. Therefore, the Co-lead Agencies believe that the analog guideline method of estimating glacial aquifer groundwater drawdown near the proposed mine is reasonable and appropriate for this site and do not recommend that additional field data collection and groundwater modeling be conducted for the purpose of estimating glacial aquifer groundwater drawdown.	GLIFWC does not agree with the co-lead disposition. Provide a link to the wetland section in the appendix.

Chapter 5.2

Comment_No.	Agency	Section	Comment	Co-Lead Disposition	GLIFWC Response
				Some Wetland IAP Workgroup members disagree with the Co-lead Agency position. They believe that additional field data collection and additional groundwater modeling are necessary to provide groundwater drawdown cone of depression information near the open pit mine. That position was an earlier recommendation of the Wetland IAP Workgroup and was supported by Workgroup members from the Fond du Lac Band, Grand Portage Band, Great Lakes Indian Fish and Wildlife Service, U.S. Fish and Wildlife Service, 1854 Treaty Authority, Minnesota Pollution Control Agency and the U.S. Environmental Protection Agency. However; it was not supported by Workgroup members from the Co-lead Agencies, Environmental Resources Management, or Barr Engineering. In addition, some Workgroup members believe that the Co-lead Agency position is contrary to standard analysis that mining companies have to conduct as part of sulfide mine EIS processes across the country. In addition, the Grand Portage Band believes that the geology of the analog sites appear to be non-analogous with the geology of the proposed mine site.	We continue to believe that use of the <u>all</u> existing data is most appropriate.
GLIFWC 185	GLIFWC	5.2.3.1.2 Potential Indirect Wetland Effects Methodology And Evaluation Criteria	As commented previously, the modeling done to assess changes in Partridge River flow is fatally flawed and does not yield usable results.	The Co-lead Agencies have concluded that the use of lateral effect equations for ditches is not suitable for use in determining glacial aquifer drawdown near open pit mines, and that method should not be used to estimate groundwater drawdown near the NorthMet project open pits. There was no disagreement among any of the Workgroup members.	We agree with the statement regarding the lateral effects model. In fact we were convinced that it would not work when the Corps suggested using the model in the NorthMet SDEIS. However, The comment refers to the XP-SWMM modeling so the lead agency disposition is appropos of nothing. Add a link to the hydrology section in the appendix.
GLIFWC 188	GLIFWC	5.2.3.2.2 Mine Site And Transportation And Utility Corridor Indirect Wetland Effects	The section on changes in hydrology due to drawdown is scientifically indefensible and fatally flawed. See GLIFWC wetland attachment.	See GLIFWC 182	GLIFWC does not agree with the co-lead disposition. Provide a link to the wetland section in the appendix.
GLIFWC 189	GLIFWC	5.2.3.2.2 Mine Site And Transportation And Utility Corridor Indirect Wetland Effects	The XP-SWMM model used for assessing impacts t Partridge River flow is fatally flawed and should not be used in the PSDEIS. See GLIFWC hydrology attachment	We believe the XP-SWMM modeling is acceptable for use in the SDEIS. The 20 year old data is acceptable as there haven't been any significant changes within the watershed. We believe the assumptions used were reasonably conservative. Additional detail is provided in the water sections of the SDEIS, and further rationale is provided in the Water Data Packages.	GLIFWC does not agree with the co-lead disposition. Provide a link to the hydrology section in the appendix.

Chapter 5.2

Comment_No.	Agency	Section	Comment	Co-Lead Disposition	GLIFWC Response
GLIFWC 190	GLIFWC	5.2.3.2.2 Mine Site And Transportation And Utility Corridor Indirect Wetland Effects	Presents an incorrect characterization of the impacts of dust emissions along the rail line. The section states that the air IAP did not identify any air quality effects. This issue was raised in the water quality IAP and the lead agencies moved it to air quality. We maintain that this is a water quality issue. The lead agencies have refused to fully address the issue and have chosed to simply monitor the waters near the rail line in order to detect impacts after they have already occured.	The Co-leads position on the potential for contamination along the rail line is discussed in 5.2.2 and 5.2.3.	GLIFWC does not agree with the co-lead disposition. Provide a link to the rail car section in the appendix.
GLIFWC 191	GLIFWC	5.2.3.2.2 Mine Site And Transportation And Utility Corridor Indirect Wetland Effects	Same comment a page 5.2.3-51. In addition the statement that deposition along the rail line would be minimal because of the coarse nature of the ore. This is incorrect. Relatively small ammounts of fine ore dust can create large water quality impacts as evidenced by the clean water act violations at the Flambeau mine in Wisconsin.	The Co-leads position on the potential for contamination along the rail line is discussed in 5.2.2 and 5.2.3.	GLIFWC does not agree with the co-lead disposition. Provide a link to the rail car section in the appendix.
GLIFWC 181	GLIFWC	5.2.3 Wetlands	Some wetlands in the indirect impact category are severely affected by drawdown, fragmentation, watershed destruction and dust deposition. These effects are well understood and so the Corps should require up front mitigation for these wetland impacts. See GLIFWC wetland attachment for additional analysis and information.	A wetland monitoring plan would be developed and implemented if the NorthMet project is permitted. The plan would require wetland hydrology monitoring, vegetation monitoring, and wetland water quality monitoring to identify if indirect wetland impacts occur during implementation of the project. If indirect wetland impacts resulting from the project are determined by the monitoring program, compensatory wetland mitigation would be required for those indirect wetland impacts. Text revised throughout the mitigation/monitoring discussions to address comment.	GLIFWC does not agree with the co-lead disposition. Provide a link to the wetland section in the appendix.
GLIFWC 193	GLIFWC	5.2.3.3.4 Monitoring	The section on monitoring for indirect effects, specifically the 4 goals, are exactly the type of analysis that is required for a federal EIS. This information should have been an integral part of the effects analysis for this project and GLIFWC staff have been advocating for this approach for years. This information, collected after the fact, cannot be used in impact assessment and thus cannot help mitigate the effects of the proposed project.	A wetland monitoring plan would be developed and implemented if the NorthMet project is permitted. The plan would require wetland hydrology monitoring, vegetation monitoring, and wetland water quality monitoring to identify if indirect wetland impacts occur during implementation of the project. If indirect wetland impacts resulting from the project are determined by the monitoring program, compensatory wetland mitigation would be required for those indirect wetland impacts.	GLIFWC does not agree with the co-lead disposition. Provide a link to the wetland section in the appendix.

Chapter 5.2

Comment_No.	Agency	Section	Comment	Co-Lead Disposition	GLIFWC Response
GLIFWC 216	GLIFWC	5.2.3.3.2 Wetland Mitigation and Contingency Mitigation	In discussing Financial Assurances there is no mention of the perpetual pump and treatment costs or liabilities for the mine. In reviewing various sections discussing Financial Assurances in no portion of the PSDEIS did authors identify: 1) annual projected operating costs for pollution control once the mine is closed including operation of the reverse osmosis system; 2) capital replacement costs and life cycle for pollution control infrastructure including piping, pumps, etc (i.e. What would have to be replaced every 10, 25, 50, 75 years and what would be the costs?); 3) and Net Present Value of the Financial Assurances (i.e. comparing the value of a dollar today to the value of that same dollar in the future). See GLIFWC socioeconomics attachment for additional information.	This comment appears to be addressing financial assurance in general and not just wetlands. Section 3 has a discussion on the project financial assurance. The level of detail provided in the SDEIS has been agreed upon by Co-Leads and with EPA. The details of the assurance will be developed during permitting. Section 3.2.2.4 provides a discussion of the financial assurance for the NorthMet Project Proposed Action.	ok
GLIFWC 184	GLIFWC	5.2.3.1.2 Potential Indirect Wetland Effects Methodology And Evaluation Criteria	The wetland sensitivity tables developed for the Crandon project in Wisconsin relied on a detailed understanding of the relationship between the surficial aquifer and the bottom of the wetland. That basic hydrologic information was never collected for this project therefore the significance criteria table is not necessarily applicable to NorthMet wetlands and its use in this context is not appropriate. See GLIFWC wetland attachment for additional information.	The wetland sensitivity tables in the Crandon mine project were used, though the Crandon project has different soils and hydrology than NorthMet, since it was decided and agreed upon in the IAP workgroup meetings. There is a general understanding on the NorthMet Project Mine Site of the general lack of connectivity of the surficial and bedrock aquifers, the soils present, the hydraulic conductivities, and the bedrock types (Barr 2006c; Barr 2008h; Barr 2010d). No text edit.	GLIFWC does not agree with the co-lead disposition. Provide a link to the wetland section in the appendix.
GLIFWC 187	GLIFWC	5.2.3.2.2 Mine Site And Transportation And Utility Corridor Indirect Wetland Effects	Based on information in the wetlands data package, we disagree with the assumptions used in defining if a wetland is fragmented or not. The method used in the PSDEIS would allow wetlands that have over 50% of their area filled to be classified as unimpacted by assuming that all of their hydrology depends on rainfall. This is not acceptable because filling a large percentage of a wetland disrupts the internal hydrologic regime and fragments the vegetation community in the wetland.	Fragmented wetlands are classified as indirect impact; however, fragmented wetlands are included in upfront mitigation. Total upfront mitigation is for the 912.5 acres of direct effects and 26.4 acres of fragmented wetlands (indirect effect). Tables have been revised to reflect this.	GLIFWC does not agree with the co-lead disposition. Provide a link to the wetland section in the appendix.
GLIFWC 183	GLIFWC	5.2.3.1.2 Potential Indirect Wetland Effects Methodology And Evaluation Criteria	The heading "Potential Indirect Wetland Effects Resulting from Changes in Hydrology" appears in both pages. Edit the title to specify how the sections are different.	Edited as suggested.	ok

Chapter 5.2

Comment_No.	Agency	Section	Comment	Co-Lead Disposition	GLIFWC Response
GLIFWC 186	GLIFWC	5.2.3.2.1 Mine Site And Transportation And Utility Corridor Direct Wetland Effects	Backfill of category 3 and 4 waste rock does not minimize or avoid wetland fill. That waste rock will be on the site for over 10 years and the wetlands in the footprint of the stockpile would be destroyed. What backfill does accomplish is provide an opportunity to create new wetlands in those locations. However, the high quality character of the existing wetlands will likely not be replaced.	Sentence revised. PolyMet proposes to mitigate wetland effects by placing waste rock back into the East Pit and Central Pit after year 11, thereby reducing the need for additional surface stockpile areas that would otherwise affect wetlands.	ok
GLIFWC 204	GLIFWC	5.2.3.3.4 Monitoring	It appears that wetland monitoring following restoration is only vegetative and hydrologic in nature. Total and methyl mercury should be monitored pre-project through post-reclamation to collect information on mercury levels and methylation rates and identify any necessary remedial actions.	Wetland monitoring following restoration would be vegetative and hydrologic in nature. Reference to water monitoring discussed in Section 5.2.2.3.6 was added. Water quality will be monitored downstream and piezometers will be located in the wetlands.	ok
5.2.5 Wildlife					
GLIFWC 205	GLIFWC	5.2.5 Wildlife - Throughout the section	The Wildlife Section (5.2.5) does not discuss mercury contamination. Similarly the Aquatic Species Section (5.2.6) does not discuss direct health impacts to aquatic species due to mercury. These impacts must be considered. See the	The Open Water discussion in Section 5.2.5.2.3 has been expanded to include discussion of the potential for wildlife exposure to mercury.	There is not enough information for us to remove our comment. Please add a link to the mercury section in the appendix
GLIFWC 207	GLIFWC	5.2.5.2.3 Species Of Greatest Conservation Need	The PSDEIS dismisses the possibility of waterfowl and waterbirds utilizing the tailings basin despite the fact that common waterfowl and waterbirds have been observed at the LTVSMC tailings basin during migration. The wetlands to be constructed over the East Pit and at the perimeter of the tailings basin are also not considered as potential waterbird/fowl habitat. We believe that there is a significant potential pathway of mercury exposure to these species from utilizing these sites. See the supplemental document "Great Lakes Indian Fish and Wildlife Commission (GLIFWC) Comments Related to Mercury" [Comment 12] for further discussion.	The Open Water discussion in Section 5.2.5.2.3 has been expanded to more accurately describe the potential wildlife use of the Tailings basin, as well as the potential for exposure to mercury.	There is not enough information for us to remove our comment. Please add a link to the mercury section in the appendix
5.2.6 Aquatic Species					

Chapter 5.2

Comment_No.	Agency	Section	Comment	Co-Lead Disposition	GLIFWC Response
GLIFWC 206	GLIFWC	5.2.6 Aquatic Species - Throughout the section	The Wildlife Section (5.2.5) does not discuss mercury contamination. Similarly the Aquatic Species Section (5.2.6) does not discuss direct health impacts to aquatic species due to mercury. These impacts must be considered. See the supplemental document "Great Lakes Indian Fish and Wildlife Commission (GLIFWC) Comments Related to Mercury" [Comment 11] for further discussion.	Mercury effects are being considered by the Co-leads and the SDEIS will be revised.	There is not enough information for us to remove our comment. Please add a link to the mercury section in the appendix
GLIFWC 208	GLIFWC	5.2.6 Aquatic Species	PSDEIS states there will be effects on flow in the Partridge R. and Embarrass R. tributaries, but that they are not expected to influence habitat. We feel that the water level fluctuations may be sufficient to impact habitat which could lead to changes in species composition or relative abundance which could in turn impact mercury foodweb dynamics. See the supplemental document "Great Lakes Indian Fish and Wildlife Commission (GLIFWC) Comments Related to Mercury" [Comment 13] for further discussion.	The text of Paragraph 2 on page 5.2.6-1 has been revised to clarify why the proposed projects flow reductions are not expected to lead to community alterations citing a 2013 USGS document that indicates that streamflow modifications below 25% are used as a baseline study and that affects on algae, fisheries, and macroinvertebrates would not be measurable at this flow reduction rate.	There is not enough information for us to remove our comment. Please add a link to the mercury section in the appendix
GLIFWC 209	GLIFWC	5.2.6.2.2 Embarrass River Watershed	Many lakes and rivers in the area are classified as “impaired waters” by the MPCA due to elevated fish mercury. All additional increases in mercury contributions to the environment therefore constitute a risk to human and ecosystem health. There are numerous aspects of the proposed action cited in the PSDEIS that will lead to increased mercury releases to the environment, increasing human and ecosystem risk. Further, the PSDEIS documents and increased risk (i.e., risk quotient) to human fish conmumers as a direct result of the project. See the supplemental document "Great Lakes Indian Fish and Wildlife Commission (GLIFWC) Comments Related to Mercury" [Comment 14] for further discussion.	Mercury effects are being considered by the Co-leads and the SDEIS will be revised.	There is not enough information for us to remove our comment. Please add a link to the mercury section in the appendix
5.2.7 Air Quality					

Chapter 5.2

Comment_No.	Agency	Section	Comment	Co-Lead Disposition	GLIFWC Response
GLIFWC 203	GLIFWC	5.2.7.2.5 Mercury Deposition Impact Analysis	The estimate of air emissions of mercury as a result of the project (4.6 lbs/yr) does not take into account emissions from electricity gereration for the site or from the burning of fuel by mining vehicles or other equipment. This should be quantified and included in the analysis.	Mercury emissions were calculated for mining vehicles and included in the emission inventory. In addition, emissions from electric generation have been incorporated within the TMDL development, by reference. Thus, these emissions have been taken into account for MPCA's evaluation and determination that the Project mercury emissions will not impede the reduction goals.	There is not enough information for us to remove our comment. Please add a link to the mercury section in the appendix
GLIFWC 210	GLIFWC	5.2.7.2.5 Mercury Deposition Impact Analysis	According the PSDEIS, "the MPCA has conducted a review of the NorthMet Project Proposed Action mercury emissions and has determined that it will not impede the reduction goals." The mercury TMDL for the St. Louis River has not yet been established due to insufficient understanding of mercury dynamics in the watershed. It is known that the statewide TMDL is insufficient for reducing mercury to acceptable levels in fish of the SLR. Since there is no SLR mercury TMDL available, the impact of the project's mercury emissions on reduction goals in the area cannot be adequately assessed.	It is agreed that there is no specific TMDL for the St. Louis River system, however, until a specific TMDL is developed for this body of water, the Statewide TMDL is the driving regulation for all other water bodies within the state, including the St. Louis River.	Comment stands.
5.2.8 Noise and Vibration					

Chapter 5.2

Comment_No.	Agency	Section	Comment	Co-Lead Disposition	GLIFWC Response
GLIFWC 214	GLIFWC	5.2.8 Noise And Vibration	There is no cumulative analysis for noise vibration and airblast in the PSDEIS. Activities at existing facilities (Mesabi Nugget, Northshore) should be looked at in conjunction with the proposed NorthMet project. See GLIFWC noise and vibration attachment for more information.	In the absence of measured ambient sound data for receptors in the immediate vicinity of the Mine Site and Plant Site (except BWCAW), literature values from the USEPA Levels guideline document (USEPA 1974) were used to represent baseline levels in the areas (measured data have been provided for the BWCAW). Since the Northshore Mine is an existing facility, the ambient Leq assumed for receptors outside the Mine Site area (Figure 4.2.8-1 and Table 4.2.8-3) account for existing noise from the Northshore Mine located approximately 2 miles north of the Mine Site (see Section 4.2.8-2). The vibration associated with blasting at the Northshore mine is also already accounted for under baseline conditions. Similarly, the baseline noise and vibration conditions of all identified receptors near the Plant Site already capture or account for noise and vibration from the Mesabi Phase I Plant, which is an existing facility. Noise and vibration diminish with distance i.e., the impacts are reduced as the receptor distance to the source increase. The Mesabi Nugget Plant is approximately 1 mile and 8 miles away from the Plant Site and Mine Site respectively. Similarly, the Northshore Mine is approximately 2 miles and 11 miles away from the Mine Site and Plant Site, respectively. Project related noise plus baseline levels (which accounts for noise from other nearby existing sources/facilities) are provided in Table 5.2.8-7.	GLIFWC does not agree with the co-lead disposition.Lack of site specific data has not stopped the lead agencies from developing and using analog information for other resource areas (e.g. wetlands) While the appropriateness of analog data can be debated, the excuse of doing nothing because of a lack of data is not credible. Provide a link to the cumulative impact section in the appendix.
GLIFWC 212	GLIFWC	5.2.8.1.1 Noise	The methods used in the PSDEIS limit the analysis to selected locations defined as sensitive to noise. While thise locations may in fact be sensitive, concentrating on those few places for the analysis inappropriately eliminates an impact assessment of other areas. See GLIFWC noise attachment for more information.	A discussion of noise impacts to all publicly accessible areas in the Superior National Forest has been included. The USFS has provided shapefiles for all recreational sites within the project vicinity (family camp grounds, camp sites, boating, fishing, swimming, and family picnic areas). In addition to the residential areas, BWCAW, and wildlife corridors already discussed in the SDEIS, we have also included recreational sites, trails, and closest State wildlife waters (used by tribal members for harvesting purposes) in all the noise and vibration contour maps. A discussion of noise impacts to all publicly accessible areas in the SNF (i.e., recreational sites) has been included in the text in Section 4.2.8.2. Though not depicted on the noise and vibration figures due to sensitivity regarding cultural resources and locations, a discussion of the nearest archaeological sites (e.g., Spring Lake Sugarbush and Mesabe Widjiu [Laurentian Divide]) within the Project vicinity has been included in the text.	ok

Chapter 5.2

Comment_No.	Agency	Section	Comment	Co-Lead Disposition	GLIFWC Response
GLIFWC 213	GLIFWC	5.2.8.2 Northmet Project Proposed Action	A discussion of applicable standards is appropriate. However, significant impacts from a project can occur without violating standards if the change from baseline condition is large enough. A discussion of this type of impact is needed.	A discussion of impacts based on change from baseline condition is discussed in Section 5.2.8.2.3, Total Noise Effects from NorthMet Project Proposed Action Operations. See sub sections titled "Daytime Operations (7 p.m. to 10 p.m.)" and "Nighttime Operations (10 p.m. to 7 a.m.). Text regarding noise change from baseline conditions in Section 5.2.8.2.3 have been revised to accommodate the new noise modeling results that accounts for reduced baseline noise levels at BWCAW and audibility limits for the BWCAW.	ok
5.2.9 Cultural Resources					
GLIFWC 211	GLIFWC	5.2.9 Cultural Resources - Throughout the section	Increased mercury, especially in fish, could negatively impact cultural resources, especially for local Native American tribes who rely on fish as a major source of subsistence food and who view fishing and fish consumption as vitally important cultural and spiritual activities. This is not acknowledge in the PSDEIS. Further, fish harvest is a treaty reserved right of these tribes. The presence of mercury in fish at levels that restrict consumption threaten the ability of the tribes to exercise this treaty right.	The Co-lead Agencies recognize that mercury accumulation in fish is an important issue to the Bands. The effects of mercury in fish are acknowledged in the SDEIS; please refer to the discussions in Sections 4.2.6, 4.2.10, 5.2.6, and 5.2.10. Additional text has been added to section 5.2.9.	There is not enough information available to remove the comment.
GLIFWC 220	GLIFWC	5.2.9.2.2 Treaty Resources - "There is little specific information concerning the use of natural resources by the Bands in the NorthMet Project area. This likely reflects limited subsistence gathering in the NorthMet Project area due to general inaccessibility. T"is lack of data also...	The authors make assumptions that because there is no written record of tribal use that no use takes place. To access potential socioeconomic impacts, all treaty resources [i.e. animals, fish and plants identified in LAC COURTE OREILLES CHIPPEWA IND. v. STATE OF WIS. NO. 74-C-313. 653 F.Supp. 1420 (1987)] need to be assessed on lands being transferred to the Forest Service and Forest Service lands being sold including: 1) presence and absence, 2) distribution, and 3) population density. See GLIFWC socioeconomics attachment for additional information.	The Co-lead Agencies disagree with the assertion that there was a focus only on the written record. Oral interviews, field surveys, consultation, and other sources were used when determining contemporary tribal use of the proposed NorthMet Project area.	Comment stands.
5.2.10 Socioeconomics					

Chapter 5.2

Comment_No.	Agency	Section	Comment	Co-Lead Disposition	GLIFWC Response
GLIFWC 215	GLIFWC	5.2 - Entire section	**It is essential that throughout the SDEIS authors need to repeatly state that Indirect and Induced Effect employment numbers are calculated by IMPLAN and may be temporary, part-time, full-time, long-term or short term jobs. It is also crititical to acknowledge estimates for full-time employment were provided by NorthMet. See GLIFWC socioeconomics attachment for additional information.	Section 5.2.10.1.3 contains this statement about type of jobs. Added a statement regarding the source of direct employment.	ok
GLIFWC 217	GLIFWC	5.2 Northmet Project Proposed Action	The Draft Environmental Impact Statement (DEIS) prepared in 2009 stated, "Due to the estimated 20-year operating life of the facility, it is estimated that approximately 55% of labor for the operations would be non-local and would relocated to the east range; 20% would commute daily or weekly from centeres such as Duluth; and the remaining labor would be local" DEIS (page 4.10-15). These two statements related to the same project give readers entirely different perspecitives on this project. This confusion is caused by including 3 counties in the "study area". Since the most recent IMPLAN modeling done in April 2012 was restricted to a single county (Lake), this section should be re-written to reflect the estimated labor that would relocated to the east range and the estimated labor that would commute from Duluth as done in the earlier DEIS for the estimated 360 direct operations-phase positions. Again authors need to state that Indirect and Induced Effect employment numbers are calculated by IMPLAN may be temporary, part-time, full-time, long-term or short term jobs. See GLIFWC socioeconomics attachment for additional information.	The DEIS definition of "local" appears to be limited to the East Range, essentially the nearby towns and cities in St. Louis County alone. By comparison, the PSDEIS clearly states that "local" workers--those who would commute daily or weekly--would come from a very wide commute shed, given the willingness of workers in this region to commute relatively long distances. The definitions of "local" are very different; therefore, no change is needed.	ok

Chapter 5.2

Comment_No.	Agency	Section	Comment	Co-Lead Disposition	GLIFWC Response
GLIFWC 218	GLIFWC	5.2.10.2.1 Population And Population Trends - "For purposes of this analysis, the SDEIS assumes that approximately 75 percent of direct and indirect operations phase employees would be local residents who would not need to relocate as a result of employment."	IMPLAN Modeling estimated that 112 of the 330 indirect jobs (i.e. temporary, part-time, full-time, long-term or short-term) would be in custom computer programming services (i.e. page 13, April 2012 IMPLAN report). Is it realistic to project 75 percent of the direct and indirect operations phase employees would be local residents given 33.9% of indirect jobs are in custom computer programming services? The basis for these estimates need to be explained and references used to base these estimates cited. See GLIFWC socioeconomics attachment for additional information.	Recall that "local" in this case is the commute-shed for the Project, which covers a wide area and several cities (Duluth, Hibbing, Virginia, etc.). As a high-level estimate, this is not unreasonable. No text edit.	ok
GLIFWC 219	GLIFWC	5.2.10.2.1 Population And Population Trends - Operations	The PSDEIS fails to provide a table entitled Anticipated Steady State Operation Employment Levels as provided in the 2009 Draft Environmental Impact Statement (DEIS)) - see pages 4.10-17 and 4.10-18 Table 4.10-13. This table was provided for the 448 direct jobs originally projected and categorized employment by: 1)Management, 2) Mine Operations - Contract supervision, operators, maintenance, 3) Mine Technical - Geology, grade control, planning, 4) Railroad Operations, 5) Plant Operations, 6) Sample Preparation and analytical laboratory, and 7) Finance, purhchasing, marketing, environmental, HR. A similar table is needed that would detail PolyMet's projected 360 full time direct jobs in the categories above. Without this data, it is impossible to evaluate the accuracy of the PSDEIS projections on employment and local hiring. See GLIFWC socioeconomics attachment for additional information.	The referenced table was produced by BBER as part of the IMPLAN model exercise. While useful to help explain the assumptions of the IMPLAN model, the table detailing the distribution of jobs by type is not a key finding of the SDEIS itself. Indeed, inclusion of the referenced table in the body of the SDEIS is not appropriate because it would distract the reader from the document's key findings about overall employment and other socioeconomic impacts of the NorthMet Proposed Project. This information is included in the IMPLAN report. Reference to IMPLAN report included.	ok

Chapter 6

Comment_No.	Agency	Section	Comment	Co-Lead Disposition	GLIFWC Response
GLIFWC 224	GLIFWC	6.2.1 Cumulative Effects Analysis Approach	The post-closure period is not correctly described. Closure in other sections of the document occurs from year 20 to year 40. Post closure is an open ended period after year 40. Because water treatment and facility maintenance needs at this project are perpetual, post-closure should be clearly defined here as year 40 to perpetuity.	For all resources, future temporal boundaries are the expected service life of the mining activities, including closure (years 20 to 40) and post-closure restoration (year 40 and beyond.)	ok
GLIFWC 225	GLIFWC	6.2.2.1.18 United Taconite	United Taconite facility is undergoing additional permit review due to their plans to fill over 1000 acres of wetland to expand the tailings basin. This would also contribute high sulfate water to the St. Louis river. The Corps and MPCA are currently involved in this work. Therefore, all appropriate information on this facility should be included in the cumulative effect analysis.	The Co-lead agencies believe that the cumulative wetland impact assessment area as defined in the wetlands work plan is sufficient to meet the requirements of NEPA and is appropriate for the NorthMet project EIS because it includes the watersheds in which the proposed direct and indirect wetland impacts would occur. For the NorthMet project, that would be the Embarrass River watershed and the Partridge River watershed. In addition, the Co-lead agencies included direction in the Final Wetland Resources IAP Summary Memo on how to identify the amount of wetland acreage below the OHWM within this part of the St. Louis River and to evaluate the potential for cumulative indirect wetland impacts in those wetlands from changes in flow in the St. Louis River based on the qualitative water flow evaluation to be conducted. No other direct or indirect NorthMet project impacts would occur in the St. Louis River watershed, and the Co-Lead Agencies do not believe that a cumulative wetland impact assessment needs to be conducted for the entire St. Louis River watershed for the environmental review of the Proposed PolyMet NorthMet project. The Co-lead agencies believe that a qualitative evaluation of cumulative wetland impacts on water quality in the Partridge River watershed and the Embarrass River watershed, including impaired waterbodies, should be included in the cumulative water quality impacts section of the SDEIS.	GLIFWC disagrees with the co-lead disposition. Provide a link to the cumulative impact section of the appendix.
GLIFWC 226	GLIFWC	6.2.2.1.21 Speculative Actions	Provide a map of the speculative projects and indicate in the text the potentially affected watershed for each project.	The speculative projects are provided for disclosure purposes only, and the locations of several of these projects are not known. No text edit.	GLIFWC disagrees with the co-lead disposition. Provide a link to the cumulative impact section of the appendix.
GLIFWC 227	GLIFWC	6.2.3.3 Water Resources	Impacts to dewatered wetlands should be mentioned in this section.	Section 6.2.3.3.3 discusses cumulative effects on hydrology. Section 6.2.3.4 discussed cumulative effects on wetlands.	GLIFWC disagrees with the co-lead disposition. Provide a link to the cumulative impact section of the appendix.

Chapter 6

Comment_No.	Agency	Section	Comment	Co-Lead Disposition	GLIFWC Response
GLIFWC 228	GLIFWC	6.2.3.3.1 Cumulative Effects Assessment Areas	The section should state that water quality standards are met only with perpetual water treatment and maintenance.	The following paragraph has been added to Section 5.2.2 - Summary: The Closure objective is to provide mechanical and non-mechanical treatment for as long as necessary to meet regulatory standards at evaluation locations in groundwater and surface water. Both mechanical and non-mechanical treatment will require periodic maintenance and monitoring activities. Modeling predicts that treatment activities will be a minimum 200 years at the Mine Site and a minimum of 500 years at the Plant Site. While long-term, these time frames for water treatment are not necessarily perpetual.	GLIFWC disagrees with the co-lead disposition. Provide a link to the perpetual maintenance section of the appendix.
GLIFWC 229	GLIFWC	6.2.3.3.1 Cumulative Effects Assessment Areas	The limited water quantity and quality data has been as issue for 7 years since the beginning of the project. The lead agencies and the applicant have been resistant to fill these data gaps. See GLIFWC hydrology attachment for further detail.	The 20 year old flow data is acceptable as there haven't been any significant changes within the watershed. Additional water quality sampling has been conducted and the results included in this PSDEIS (Section 4.2.2). No text edit.	GLIFWC disagrees with the co-lead disposition. Provide a link to the hydrology section of the appendix.
GLIFWC 230	GLIFWC	6.2.3.3.2 Cumulative Actions	Add United Taconite to the list.	Disagree. The analysis in Section 6.2.3.3 includes existing and potential future actions that have the potential, in combination with the NorthMet Project Proposed Action, to cumulatively affect surface water hydrology and quality within the Partridge River and Embarrass River watersheds. The United Taconite mine is outside the analysis area as the six permitted mine pit dewatering discharges all discharge to the St. Louis River Basin. No text edit.	GLIFWC disagrees with the co-lead disposition. Provide a link to the cumulative impact section of the appendix.
GLIFWC 231	GLIFWC	6.2.3.3.3 Cumulative Effects On Hydrology - Embarrass River	Should not assume that the passive treatment will prove effective. Change language to "...if passive treatment proves effective...	No text change needed. The NorthMet Project Proposed Action would rely upon mechanical treatment to achieve water resource objectives as long as needed; however, the goal would be to transition to non-mechanical treatment to ensure attainment of water resources objectives, including compliance with applicable groundwater and surface water standards, during the closure phase.	GLIFWC disagrees with the co-lead disposition. Provide a link to the perpetual maintenance section of the appendix.
GLIFWC 232	GLIFWC	6.2.3.3.4 Cumulative Effects On Surface Water Quality - Partridge River Section	The section states that all water quality evaluation criteria would be met. The section should clearly state that that assumption is based on the successful operation of water capture and water treatment systems in perpetuity. In addition, evaluation criteria are not the same as water quality standards. Water quality standards would be exceeded for several constituents. The same comment applies to the assumptions in the sulfate and mercury sections.	The SDEIS is comparing water quality predictions against water quality evaluation criteria. We acknowledge that the evaluation criteria could differ from water quality standards.	ok
GLIFWC 233	GLIFWC	6.2.3.3.4 Cumulative Effects On Surface Water Quality - Embarrass River	The river is on the draft 2012 303d list for sulfate. Correct the text.	Text revised to clarify the current status of 303(d) listings.	ok

Chapter 6

Comment_No.	Agency	Section	Comment	Co-Lead Disposition	GLIFWC Response
GLIFWC 234	GLIFWC	6.2.3.3.4 Cumulative Effects On Surface Water Quality	Reduction in sulfate loads depend on perpetual capture and treatment of water. Include this caveat.	The following paragraph has been added to Section 5.2.2 - Summary: The Closure objective is to provide mechanical and non-mechanical treatment for as long as necessary to meet regulatory standards at evaluation locations in groundwater and surface water. Both mechanical and non-mechanical treatment will require periodic maintenance and monitoring activities. Modeling predicts that treatment activities will be a minimum 200 years at the Mine Site and a minimum of 500 years at the Plant Site. While long-term, these time frames for water treatment are not necessarily perpetual.	GLIFWC disagrees with the co-lead disposition. Provide a link to the perpetual maintenance section of the appendix.
GLIFWC 235	GLIFWC	6.2.3.4.4 Cumulative Effects Assessment - Partridge River watershed section	The section states that lake acreage has increased by 19% compared to pre settlement times. Are these lakes natural, impoundments/flowages, or flooded mine pits? Should specify in the text. If these new waters are mine pits, we disagree with their characterization as "resources" because of their contaminated nature. In addition, many of the impacted wetlands are part of the 100 mile swamp system A detailed discussion of the ecological significance of this wetland complex is needed as well as the overall effect of fragmenting the complex.	Pre-settlement conditions were identified using NWI and GLO survey maps, while existing conditions were determined using delineations, NWI maps, NHD shapefiles, and MDNR Mining features (2009 shapefile). The 19% increase in lakes between pre-settlement and existing conditions stems from the increase in size of White Water Reservoir (increase of 314 acres) and areas classified as lake in the NHD shapefile. When calculating pre-settlement, existing, and future lakes, no deepwater habitats/mine pits were included; these would fall under the deepwater category. The potential effects to the wetlands within the 100 mile swamp are discussed in Chapter 5.	ok
GLIFWC 236	GLIFWC	6.2.3.3.4 Cumulative Effects On Surface Water Quality - Embarrass river watershed section	Same comments an above for the Partridge River section. In addition, this section should provide a description of the wetlands impacted by seepage from the LTV tailings basin.	Section 6.2.3.3.3 discusses cumulative effects on hydrology. Section 6.2.3.4 discussed cumulative effects on wetlands.	The co-lead disposition does not answer the comment.
GLIFWC 237	GLIFWC	6.2.3.4.3 Cumulative Actions	The XP-SWMM model uses antiquated data collected from far downstream of the site. The model is fatally flawed and yields unreliable results. The conclusion that no effects would occur on riparian wetlands is not supportable. See GLIFWC hydrology attachment for more detail.	We believe the XP-SWMM modeling is acceptable for use in the SDEIS. The 20 year old data is acceptable as there haven't been any significant changes within the watershed. We believe the assumptions used were reasonably conservative. Additional detail is provided in the water sections of the SDEIS, and further rationale is provided in the Water Data Packages.	GLIFWC disagrees with the co-lead disposition. Provide a link to the hydrology section of the appendix.

Chapter 6

Comment_No.	Agency	Section	Comment	Co-Lead Disposition	GLIFWC Response
GLIFWC 238	GLIFWC	6.2.3.6.4 Cumulative Effects Assessment - Wildlife travel corridors	The corridor southeast of the plant site is characterized as poor. Therefore the discussion in the section is misleading because this is not in fact a viable wildlife corridor. It should then be removed from the corridor list and removed from the map. In addition, cumulative effects from noise and vibration are not analyzed and would have a significant impact on wildlife corridors (See GLIFWC noise attachment for more detail) Finally, the conclusions should be revisited in light of fewer corridors along the range than originally identified.	The Emmons and Oliver report characterizes this corridor as small but important. The Barr Report on wildlife corridors states that the current LTVSMC Tailings Basin is located within the moderate quality habitat corridor. Neither of these studies classifies the corridor as poor quality, though Section 6.2.3.6.4 describes the Tailings Basin, which is within(but not occupying the entire width of the corridor, as being of poor quality for wildlife travel. The text will be edited for additional clarity.	ok
GLIFWC 239	GLIFWC	6.2.3.7.4 Cumulative Effects Assessment - Cumulative water quality effects	The conclusion of no cumulative effect depends on perpetual water capture and treatment as well as perpetual maintenance of the facilities that would remain after the end of mining. We believe that this is not a realistic assumption and that it short-circuits the evaluation of cumulative effects. In addition, evaluation criteria are not the same as water quality standards. Water quality standards would be exceeded for several constituents.	The Closure objective is to provide mechanical and non-mechanical treatment for as long as necessary to meet regulatory standards at evaluation locations in groundwater and surface water. Both mechanical and non-mechanical treatment will require periodic maintenance and monitoring activities. Modeling predicts that treatment activities will be a minimum 200 years at the Mine Site and a minimum of 500 years at the Plant Site. While long-term, these time frames for water treatment are not necessarily perpetual. Co-leads agree that evaluation criteria are not the same as water quality standards (for some constituents). The SDEIS is comparing water quality predictions against water quality evaluation criteria. We acknowledge that the evaluation criteria could differ from water quality standards.	GLIFWC disagrees with the co-lead disposition. Provide a link to the perpetual maintenance section of the appendix.
GLIFWC 240	GLIFWC	6.2.3.7.4 Cumulative Effects Assessment - Physical habitat effects	As previously stated, the conclusion of no changes to flows in the Partridge River is based on fatally flawed XP-SWMM modeling. This conclusion is not supported.	We believe the XP-SWMM modeling is acceptable for use in the SDEIS. The 20 year old data is acceptable as there haven't been any significant changes within the watershed. We believe the assumptions used were reasonably conservative. Additional detail is provided in the water sections of the SDEIS, and further rationale is provided in the Water Data Packages.	GLIFWC disagrees with the co-lead disposition. Provide a link to the hydrology section of the appendix.
GLIFWC 241	GLIFWC	6.2.3.8.10 Climate Change	A discussion of the effects of wetland destruction is needed in this section. The discussion should include the release of carbon to the atmosphere from wetland and peat excavation as well as the loss of carbon sequestration capacity of the existing high quality wetlands.	Agreed. The direct GHG estimated emissions will be revised in the text and in Table 6.2-20 as discussed in Comment # FDL 77.	ok

Chapter 6

Comment_No.	Agency	Section	Comment	Co-Lead Disposition	GLIFWC Response
GLIFWC 242	GLIFWC	6.2.3.8.11 Noise And Vibration	This section does not provide a cumulative assessment of noise impacts. For example the section should identify areas of national forest and forest service roads that would be subjected to noise plus airblast effects. Another example, what acreage of publicly accesible lands would be withing the noise and vibration / airblast zone. Reliance on an few receptors is not a proper way to conduct an analysis of noise impacts. See GLIFWC noise attachment for more detail.	The only reasonably foreseeable actions that could interact in such a way as to have a cumulative effect on the receptors identified in Sections 4.2.8 and 5.2.8 is the Mesabi Nugget Phase II Mine Project located approximately 2 miles west of the Plant Site and 10 miles west of the Mine Site. Other reasonable foreseeable projects in the region are 25 to 55 miles away from the NorthMet Project and as such, would have no cumulative effect on nearest receptors (see Figure 6.2.2-1 and Table 6.2-1). Noise from existing industries (logging, mining, etc.) have been accounted for in the baseline noise levels discussed in Section 4.2.8 and 5.2.8. Section 6.2.3.8.11 has been revised to assess the cumulative impact of the Mesabi Phase II Mine Project. The maximum impact area for noise (11,456 acres), ground vibration (11,469 acres), and airblast (11,334 acres) are discussed in Section 5.2.8.	GLIFWC disagrees with the co-lead disposition. Provide a link to the cumulative impact section of the appendix.
GLIFWC 243	GLIFWC	6.2.3.11.4 Cumulative Effects Assessment - Visual Resources	A calculation of the viewshed for the water vapor plumes and night visibility of tower lights should be developed and included. Are these features visible from public access points?	This comment belongs in Section 5.2.11, not here, since it is a primary impact of the operations themselves, and not cumulative with other resources. Please see response in Recreation/Visual spreadsheet. Response in this section to be developed based on language to be added to Section 5.2.11.	ok
GLIFWC 244	GLIFWC	6.2.3.3.4 Cumulative Effects On Surface Water Quality	There is a general lack of understanding of mercury dynamics in the St. Louis River Watershed. See the supplemental document "Great Lakes Indian Fish and Wildlife Commission (GLIFWC) Comments Related to Mercury" [Comment 1] for details.	The Co-leads agree that the mercury dynamics are complex; however, the analysis as presented indicated that there was minimal potential for a downstream increase in mercury loading	GLIFWC disagrees with the co-lead disposition. Provide a link to the mercury section of the appendix.

Chapter 7

Comment_No.	Agency	Section	Comment	Co-Lead Disposition	GLIFWC Response
GLIFWC 245	GLIFWC	7.2.4 Comparison Of Effects	As previously commented, the PSDEIS does not provide an adequate comparison of effects for water quality and water quantity. The assumption that the no action alternative is equivalent to a continuation of existing conditions leads to errors in water quality modeling. In addition, a lack of usable water quantity and flow data lead to conclusions that cannot be supported.	Refer to the water section and response to comments with respect to the suitability of the water quantity and flow data, and a discussion on the purpose and intent of the water modeling scenarios. Further clarity on these modeling scenarios is provided in Chapter 5.2.2	GLIFWC disagrees with the co-lead disposition. Provide a link to the hydrology section of the appendix.
GLIFWC 246	GLIFWC	7.2.4 Comparison Of Effects - water resources section	99.9% capture is not realistic and is not supported by text in other sections of the SDEIS.	Greater than 90% of water would be captured and treated to meet effluent limits set to meet water quality standards	ok
GLIFWC 247	GLIFWC	7.2.4 Comparison Of Effects - water resources section	GLIFWC staff disagree with second and third bullets of combined proposed action. Standard is exceeded for sulfate and there is not enough information in the document to reach a conclusion on mercury.	The GoldSim results do not indicate an exceedance of the waters supporting the production of wild rice sulfate standard pursuant to the MPCA staff recommendation. Mercury is addressed in the air and water sections (Section 5.2.2 and 5.2.7) as well as in aquatic resources (5.2.6)	Data collected at SW005 indicates that the standard is exceeded for some measurements. GOLDSIM is not properly calibrated and therefore is not able to reproduce existing conditions. Provide a link to the hydrology section in the appendix.
GLIFWC 248	GLIFWC	7.2.4 Comparison Of Effects - aquatic species section	The claim of a decrease in mercury loading is not suportable. See GLIFWC mercury attachment	The aquatic species summary points in the SDEIS table have been revised and does no longer include the mercury loading conclusion commented on.	ok
GLIFWC 249	GLIFWC	7.2.4 Comparison Of Effects - air quality and climate change	Combined proposed action would create a pulse of carbon through the exposure of peat. There would also be a loss of carbon sequestration potential due to the destruction of wetlands.	Acknowledge partial loss of carbon sink and release of stored carbon from wetlands destruction. The text has been updated to address carbon release in the wetland summary section of the table	ok pending review of the new language.
GLIFWC 250	GLIFWC	7.2.4 Comparison Of Effects - noise	Use of receptors to limit analysis is not appropriate. In addition no cumulative assessment is available. See GLIFWC noise attachment for more information.	A discussion of noise impacts to all publicly accessible areas in the Superior National Forest has been included in the noise section of Chapter 5 (Section 5.2.8).	ok
GLIFWC 251	GLIFWC	7.2.4 Comparison Of Effects - socioeconomics	biased information. There is no discussion of expected adverse effects.	See discussion in Section 5.2.10.14.	Information presented in the Freudenberg paper should be described here. The comment stands.

Chapter 7

Comment_No.	Agency	Section	Comment	Co-Lead Disposition	GLIFWC Response
GLIFWC 252	GLIFWC	7.3.1 Irreversible Or Irretrievable Commitment Of Resources	GLIFWC disagrees with the statement indicating no exceedance of water quality standards. The document indicates that standards would be exceeded.	As described in the SDEIS, the evaluation criteria do use the standards, but interpret the standards from a probabilistic perspective. The P90 approach for assessing compliance is a reasonable method for applying the results of probabilistic modeling to regulatory decision making. In this context, it is not appropriate to say that "a constituent will exceed a water quality standard". It is more accurate to say that "there is at least a 90 percent probability that a constituent will not exceed a standard (or up to a 10 percent probability that it will)". These quoted statements are very different.	GLIFWC disagrees with the co-lead disposition. Provide a link to the perpetual maintenance section of the appendix.
GLIFWC 253	GLIFWC	7.3.1 Irreversible Or Irretrievable Commitment Of Resources	Section should state that the NorthMet project would require maintenance and water treatment in perpetuity which constitutes and irreversible and irretrievable commitment of resources.	The Closure objective is to provide mechanical and non-mechanical treatment for as long as necessary to meet regulatory standards at evaluation locations in groundwater and surface water. Both mechanical and non-mechanical treatment will require periodic maintenance and monitoring activities. Modeling predicts that treatment activities will be a minimum 200 years at the Mine Site and a minimum of 500 years at the Plant Site. While long-term, these time frames for water treatment are not necessarily perpetual.	GLIFWC disagrees with the co-lead disposition. Provide a link to the perpetual maintenance section of the appendix.
GLIFWC 254	GLIFWC	7.3.2 Short-term Uses Versus Long-term Productivity Of The Environment	section does not appear to have been updated from information presented in the 2009 DEIS. It still talks about categore 3 and 4 permanent stockpiles. Correct the text.	The section has been updated and does not talk about permanent category 3 and 4 stockpiles. Extra detail has been added to the section to help make it clear that the Category 2/3 and 4 Stockpiles will be removed and backfilled into the East Pit/	ok
GLIFWC 255	GLIFWC	7.3.2 Short-term Uses Versus Long-term Productivity Of The Environment	wetland impacts would not be short term. Restoration of wetlands is not likely to replace the high quality wetlands found at the site. In addition water quality impacts are long term because treatment would be needed in perpetuity.	The sentence commented on has been clarified. The Co-leads consider that the potential wetland impacts as described in the section would be short-term because impacts would be mitigated and monitored. Additional information on impacts, mitigation and monitoring of wetlands is provided in chapter 5.2.3.	GLIFWC disagrees with the disposition of the comment. It is not likely that mitigaion will be able to replace the functions of the high quality wetlands that would be destroyed at the mine site.
GLIFWC 256	GLIFWC	7.3.3 Unavoidable Adverse Effects	GLIFWC staff disagree with the claim that new exceedances of relevant standards would not occur. Water quality standards will be exceeded. Perpetual water treatment and perpetual maintenance needs are residual practical effects of the proposed project.	As described in the SDEIS, the evaluation criteria do use the standards, but interpret the standards from a probabilistic perspective. The P90 approach for assessing compliance is a reasonable method for applying the results of probabilistic modeling to regulatory decision making. In this context, it is not appropriate to say that "a constituent will exceed a water quality standard". It is more accurate to say that "there is at least a 90 percent probability that a constituent will not exceed a standard (or up to a 10 percent probability that it will)". These quoted statements are very different.	The response does not address the fact that if standards are met, it will require perpetual treatment. Provide a link to the perpetual maintenance section in the appendix.

Appendix D

Biological Assessment and Biological Evaluation (to be provided with the Final EIS)